



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: December 3, 1991

In reply refer to: A-91-104 through -121

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

On February 1, 1991, at 1807 Pacific standard time, USAir flight 1493 (USA1493), N388US, a Boeing 737-300 (B-737), collided with Skywest flight 5569 (SKW5569), N683AV, a Fairchild Metroliner (SA-227-AC), while USA1493 was landing on runway 24 left at Los Angeles International Airport (LAX), Los Angeles, California. SKW5569 was positioned on the same runway, at intersection 45, awaiting clearance for takeoff. As a result of the collision, both airplanes were destroyed. All 10 passengers and 2 crewmembers aboard the Metroliner and 20 passengers and 2 crewmembers aboard the B-737 were fatally injured.¹

The physical evidence on the surface of runway 24 left indicated that the collision occurred on an active runway that was the responsibility of the local controller 2 (LC2). Both flightcrews had received clearance from the LC2 to occupy the runway.

The Safety Board believes that the LC2's performance was related to Air Traffic Control (ATC) facility procedures in place at LAX on the date of the accident that did not allow for lapses in judgment and decisionmaking and removed human performance redundancies. The LC2 was required to assume full responsibility for strip marking and position determination, departure and arrival sequencing, working a combined position (helicopter control), and performing the coordination responsibilities to operate that position. As the workload increased, she initially forgot about and then subsequently misidentified SKW5569. The LC2 experienced two compelling distractions which led to this accident: a communications lapse with the flightcrew of Wings West 5006 which was waiting to cross the runway, and an untimely search for an outbound flight progress strip for Wings West 5072.

¹For more detailed information, read Aviation Accident Report--"Runway Collision of USAir Flight 1493, Boeing 737, and Skywest Flight 5569 Fairchild Metroliner, Los Angeles International Airport, Los Angeles, California, February 1, 1991." (NTSB/AAR-91/08)

The Safety Board is aware that the current operational procedures at LAX permit departures and arrivals to be sequenced to all runways. These procedures create an additional burden on the LC position because the focus and span of attention must include all runways for potential departures and landings and interconnecting taxiway traffic; these procedures may also increase the number of runway intersection takeoffs, position and hold clearances and runway crossings that will occur. The Safety Board believes that LAX and the FAA assume an additional risk under current operational guidelines, unlike the airports in Atlanta and Dallas-Ft. Worth that primarily segregate arrival and departure traffic to specific runways. In public testimony, the FAA's Executive Director for System Development recently stated that the priorities of the FAA are, "safety first...capacity second." The Safety Board concurs with this FAA position and believes that the operating procedures at LAX should be modified so that arrivals and departures are segregated to specific runways. In addition, the Safety Board believes that the FAA should undertake a thorough risk based evaluation of ATC procedures at LAX to determine whether changes are required and implement those changes necessary to enhance safety. The evaluation should consider at least the issues of runway intersection takeoffs, position and hold clearances, displaced runway thresholds, runway crossing traffic, local assist controller manning and Airport Surface Detection Equipment use and maintenance.

The FAA's National Operational Position Standards (National OPS) Order, 7220.2A, were developed in the 1980's to provide detailed guidance on how operations should be conducted at the different positions and to standardize, "how the job is to be done." The order states, "this order contains National OPS that apply to all facilities and instructions that shall be used to write the Facility-level OPS." The National OPS state, "The Air Traffic Manager shall be responsible for ensuring that the requirements of this handbook are met in the facility."

Paragraph 3-7 of the order entitled "Modifications to the National OPS Prohibited," states, "The National OPS shall not be modified when including the details to produce the Facility-level OPS." The supplemental portion of the National OPS entitled, "Facility Level Details," ensures that all of the local details required to complete a particular step in the OPS procedure are included.

The National OPS state "If the Air Traffic Manager authorizes additions to the Facility-level OPS, the additions shall be made in such a way that the elements, functions, and procedural steps required by the National OPS are not modified or deleted, and the required sequences of procedural steps are not altered."

The Ground Control (GC) position is outlined in Chapter 23 of the National OPS. Under Section 5, "Process Flight Progress Strips," paragraph 23-43, "Mark Flight Progress Strip," states that the flight strip will be marked with, "the runway the aircraft is assigned."

In an effort to reduce workload at the GC position, LAX ATC procedures did not specify the use and handling of flight progress strips at that

position. As a result, aircraft could request intersection departures directly from the LC. The GC was thereby relieved from coordinating with the LC and marking flight progress strips accordingly. Although intended to reduce the GC's workload, the procedures eliminated redundancies that were built into the system and increased the LC's workload. Without the flight progress strip information, the LC was required to determine the flightcrew intentions and rely on memory and observations of aircraft moving on the ground to identify and track the progress of aircraft under his/her control.

The Facility OPS for the LAX GC position stated, "strips are not required." Testimony received from the previous facility manager, and from the current facility manager, indicated that the facility was in compliance with the National OPS. Their testimony indicated that because the National OPS state that a flight progress strip will be forwarded to the "appropriate position," the decision to forward the flight progress strip from the clearance delivery (CD) position to the LC position was appropriate and in compliance with the intent of the National OPS. The FAA's testimony indicated that facility management could determine, independently, the sequence for flight strip processing. If this rationale was followed to its conclusion, it would render the FAA's attempt to standardize operations in all ATC facilities moot.

The Safety Board recognizes that the GC and LC have a shared responsibility for operations on the airport surface. The procedures in effect at LAX at the time of the accident allowed taxiing aircraft flightcrews to randomly communicate with LC on the tower frequency, precluding advance notification from the GC. The LC was then required to select the flight progress strip and determine the aircraft's position on the airport. The decision by facility management to remove the GC from strip marking and flight progress strip forwarding removed a vital redundancy in aircraft tracking.

The Safety Board believes that there is no existing automated monitoring system on which a tower can rely to ensure that human performance errors will always be detected. Unlike radar controllers, who have conflict and minimum safe altitude alerting, or most air carrier flightcrews, who have ground proximity and traffic conflict alerting, local and ground controllers must rely almost totally on their eyes, ears and memory to perform their duties. The expectation that controllers can perform for any length of time without error is unwarranted. In addition, the FAA's expectation of flawless human performance is unrealistic in rapidly changing and dynamic environments that exist at airports such as LAX. Therefore, the Safety Board believes that any job aids and procedures, such as strip marking and flight strip forwarding, which are designed to improve each tower controller's performance, should be adopted and emphasized, repeatedly, until other independent, automated systems become available. The Safety Board also believes that procedural redundancy through the use of tower cab coordinators, local assist controllers and ground control assistants, who can provide a "second set of eyes and ears," should be utilized to the maximum extent possible, especially when traffic conditions warrant that such an additional position be manned.

In the aftermath of the accident at the Atlanta Hartsfield International Airport, involving a B-727 and a Beech King Air that collided on the runway,² the Safety Board concluded that the cause of the accident was, "the failure of the FAA to provide air traffic control procedures that adequately take into account those occasional lapses in performance that must be expected." The Safety Board believes that the circumstances of the Los Angeles runway incursion underscore the need to recognize, acknowledge, and take into account those lapses in performance. The designers and operators of complex systems, such as the ATC system, who fail to fully implement required design features and operating procedures, and who allow a single individual to assume the full burden for safety-critical operations, must share responsibility for occasional human performance errors. The Safety Board believes that adherence by the LAX ATC tower to the National OPS requirements would have provided the redundancy that could have prevented this accident. The Safety Board notes that the local assist position at LAX tower was not contained in the local facility OPS. The Safety Board believes that the LAX tower management should revise and implement, at the earliest date, the local facility OPS so that they are in compliance with the National OPS.

In July 1991, Safety Board and FAA staff met to discuss the National OPS. Safety Board staff was informed that an ad hoc group had determined that the most probable course of action would be to cancel the existing National OPS order and to incorporate portions into the FAA Air Traffic Control Handbook, 7110.65F. This determination was suggested because the National OPS was reported to be difficult to revise and maintain and that portions were redundant to other FAA orders. The original intent of the National OPS was to standardize operations in all ATC facilities. The Safety Board believes that the FAA should review and strengthen the language in the current National OPS and retain it as a separate, independent order. The Safety Board also believes that this review should determine the adequacy of human performance redundancies currently called for in the National OPS. The Safety Board believes that the review should be conducted by the FAA's Human Factors and Air Traffic Service staffs and that any resultant recommendations, if feasible, should be incorporated into the National OPS.

In addition, the Safety Board is aware that Chapters 5 through 10 of the National OPS for supervisory and controller-in-charge positions have not been completed. The Safety Board believes that the FAA should expedite the development of these chapters and incorporate these standards into the National OPS.

The FAA Air Traffic Service management's perception that LAX procedures contained sufficient redundancies as provided by the National OPS may have been reinforced following a facility evaluation that was conducted from July 24 through 28, 1989. A review of this evaluation disclosed that it did not identify that essential redundancies were absent. A followup evaluation

²Runway Collision of Eastern Airlines, Boeing 727, Flight 111 and Epps Air Service, Beechcraft King Air A100, Atlanta Hartsfield International Airport, Atlanta, Georgia, January 18, 1990. (NTSB/AAR-91/03)

in February 1990 was conducted by observation, monitoring positions, review of actions taken to correct identified problems, and limited interviews. Again, this evaluation failed to identify that essential redundancies were absent.

The Safety Board's investigations of previous accidents and incidents involving ATC deficiencies, as well as its investigations of ATC operational errors, have been critical of the FAA's safety oversight and quality assurance of the ATC system. For example, following the Safety Board's investigations of a series of operational errors at Chicago's O'Hare Airport during 1987, the Safety Board issued Safety Recommendation A-88-90 to the FAA that urged the establishment of an independent national division that would be responsible for the quality assurance of the ATC system and that would report directly to the Administrator of the FAA.

In early 1989, the FAA established the Office of Safety Quality Assurance to provide safety oversight of operational programs, including the Air Traffic Service, reporting directly to the FAA Administrator. The Safety Board closed its initial Safety Recommendation A-88-90 to the FAA and classified it "Superseded" by Recommendation A-89-41, which urged the FAA to implement and provide adequate staff and funding for the Office of Safety Quality Assurance. On August 17, 1989, the FAA Administrator informed the Safety Board in response to this recommendation that the Office of Safety Quality Assurance would provide quality assurance and safety evaluation of activities to include the Air Traffic Service. He added that this office would "participate in program evaluations [and] independently analyze evaluation reports, conduct its own evaluation of the technical and managerial aspects of those program areas, develop recommendations for correcting deficiencies and actively track the implementation of the recommendations."

The Safety Board responded to the FAA Administrator on January 22, 1990, noting that this office would be staffed by 19 persons but would only have 2 individuals dedicated to ATC issues. The Safety Board concluded that because of the small number of persons tasked with ATC quality assurance and the magnitude of the ATC system, the FAA's Office would not be capable of providing the necessary oversight of the ATC system. It therefore classified Safety Recommendation A-89-41 as, "Open--Unacceptable Action."

On April 12, 1990, the FAA Administrator informed the Safety Board, in response to Safety Recommendation A-89-41, that, "the FAA's intention in establishing the Office of Safety Quality Assurance was not to exercise "total oversight" in a manner that would routinely involve its staff in the day-to-day events occurring in the system, but to monitor and assess programs on a broad national scale." Further he stated, "The principal role of the Office of Aviation Safety is to monitor the system and to ensure that the Office of the Associate Administrator for Air Traffic has an effective quality assurance organization in place and functioning properly."

On September 11, 1990, the Safety Board classified Safety Recommendation A-89-41 as, "Closed-Unacceptable Action/Superseded," and issued Safety Recommendation A-90-125 to the FAA urging it to, "Modify the

functional statement of the Federal Aviation Administration Office of Safety Quality Assurance and provide sufficient resources to it to make it capable of providing effective quality assurance and safety oversight of the air traffic control system."

On December 18, 1990, the FAA Administrator in his response to Safety Recommendation A-90-125, informed the Safety Board, "The responsibility for the overall quality assurance and safety oversight functions of the air traffic control system is assigned to the Office of Air Traffic System Effectiveness. This organization provides a thorough and comprehensive national program of system effectiveness and evaluation, air traffic accident and incident investigation, and system analysis and improvements. The office is staffed adequately and empowered to accomplish its mission." He added, in part, "...I continue to believe that the Office of Safety Quality Assurance has a proper mission within the FAA, and that its staff is accomplishing the mission in a professional manner."

The Safety Board questions the FAA's depth of commitment to provide effective quality assurance and safety oversight of the ATC system. This fatal accident, which might have been prevented if FAA national facility evaluations had identified that mandatory redundancies were not present, demonstrates conclusively an inadequate and ineffective quality assurance and safety oversight program. The Safety Board also believes that because of inadequate authority and resources, the Office of Safety Quality Assurance is unable to effectively monitor and provide the necessary oversight of the ATC system. The Safety Board is concerned by the FAA's failure to recognize the need for and to establish an office that would be independent, and therefore objective, and empowered with the responsibility to conduct system safety oversight of the ATC system. The Safety Board concludes that the Office of System Effectiveness, which is embodied within the Air Traffic Service, is, in effect, evaluating itself. It is organized in such a way that no actual oversight exists.

The Safety Board recognizes that the Office of Air Traffic Service must have an oversight capability to manage, identify and correct day-to-day events that occur in the system; however, an independent national office, which is separate, organizationally, from the Air Traffic Service and would be responsible for the total quality assurance of the ATC system, is required to ensure that compliance and system safety are being achieved. It is apparent to the Safety Board that the FAA has not been receptive to any safety recommendation that urges the development of an independent office that has the responsibility for quality assurance and system safety oversight of the ATC system. On July 11, 1991, the Safety Board classified Safety Recommendation A-90-125 as "Closed--Unacceptable Action." The Safety Board firmly believes that the FAA should reconsider its position and provide the authority and resources to the Office of Safety Quality Assurance to independently evaluate ATC facility compliance with FAA directives and to audit facility evaluations performed by the Office of Air Traffic System Effectiveness to determine that noted deficiencies are corrected.

The Safety Board also recognizes the important aspect of personnel training related to this accident. A month after the LC2's certification as a full-performance-level controller at LAX, her first such certification at a Level V facility, she was assessed on performance by her supervisor in accordance with the requirements of the Technical Appraisal Program (TAP). The TAP, which provides a means to identify deficient areas of performance through firsthand observations, is intended to assist supervisors in determining training needs for controllers so that they may improve their performance.

Prior to the accident, the area supervisor identified deficiencies that were indicative of weaknesses in the LC2's performance. Two of these deficiencies were "critical training indicators" (CTI), loss of awareness of aircraft separation and aircraft misidentification. These two deficiencies were again evident in the LC2's performance on the night of the accident. The supervisor's subsequent testimony at the Safety Board's public hearing indicated that although he completed the evaluation and discussed these items with the controller, he did not initiate any other remedial action. Regarding the definition of CTI's he stated "...I'm not completely clear on that point."

The Safety Board is concerned that the FAA may not benefit from the full potential of the TAP because of inadequate understanding of the intent and purpose of the program at the supervisory level. Therefore, the Safety Board believes that more effective training of supervisors concerning the TAP is warranted. In addition, it was noted that the effectiveness of the TAP could be enhanced if the records of observations were retained for periodic review. The Safety Board believes that training requirements could be better determined if TAP evaluations were retained for 2 years.

During the field phase of the investigation, members of the Safety Board's technical staff, with support from representatives of the airline industry and the FAA, conducted an aircraft external lighting detection task/exercise at LAX during night visual meteorological conditions. A Metroliner identical to the one involved in the accident was placed at the same location on runway 24 left where the collision occurred. The airplane was aligned with the centerline of the runway and its navigation and anticollision lighting were on and operating. The runway edge lighting and centerline lighting were at low (step 2) intensity. The participants in the tower portion of the exercise agreed that the three northernmost lighting fixtures mounted on poles on the roof of Terminal 2, northwest of the control tower, produced a glare that impeded visual observation of the area in which the collision occurred. The fixtures and glare did not totally block the view of the accident area. The investigation disclosed that the Metroliner's navigation/position lights and red anticollision beacon located on top of the vertical stabilizer were the only lights illuminated on the airplane at the time of the collision. During visual approaches to the runway, cockpit observers found it difficult to differentiate between the Metroliner and the lighted runway environment. The size of an aircraft and its proximity to the runway lighting, especially on runways with centerline lighting, make these light sources virtually indistinguishable when viewed from directly behind and above.

The visual approach exercises also indicated that the likelihood of detecting an aircraft from the rear on an active runway by an approaching aircraft can be increased if the first aircraft is displaced from the runway centerline lighting by approximately 3 feet. Moreover, when this offset procedure was used in conjunction with high-energy strobe lighting and anticollision and navigation lighting, aircraft conspicuity was enhanced. The Safety Board notes that most air carriers, and a considerable number of general aviation aircraft operating in the National Airspace System (NAS), are equipped with some form of high-energy strobe lighting. Therefore, this combination of actions, as well as equipment, would be available to nearly all users in the NAS.

The Safety Board considers that the use of strobe lighting, along with the practice of displacing the aircraft off the centerline lighting, would significantly enhance the ability of pilots and air traffic controllers to visually detect traffic conflict situations. The use of strobe lighting by aircraft occupying an active runway would also ease the controllers' memory load by assisting them in locating, identifying, and segregating aircraft on an active runway.

The Safety Board believes that the FAA should study and evaluate ways of enhancing the conspicuity of aircraft on airport surfaces during night or periods of reduced visibility. The concept of displacing an aircraft away from the centerline lighting and the use of lighting enhancements, such as high-energy strobe lighting and logo lighting, by aircraft on active runways should be explored and evaluated for their value to the conspicuity issue. The Safety Board also believes that the FAA should encourage operators of airplanes certificated prior to September 1, 1977, to enhance the nighttime conspicuity of their airplanes by upgrading to the current standard for anticollision light installations.

During the Safety Board's public hearing on the Los Angeles accident, testimony was received from representatives of the FAA and industry concerning aircraft external lighting standards and conspicuity. An FAA lighting specialist testified that the federal standards for aircraft external lighting are primarily intended to serve in-flight conspicuity needs and that no effort has been made by the FAA to address the issue of conspicuity of aircraft on airport surfaces.

A representative of the Fairchild Aircraft Company, the manufacturer of the Metroliner, testified that the flightcrew of USA1493, due to line-of-sight obstruction, may have been unable to see the anticollision beacon on top of the vertical stabilizer. The Metroliner's rudder cap obstructs the beacon when viewed from the rear. As the flight descended below 100 feet over the runway surface, "it is very possible he couldn't see the beacon." When the surviving flight crewmember of USA1493 was asked to account for the fact that he didn't see the Metroliner earlier, he testified, "It wasn't there. It was invisible."

Federal Aviation Regulations permit some aircraft structural obstructions, which, in this case, interfered with the flightcrew's ability to see the anticollision beacon. Nevertheless, the anticollision beacon obstruction on N683AV was within the allowable criteria.

The Safety Board believes that in establishing permissible areas of obstruction, the coverage compliance standards should give consideration to the approach, overtaking, and takeoff situations; that is, the anticollision light of an aircraft in position on a runway should be clearly visible to the pilot of another aircraft planning to land or take off on that runway. The Safety Board therefore believes that the FAA should reevaluate and redefine the permissible areas in which the illumination of an anticollision light is obstructed by aircraft structure.

Inherent in the "see and avoid" concept to avoid collision is a need for pilots to be alert and vigilant in monitoring air traffic communications for situations that may lead to conflicts with other aircraft. The Safety Board believes that the importance of such attentiveness should be reemphasized within the aviation community.

As in some previous accidents investigated by the Safety Board, both the USAir and Skywest flightcrews were operating their aircraft in accordance with their respective ATC clearances. The clearance for SKW5569 to taxi into position and hold on runway 24 left and the clearance for USA1493 to land on runway 24 left were communicated by the local controller.

The Safety Board is concerned that the relatively low number of runway incursions may lead to a relaxed vigilance and a decrease in the high state of situational awareness of pilots that is so critical to their performance. In the radar environment of an approach and after having received specific landing clearance, pilots may relax their vigilance in listening to communications that are not specifically directed to their aircraft. In addition, they may reduce efforts to visually scan for aircraft between their position and the intended landing runway. Pilots of an aircraft on an active runway or on final approach to landing should be especially vigilant in listening for information about the runway they currently occupy or expect to occupy. It is essential that pilots monitor the ATC system to the fullest extent possible to detect unsafe practices or conditions that may affect their flight and to take action to protect themselves from dangerous practices or conditions before they result in accidents. The Safety Board recognizes the challenging, inherent difficulties in monitoring the flow of information that is intrinsic to high-density environments. The Safety Board is aware that more than 60 ATC communications took place in the 3 minutes and 43 seconds from the time USA1493 came on the LC2 frequency until the accident. The Safety Board is also aware that the LC2 missed some key transmissions. Nevertheless, the Safety Board believes that effective training, planning, and resource management can diminish the effects of limitations on the ability of pilots to detect time-critical information and that all NAS users will benefit.

The Airman's Information Manual (AIM) is the U.S. official guide to basic flight information and ATC procedures for operating in the NAS. The Safety Board believes that appropriate language should be added to the AIM that reinforces the need for pilots to maintain vigilance in listening to ATC frequencies for information that may jeopardize the safety of their aircraft. The Safety Board also believes that the general aviation and commercial air carrier community should take steps to ensure that their respective training programs, including cockpit resource management training and flight operating procedures, place sufficient emphasis on the need for pilots to maintain vigilance in the monitoring of ATC communications for potential traffic conflicts with their aircraft, especially when on active runways and during final approach/landing segments. The enhancement of situational awareness of flightcrews can be attained through the application by pilots of the concepts of cockpit resource management (CRM) training. Improved flightcrew performance, such as the reduction of selective listening and other practices, can increase opportunities to receive helpful information that may prevent accidents. Nevertheless, the FAA does not require CRM training programs for flight personnel. Based on its accident investigation experience, the Safety Board has frequently advocated more widespread use of CRM training concepts by air carriers.

In January 1990, and again in November 1990, the Safety Board issued recommendations to the FAA following investigations of two accidents that occurred as a result of poor flightcrew coordination and situational awareness. The first recommendation, A-89-124, urged the FAA to require 14 Code of Federal Regulations (CFR) 121 operators to develop and use CRM programs. It was issued following the crash of Delta Air Lines flight 1141, a Boeing 727, at Dallas-Fort Worth International Airport, on August 31, 1988. In that accident, 14 persons were fatally injured and 26 other people aboard were seriously injured. The second recommendation, A-90-135, urged the FAA to require scheduled 14 CFR 135 operators to develop and use CRM training programs. This recommendation was issued following the crash of Aloha IslandAir flight 1712, a deHavilland DHC-6, at Molokai, Hawaii, on October 28, 1989, which killed all 20 persons aboard. The Safety Board believes that the circumstances of this accident underscore the need for both requirements and therefore it reiterates these open recommendations to the FAA.

The Safety Board believes that pilots and air traffic personnel should adopt more clear and concise standard phraseology regarding intersection takeoffs and "position-and-hold" clearances. In all likelihood, such action would contribute significantly to a reduction in the number of runway incursions.

A review of the air traffic local control frequency recording at LAX disclosed several occasions where the phraseology used by pilots was inappropriate. Examples include the use of such words and phrases as, "We'll take forty seven," "Okay," "We'd like to go from here," "For the left side two four left." These words do not convey the extent of specificity that is required in the NAS. Specifically, the LC2 stated that she did not hear the flightcrew of SKW5569 state that they were at taxiway 45. If the flightcrew of SKW5569 had stated, "we are at the taxiway 45 intersection, ready for

takeoff," it is possible that the misidentification might not have occurred. The use of nonstandard words and conversational phraseology precipitates misunderstanding between pilots and controllers.

Neither the AIM nor the Air Traffic Control Handbook (7110.65F) contain specific phraseology to be used by pilots when requesting an intersection departure and by ATC personnel when issuing a position-and-hold clearance for an intersection departure. The Los Angeles accident provides vivid evidence that position-and-hold operations at intersecting points along runways continue to play a significant role in the runway incursion problem.

The Safety Board believes that a solution to reducing misunderstandings and/or loss of situational awareness by pilots and controllers concerning intersection takeoffs is to establish clear and concise standard terminology for pilots and controllers. For example, pilot request: "Cessna N12345 request intersection takeoff from runway 24 Left at taxiway 45;" controller reply: "Cessna N12345, taxi into position and hold runway 24 Left at intersection 45." Recommended communication phraseology regarding the request for intersection departures should be incorporated into the appropriate section of the AIM. In addition, standard air traffic phraseology and procedures regarding position and hold at intersections should be incorporated into the Air Traffic Control Handbook (7110.65F).

Moreover, the Safety Board believes that all pilots, general aviation and commercial, should be made aware of the events leading up to this accident through operations bulletins and safety seminars, such as the "Wings Pilot Proficiency Program."

The emergency response for this accident was timely and effective and 64 passengers were able to escape from the B-737 while the scene was involved in fire. However, one flight attendant and 20 passengers perished. Based on the circumstances of this evacuation, several issues warrant review.

The USAir policy for the B-737 assigns flight attendants "2nd choice" exits at the overwing (Type III) location. The Safety Board believes that air carriers that have a second choice exit assignment should emphasize in flight attendant training the need to evaluate personal risk in a decision to go to a second choice exit as opposed to choosing a closer escape path. For example, another door or any opening in the fuselage may be acceptable and more appropriate. Therefore, the Safety Board believes that the Emergency Evacuation Subcommittee of the FAA Aviation Rulemaking Advisory Committee should examine air carrier flight attendant emergency procedures regarding the second choice exit assignments to ensure that such assignments provide for use of the nearest appropriate exit point.

The Safety Board also notes that both of the flight attendants located in the rear of the airplane released their restraint systems after the collision with the Metroliner but before the B-737 impacted the abandoned fire station. Both flight attendants stated that they were trained not to release their restraints until the airplane came to a complete stop and that, in retrospect, they understood the wisdom in that procedure. Their rationale for their premature restraint release was that they saw fire outside the

airplane and released their restraints based on their limited knowledge of the hazards that existed. Nonetheless, on final impact with the building, both of them were thrown forward into the galley bulkhead, action that could have incapacitated them. In this case both of them were able to respond and facilitate the evacuation from the right rear exit. Although releasing their restraints was intended to speed up the evacuation, the possible consequences of serious injury could have prevented either or both of them from assisting in the evacuation. The Safety Board believes that the potential for flight attendant survival can be significantly increased by providing flight attendants with supplemental training to underscore the importance of remaining in their jump seats with their restraints fastened until the airplane has come to a complete stop.

When the B-737 overrode the Metroliner, the cockpit and forward lower cargo bay areas were extensively damaged. As the B-737 and Metroliner continued to slide, the fuselage and lower cargo bay of the B-737 were involved with fuel from the Metroliner's ruptured fuel cells and hydraulic fluid from the B-737's damaged nose gear. The initial impact with the Metroliner also damaged the avionics bay located below the cockpit in front of the lower forward cargo bay. The crew oxygen system on the forward right side of the cargo compartment was most probably damaged during the initial impact sequence which resulted in the escape of gaseous oxygen.

The extent to which the release of oxygen from the crew emergency cylinder accelerated the fire is unknown. However, oxygen released from the bottle would have enriched the burn environment and thereby accelerated the generation of heat and smoke.

Comments by survivors regarding the appearance within the cabin of thick black smoke very early in the accident sequence are consistent with observations in other airplane accidents involving gaseous oxygen and fire. The Safety Board believes that the propagation of the fire in the cabin of USA1493 was accelerated by the release of oxygen from the flightcrew oxygen system that was damaged in the initial collision sequence on the runway and that the accelerated fire significantly reduced the time available for emergency evacuation.

The technical data surrounding this accident and the historical data regarding gaseous oxygen fires do not appear to be sufficient to support the need for specific airplane structural or systems modifications. The Safety Board is aware of and encourages ongoing FAA research on the potential for gaseous oxygen involvement in aircraft fires. The Safety Board supports this effort and urges the FAA to continue the research with a view toward system modification.

In 1985, the FAA issued a Notice of Proposed Rulemaking entitled "Improved Flammability Standards for Materials Used in the Interiors of Transport Category Airplane Cabins," which became a regulation that same year. The regulation required that the cabin interiors of airplanes manufactured after 1985, and used in air carrier service, comply with these new criteria, and required that cabin interiors of all other airplanes type

certified after January 1, 1958, and used in air carrier service, comply with these new criteria upon the first replacement of the cabin interior.

The accident B-737 was manufactured before the effective date of the regulation and therefore any retrofit of fire retardant cabin furnishings was required only in the event of a "general retrofit" by the carrier. If air carriers apply this regulation, as written, an airplane in service for 20 or more years might never be subjected to a "general retrofit," which requires an upgrade to the fire retardant materials.

In this accident, all of the cabin furnishings burned except for the carpeting and seats. The overhead bins melted and ignited and then fell on the passengers and the cabin floor. If cabin furnishings of the type specified for newly manufactured aircraft had been installed in the accident airplane, fire and toxic smoke might not have spread so quickly through the cabin. The Safety Board believes that the FAA should set a specified date after which air carriers should be required to use fire retardant materials in all transport category airplane interiors that meet the provisions of 14 CFR 25.853.

The results of the examination of the toxicological specimens taken from the captain of USA1493 were positive for phenobarbital, a medication prescribed by his personal physician for the treatment of a gastrointestinal disorder. The presence of the medication in the captain at the time of the accident indicates that he had used it shortly before flying, contrary to the instructions of his physician and FAA requirements. He failed to report his use of any medications to his FAA Aviation Medical Examiner. He concealed the use of phenobarbital from the FAA and his employer.

Specimens taken from the first officer of SKW5569 revealed the presence of substances found in typical over-the-counter medications. The presence of these substances again raises the question concerning the frequency with which pilots self-medicate shortly before flying.

The circumstances revealed by this accident indicate that all pilots may not fully appreciate the potential dangers of many medications and, as a result, may use them inappropriately. Therefore, the Safety Board believes that there is a need for the FAA to undertake a special educational program about the use of these types of drugs to reach all active pilots. Such a program must describe, illustrate, and alert pilots to the potential consequences of the misuse of legitimately prescribed medications and over-the-counter preparations. It must also stress that pilots must seek and heed the advice of their physicians and FAA Aviation Medical Examiners concerning the use of all medications they take and the effect that each may have on the safety of their flight operations.

USA1493 was equipped with a Sundstrand model AV557C cockpit voice recorder (CVR) and, although a transcript of the CVR tape was prepared, problems were encountered with the recording.

Some areas of the recording were of substantially poorer quality than others, and there was a significant reduction in recording speed in the areas of reduced quality. Furthermore, the recording was fragmented and discontinuous, with conversations apparently cut off by segments of other portions of the landing conversations. These recording aberrations were determined to be the result of small imperfections in the tape that caused the CVR internal end-of-tape sensor circuits to function abnormally. Sundstrand representatives stated there were no tests available, or feasible, that could detect the presence of these small imperfections. The self-test procedure, required to be performed routinely by the flightcrews, does not detect such imperfections.

The Safety Board concludes that the tape supplied with the CVR aboard USA1493 by Sundstrand was defective when it was installed. The tape was relatively new and not expected to have degraded substantially from normal use. The Safety Board believes that the FAA should perform a directed safety investigation of the Sundstrand Model AV-557 CVR to determine what modifications need to be made to ensure that the switching mechanism in the unit is able to withstand recording tape anomalies and variation in tape opacity that are expected to appear during normal service life of the tape.

As a result of its investigation of this accident, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

Modify Air Traffic Control procedures at the Los Angeles International Airport to:

- a.) segregate arrivals and departures to specific runways;
- b.) provide redundancies as intended in the National Operational Position Standards in the control tower.

(Class II, Priority Action) (A-91-104)

Undertake a thorough risk-based evaluation of air traffic control procedures at the Los Angeles International Airport, evaluate whether changes are required, and implement necessary changes. The evaluation should consider at least the following issues:

- a.) runway intersection takeoffs;
- b.) position-and-hold clearances;
- c.) displaced runway thresholds;
- d.) hazards associated with runway crossing traffic;
- e.) local assist controller;

f.) Airport Surface Detection Equipment use and maintenance.

(Class II, Priority Action) (A-91-105)

Include in the Office of Safety Quality Assurance the authority and resources to: (1) independently evaluate air traffic control facility compliance with FAA directives and; (2) audit facility evaluations performed by the Office of Air Traffic System Effectiveness to determine that noted deficiencies are corrected. (Class II, Priority Action) (A-91-106)

Retain the National Operational Position Standards as a separate, independent order and:

- a.) direct the FAA's Human Factors and Air Traffic Service staffs to perform a combined review of the order to determine the adequacy of redundancies and incorporate any resultant recommendations into the National Order;
- b.) expedite the development of Chapters 5 through 10 of the National Order.

(Class II, Priority Action) (A-91-107)

Provide Air Traffic Control Supervisors with formal training to improve their understanding of the intent, objectives and administration of the Technical Appraisal Program. (Class II, Priority Action) (A-91-108)

Require that interim evaluations of controller performance, such as those of the Technical Appraisal Program, be retained for 2 years and utilized in conjunction with other performance appraisals to track the performance and training needs of air traffic controllers. (Class II, Priority Action) (A-91-109)

Conduct a one-time examination of the airport lighting at all U.S. tower-controlled airports to eliminate or reduce restrictions to visibility from the control tower to the runways and other traffic movement areas. (Class II, Priority Action) (A-91-110)

Redefine the airplane certification coverage compliance standards for anticollision light installations to ensure that the anticollision light(s) of an aircraft in position on a runway are clearly visible to the pilot of another aircraft preparing to land or take off on that runway. (Class II, Priority Action) (A-91-111)

Evaluate and implement, as appropriate, suitable means for enhancing the conspicuity of aircraft on airport surfaces during night or periods of reduced visibility. Include in this effort measures, such as the displacement of an aircraft away from the runway centerline, where applicable, and the use of conspicuity enhancements, such as high-intensity strobe lighting and logo

lighting by aircraft on active runways, and encourage operators of airplanes certificated prior to September 1, 1977, to upgrade their airplanes to the present higher intensity standards for anticollision light installations. (Class II, Priority Action) (A-91-112)

Direct the general aviation community and the airlines to take steps to ensure that pilot training programs, including cockpit resource management training and flight operations procedures, place sufficient emphasis on the need for pilots to maintain vigilance in monitoring air traffic control radio communication frequencies for potential traffic conflicts with their aircraft, especially when on active runways and/or when conducting a final approach to a landing. (Class II, Priority Action) (A-91-113)

Incorporate into the Airman's Information Manual language that will alert pilots to the need for vigilance in monitoring air traffic frequencies for traffic conflict situations which may affect the safety of their flight. (Class II, Priority Action) (A-91-114)

Develop for inclusion in the Airman's Information Manual and the Air Traffic Control Handbook (7110.65F) specific phraseology to be used by pilots when requesting an intersection departure and specific phraseology to be used by controllers when issuing a position-and-hold clearance for an intersection departure. (Class II, Priority Action) (A-91-115)

Prohibit the use, after a specified date, of cabin materials in all transport category airplanes that do not comply with the improved fire safety standards contained in 14 CFR 25.853. (Class II, Priority Action) (A-91-116)

Direct the Emergency Evacuation Subcommittee of the Aviation Rulemaking Advisory Committee to examine flight attendant emergency procedures regarding the "2nd choice" exit assignments to ensure that such assignments provide for use of the nearest appropriate exit point. (Class II, Priority Action) (A-91-117)

Issue an Air Carrier Operations Bulletin directing Principal Operations Inspectors to emphasize that during a crash sequence flight attendants must remain properly restrained and seated in their crew seats until the airplane has come to a complete stop. (Class II, Priority Action) (A-91-118)

Establish a comprehensive educational program to alert pilots to the potential adverse effects on flightcrew performance that may arise from the misuse of prescribed and over-the-counter medication. (Class II, Priority Action) (A-91-119)

Conduct a directed safety investigation of the Sunstrand Model AV-557 CVR to determine the necessary modifications to ensure that

the switching mechanism in the unit is able to withstand recording tape anomalies and variations in tape opacity that can be expected to appear during the normal service life of the tape. (Class II, Priority Action) (A-91-120)

Disseminate information regarding the circumstances of this accident and the findings of the Safety Board's investigation to the pilot community through operations bulletins and safety seminars, such as the "Wings Pilot Proficiency Program." (Class II, Priority Action) (A-91-121)

Also as a result of this accident, the National Transportation Safety Board reiterates the following recommendations to the Federal Aviation Administration:

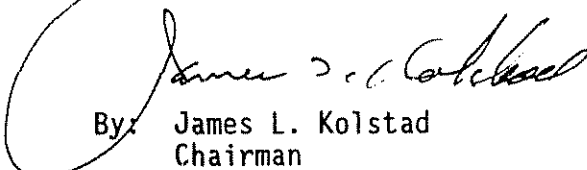
A-89-124

Require 14 CFR Part 121 operators to develop and use Cockpit Resource Management programs in their training methodology by a specified date. (Class II, Priority Action)

A-90-135

Require that scheduled 14 CFR Part 135 operators develop and use Cockpit Resource Management programs in their training methodology by a specified date. (Class II, Priority Action)

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


By: James L. Kolstad
Chairman