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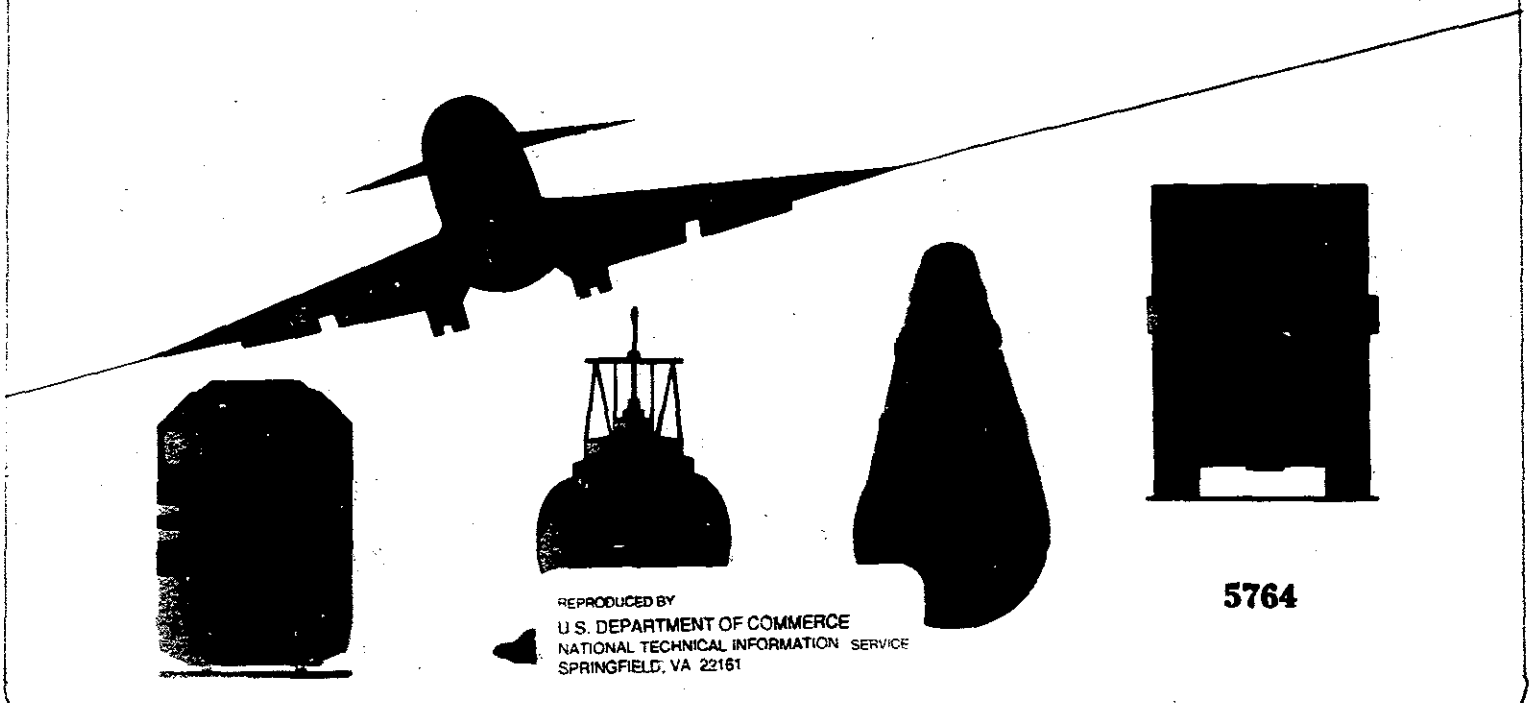
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

FLIGHT ATTENDANT TRAINING AND PERFORMANCE DURING EMERGENCY SITUATIONS



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Adopted: June 9, 1992
Notation 5764

Abstract: This report reviews recent aviation accidents and incidents, Federal Aviation Regulations related to flight attendant training, and flight attendant training programs from 12 air carriers. Evidence from recent accident and incident investigations revealed that some flight attendants did not perform emergency duties in accordance with their air carrier training programs. The Safety Board believes that the ability of flight attendants to perform their duties successfully during emergency situations is directly related to the quality of their emergency training. As a result of this special investigation, the Safety Board issued 13 recommendations to the FAA about flight attendant training.

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EXECUTIVE SUMMARY

It is well known that the routine safety duties performed by flight attendants, such as ensuring that seat belts are fastened, tray tables and seatbacks are upright for takeoff and landing, carry-on baggage is properly stowed, galleys are secured, exits and evacuation slides are armed, and predeparture safety briefings are conducted, increase passenger protection. It may not be so well known, however, that the performance of flight attendants in emergencies can profoundly affect the survival and injury rates of passengers.

While airline accidents are rare, there are nonetheless a number of emergency situations that passengers may face in flight, such as cabin decompression, hijacking, in-flight illness and injury, in-flight smoke and fire, and severe turbulence.

In some emergencies, passengers and crewmembers have sufficient time to prepare themselves for the situation. However, more often than not, an emergency occurs with little or no warning, and it may take place in combination with other abnormal situations. For example, an encounter with severe turbulence may cause injuries to crew and passengers; and a bomb threat, a mechanical failure, or an in-flight fire can result in an immediate evacuation upon landing. In these cases, flight attendants usually provide the most immediate assistance to passengers.

Reflecting the importance of these safety duties, the Federal Aviation Administration (FAA) requires flight attendants to be aboard passenger-carrying airplanes with more than nine seats that operate under the Federal Aviation Regulations (FARs) found at 14 Code of Federal Regulations CFR 121. Air carriers must have FAA-approved training programs that provide specific programmed hours for selected subjects, and flight attendants must maintain their proficiency and attend recurrent training each year. The purpose of emergency procedures training is to ensure that flight attendants have the knowledge, skills and ability to react properly during emergency situations. The Safety Board strongly believes that the ability of flight attendants to perform their duties successfully during emergency situations is directly related to the quality of their emergency training. The Safety Board further believes that it is incumbent upon each flight attendant to recognize the importance of active participation in all aspects of emergency training.

The regulations state that a flight attendant who completes an approved training program is "adequately trained to perform his assigned duties." (14 CFR 121.405(c)) Accident investigations have identified flight attendant actions that were unacceptable and/or contrary to their training. This special investigation of Part 121 flight attendant training reviews accidents and Safety Board recommendations and regulations that address flight attendant training. It also examines the initial and recurrent training programs and programmed hours of 12 air carriers.

In several recent accident investigations, the Safety Board found that although flight attendants provided valuable assistance to passengers during emergency situations, they did not always follow their air carrier's approved emergency procedures or perform their duties in accordance with

training. In 2 of the 24 evacuation cases cited in this report, the actions of some flight attendants contributed to an increase in the number of passenger injuries. In some of the other cases, flight attendant actions came very close to increasing the number of injuries. The Safety Board is concerned that these same actions in other situations could have disastrous results and that flight attendant training may not adequately prepare flight attendants for actions that they may be required to take.

As a result of this special investigation, the Safety Board makes 13 safety recommendations to the Federal Aviation Administration that are intended to improve flight attendant training and performance during emergency situations.

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PREVIOUS SAFETY BOARD ACTION

The Safety Board first issued safety recommendations 24 years ago to the Federal Aviation Administration (FAA) that addressed the adequacy of flight attendant training and procedures. Those and subsequent recommendations related to such diverse matters as:

The need to open all usable emergency exits to the extent reasonably possible during an evacuation.

The participation of flight and cabin crewmembers in periodic evacuation and wet ditching drills.

Hands-on exit opening drills.

The use of realistic training devices and procedures to more accurately simulate emergency conditions.

The need to conduct emergency evacuation training in an environment that simulates an actual evacuation and conducted as a team rather than individually.

The need for detailed information for flight attendants on the operational characteristics of chemically generated oxygen systems.

Procedures for the emergency deployment of the B-727 ventral airstair. The need for flightcrew and flight attendant manuals and training programs to contain compatible emergency procedures, checklists, and crew communication procedures for emergencies.

The need for pilots to inform flight attendants of the nature of an emergency, the approximate time available for cabin preparation, and a standardized signal indicating brace for impact.

Operational procedures for the DC-10 galley lift system.

The need for flight attendants to inform flightcrews immediately of the location, source and severity of fire or smoke within the cabin.

The need for flight attendants to know how to attack cabin fires, and how to don protective breathing equipment.

The need to turn on all emergency lights during an evacuation.

The importance of managing the remaining time for preparing the cabin for an impending emergency landing.

The need for flight attendants to remain seated during taxi, unless required to perform safety-related duties.

The need for joint cockpit and cabincrew training on emergency procedures and periodic emergency drills in which cockpit/cabincrew coordination and communication are practiced.

The Safety Board reviewed its investigations of accidents and incidents where information was available on flight attendant performance during emergency situations. There were many examples of flight attendants who have performed extremely well, even heroically, during life-threatening emergencies and who were responsible for preventing and/or minimizing/injuries to passengers. Nonetheless, there have been many examples of flight attendants who lacked knowledge about emergency equipment and procedures, or who acted otherwise contrary to their training. The following four accidents, and the accidents listed in Appendix A, illustrate some of these problems, such as the inability to locate and operate emergency equipment, the failure to follow procedures, and/or the inability to understand the consequences of improper actions, such as opening an exit while the airplane is moving or while engines are still operating, or inflating an evacuation slide before it is fully deployed.

On December 3, 1990, during its takeoff roll, a B-727 collided with a DC-9 at the Detroit Metropolitan/Wayne County Airport.[1] The right wing of the B-727 was substantially damaged, but none of the occupants were injured. The DC-9 was destroyed during the collision and subsequent fire, and seven passengers and one flight attendant died. The lead flight attendant aboard the DC-9 had been flying for 2 1/2 years and was qualified on seven airplane types. The Safety Board determined that she was not in her jump seat when the collision occurred, failed to properly secure the R-1[2] emergency evacuation slide girt bar into the floor brackets, failed to fully open the L-1 door, and, along with three other trained crewmembers, failed to inflate the L-1 evacuation slide, thereby slowing the evacuation and increasing the number of evacuation-caused injuries.

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[1] Aircraft Accident Report: Northwest Airlines, Inc., Flights 1482 and 299, Runway Incursion and Collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990. (NTSB/AAR-91/05).

[2] Floor-level exits are identified by their location, are numbered sequentially from the front of the airplane, and designated as being either on the left or right side. For example, R-1 is the most forward floor-level exit on the right side.

Because of structural deformation, the lead flight attendant was unable to fully open the L-1 exit door. Two male passengers, who were able with some difficulty to lift the door handle, opened the exit door. The lead flight attendant stated that although the door was not fully opened, she looked for the evacuation slide's inflation handle before jumping from the airplane. She added that she would have pulled the inflation handle even if the door was not fully opened. She exited when the L-1 exit door was only partially open and gave evacuation instructions from the ground. An off-duty flight attendant, who had 9 months experience, assisted an injured passenger to the L-1 exit, took command of the evacuation at the L-1 door, and prevented additional injuries to evacuating passengers by lowering them to the ground. She did not attempt to manually inflate the evacuation slide because she assumed that the lead flight attendant had attempted to inflate the slide before she exited and that the slide had malfunctioned. She was concerned that the airplane might "blow up" but thought that she needed to direct the evacuation because the lead flight attendant had exited. When she thought that everyone was off the airplane, she exited and assisted passengers on the ground. The lead flight attendant, the first officer, and two off-duty flight attendants all exited the L-1 exit without attempting to inflate the evacuation slide.

A flight attendant, who had 22 years experience, and a passenger died of smoke inhalation in the tailcone of the DC-9 because the tailcone emergency release handle assembly was broken, rendering the tailcone emergency exit inoperable. Although the FAA had approved the air carrier's DC-9 tailcone release handle training simulator, the Safety Board found that flight attendants had not been adequately trained in the use of the tailcone exit because the simulator was not installed in a realistic environment. A door or a hatch was not used to gain access to the handle, and the handle was not installed in clips that would have provided the actual force to remove the handle from the restraining clips.

For 4 or 5 days after the accident, the operator tested 238 flight attendants who were scheduled to operate on DC-9 airplanes. Of the 238 flight attendants tested, 4 required additional training. Flight attendants who failed the proficiency test received accelerated training for the DC-9 before returning to flight status.

In its report on the accident, the Safety Board took exception to FAA Air Carrier Operations Bulletin (ACOB) 8-76-46, "Crewmember Emergency Training, Use of Mockups," which stated, in part, "For those exits where it is impractical for each individual to operate the exit or device, such as a DC-9 tailcone, a group demonstration will suffice provided it is supported by a realistic, detailed visual/pictorial presentation." The Safety Board disagreed, finding that flight attendants should have "hands on" operating experience with all exits they are required to open during emergency evacuations. As a result of its investigation, the Safety Board issued Safety Recommendation A-91-60 that called for the FAA to issue an Advisory Circular (AC) addressing acceptable methods for design, construction, operation, and maintenance of mockups used for exit training during crewmember emergency training, and also asked the FAA to provide guidance to FAA inspectors to ensure that emergency equipment training devices

accurately replicate the intended operational environment. The FAA responded that it intends to issue an AC, and the recommendation is currently classified as "Open--Acceptable Action."

On February 1, 1991, a B-737 collided with and overrode a Fairchild Metroliner on runway 24 left at the Los Angeles International Airport.[3] Both airplanes veered to the left as they slid down the runway, and flames were visible through the windows in the aft exits. The airplanes eventually struck an unoccupied building. Both of the flight attendants occupying the aft jumpseat had 20 months of experience. After the collision, but before the airplane came to a stop, they released their restraints and got out of their seats. The flight attendant assigned to the aft left exit (L-2) turned on the emergency lights (as had been practiced in training) and assessed conditions at the aft left exit. She stated that she did not feel heat as she touched the door seal but that she did see fire. She opened the door 2 or 3 feet, and the slide pack released from the door and fell outside the airplane. She stated that flames were "shooting down at the bottom of the airplane where my slide was, so I immediately shut my door and locked it." She closed the door because there was "no way" anyone could escape from that exit. She then took two steps away from the door before the airplane struck the building. She was thrown forward and then backwards, grabbing a handle in the galley to keep from falling. When she turned around to proceed to the overwing exits, she saw that the right overwing exit was already open, and she assisted the flight attendant at the aft right (R-2) exit. She stated that she had been trained to expect two or three impacts and to remain seated until the airplane stopped but that she did not follow those instructions because, "I'm not going to sit and wait. If I can get one person off that airplane while it was [sic] moving or save a life, I'm going to do it. I thought we were going to blow up."[4] After 15 to 18 passengers had evacuated through the R-2 door exit, she tried to enter the cabin to check for passengers. However, the cabin was filled with smoke, and she could not see anything. She was shocked by the amount of smoke, noting that it was "completely dark." When she became dizzy, she evacuated at R-2.

The other flight attendant who was seated on the aft jumpseat observed a "bright orange glow" through the window of the R-2 exit following the first impact but while the airplane was still moving. He released his seatbelt, proceeded to the R-2 door, lifted its handle, and opened the door "slightly." The evacuation slide "did not look right," and he was worried that the slide would inflate inside the airplane so he did not open the door fully. The airplane struck the building, and he was thrown back into the aft galley area and to the floor. He jumped up, fully opened the R-2 door and began evacuating passengers.

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[3] NTSB Survival Factors Group Chairman's Factual Report: USAir, Inc., and Skywest Airlines, Inc., Los Angeles, California, February 1, 1991, (NTSB/AAR-91/08).

[4] Volume IV Testimony Public Hearing in the Matter of the Investigation of USAir, Inc., and Skywest Airlines, Inc., Los Angeles, California, February 1, 1991, (Docket No. SA-505).

On May 5, 1991, an MD-80 was struck by a baggage cart while the airplane was taxiing to a terminal gate in Atlanta, Georgia.[5] A fire erupted outside the airplane, and the flight attendants immediately initiated an emergency evacuation. While the lead flight attendant, who had 3 years and 9 months experience, attempted to contact the cockpit on the interphone, "panicked" passengers rushed toward her and slammed her against the L-1 main boarding door. A nonrevenue passenger, who had been seated in the first class cabin, pulled passengers away from the door, allowing the flight attendant to open the door and deploy the evacuation slide. She believed it was only with the assistance of the passenger that she was able to get passengers back far enough so that she could open the exit door. When she moved away from the open exit, passengers pinned her against the cockpit bulkhead, and she could not reach the R-1 galley service door. The R-1 exit was opened by the same nonrevenue passenger who had initially assisted her at the L-1 exit. The Safety Board found that although some flight attendants were responsible for opening two exits, they had not practiced opening two exits during their emergency procedures training.

The lead flight attendant stated that it was "hard to get the [L-1] door open." She believed that the door weighed more than the door trainer that had been used during her recurrent training and she did not think that the door on the airplane would be harder to open than the training door. Although the slide inflated automatically, she reached for the manual inflation handle because that was an action she had practiced in training. Although the cabin was very dark, she did not activate the emergency light switch located at the forward flight attendant panel because flight attendants had not been trained to do so.

In the same accident, a flight attendant, who had about 7 years experience, was seated on the aft jumpseat when she heard a loud "boom," and saw passengers immediately get out of their seats. She could not see what caused passengers to get up because the jumpseat was "so far back we could not see what happened." She got up from her jumpseat, went to the aft galley and saw flames outside the galley service door. She returned to the aft jumpseat and opened the door in the pressure bulkhead, causing the tailcone exit to jettison. She entered the tailcone and saw that the evacuation slide was not inflated and mistakenly pulled the tailcone release handle in an attempt to inflate the slide. She then took the correct action and threw the slide out of the tailcone, and the slide inflated. She thought she had been taught to hold a handle at the end of the catwalk to keep from falling out, but she did not see a handle and thus did not hold onto anything. She stated that the tailcone exit training mockup provided her with the experience of being inside a tailcone but that the "darkness and height were different" and that the noise [the engines were operating] while she was on the catwalk was not experienced during training. Contrary to the air carrier's procedures, she did not attempt to notify the cockpit before initiating the evacuation. Moreover, she did not hear the evacuation command from the pilots because she

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[5] NTSB Survival Factors Group Chairman's Factual Report: Delta Air Lines, Inc., McDonnell Douglas MD-80, Atlanta, Georgia, May 5, 1991.

was inside the tailcone area and was sure that she "had evacuated before they [the flightcrew] had turned off their engines."

On September 20, 1989, a B-737-400 carrying 6 crewmembers and 57 passengers overran the end of runway 31 during a rejected takeoff in darkness at La Guardia Airport, Flushing, New York.[6] The airplane collided with a wood airport approach light stanchion and came to rest partially in Bowery Bay. The forward fuselage came to rest on a portion of the elevated light stanchion; and the aft fuselage was partially submerged in the water. Two passengers were fatally injured, and 55 passengers and 6 crewmembers evacuated the airplane. The evacuation was conducted during darkness. It was not until the first passenger evacuated that flight attendants in the forward cabin realized that the airplane was in the water.

The lead flight attendant, who had 3 years and 5 months experience, remained in the cabin until rescuers had boarded the airplane to free a trapped passenger. The lead flight attendant used almost all of the emergency equipment available to him, including a flashlight, lifepreserver, megaphone, crash ax, and an evacuation slide disconnect handle. He had difficulty finding his lifepreserver because flight attendant lifepreservers were located in different positions on different models of the B-737 that were used by the air carrier. Even though he was onboard a B-737-400, he looked for his lifepreserver where it would have been located on a B-737-200, and found none there. Flight attendant "C" retrieved the lifepreserver for him from the B-737-400 storage location. He stated, "I wasn't thinking, I was checking everyplace else for it.... I don't know if I just blanked out on it [the location] or what."

The lead flight attendant had difficulty attempting to release the evacuation slide from the R-1 exit so that it could be used as a flotation device to reach people who were trapped in the rear cabin. He had been taught that the quick release handle was under a velcro flap, but he pulled the red slide inflation handle by mistake. When he realized that he had pulled the wrong handle, he pulled on "whatever I could" until he found another handle. He pulled it and nothing happened; then he pulled and tore the "white heavy thread-type cord and lacing" until "somehow the slide did release [from the airplane]." He said that he had seen "pictures during training" of the slide quick release handle but thought that it was different from the one on the airplane. He stated that "hands on" training would have provided him a better understanding of how the slide release operated.

Passengers stated that flight attendants urged them to get off the wing and into the water and away from the airplane because the airplane could "explode." Rescuers urged them to stay with the airplane, because some persons in the water were being swept under the overhanging runway deck and could not be seen.

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[6] NTSB Survival Factors Group Chairman's Factual Report: USAir, Inc., Boeing 737-400, Flushing, New York, September 20, 1989, (NTSB/AAR-90/03).

FEDERAL AVIATION REGULATIONS

Flight attendants are required to be aboard air carrier airplanes with more than nine passenger seats that operate under 14 CFR 121. Each air carrier operating under Part 121 provisions is required to have an approved flight attendant training program (Sections 121.400 and 121.401), to maintain a written curriculum with a list of subjects, programmed training hours, and a list of mockups, door trainers, cabin simulators, and any other equipment used in flight attendant training (121.403), to obtain initial and final approval from the Principal Operations Inspector (POI) (121.405), and to meet the crewmember training requirements for basic indoctrination (121.415), crewmember emergency training (121.417), initial and ground transition training (121.421), and recurrent training (121.427). Flight attendants are required to have 5 hours of initial operating experience (121.434) before they can serve as required crewmembers. No flight attendant is permitted to serve as a required crewmember unless he/she has successfully completed the training required under Section 121.433, which includes initial training, differences training, and recurrent training (if applicable).

Security training is required under 14 CFR Section 108.23 for all crewmembers. The standard security training program requires 8 hours of initial and 4 hours of recurrent training which can be reduced to 4 hours and 2 hours, respectively, with the approval of the FAA.

On October 2, 1990, the FAA adopted a Special Federal Aviation Regulation (SFAR), 14 CFR Parts 61, 63, 65, 108, 121, and 135, Advanced Qualification Program (AQP), as an alternative method to qualify, certify, and train flight crewmembers, flight attendants, aircraft dispatchers, instructors, and evaluators who are currently trained under 14 CFR Part 121. AQP is proficiency-based training rather than the current time-based training. Air carriers that want to establish this type of training must apply to the FAA's Air Carrier Training Branch for approval. The FAA evaluates, then accepts or denies the application. If the application is approved, the air carrier, its POI, and the Air Carrier Training Branch work together to implement and evaluate the program. The use of an AQP may allow an air carrier to extend the elapsed time between required training sessions. Currently, there are no FAA-approved AQP flight attendant training programs. However, it is expected that some operators will develop this type of training program in the near future.

Initial and final approval of flight attendant training programs are required under 14 CFR Section 121.405. Initial approval is granted for a specific period of time of a new training program during which the POI evaluates whether the program complies with the regulations. Section 121.405(c) allows for final approval when it is determined that the initial approval "ensures that each person that successfully completes the training is adequately trained to perform his assigned duties." There is no expiration date for a training program that has received final approval; however, changes to any part of the program require new approval. Although some FARs specify programmed class hours, 121.405 allows an operator to seek a reduction in programmed hours from the FAA. For example, air carriers who wish to operate more efficiently and improve flight attendant utilization may

change instructional methods, techniques, or equipment and request a waiver for the hourly requirements for recurrent training. In order to grant that approval, the POI must ensure that the air carrier achieves the same level of training that was required prior to requesting the waiver for training hours.

Basic Indoctrination

Initial training, 14 CFR Section 121.415, requires 40 hours of basic indoctrination training unless such training is reduced in accordance with Section 121.405, and must cover the duties and responsibilities of crewmembers, the applicable FARs, and the appropriate parts of the operator's operations manual. Basic indoctrination includes aircraft familiarization; aviation terminology; authority of the pilot in command; the flight attendant manual; requirements on the number of flight attendants; flight attendant preflight responsibilities and routine flight duties; the sterile cockpit regulation; no smoking regulations; passenger safety briefings; requirements for passengers needing special assistance; document requirements; uniform requirements; in-flight turbulence problems; company organization and the responsibilities of government organizations, such as the FAA, the Safety Board, the U.S. Customs Service, and the Immigration and Naturalization Service.

Crewmember Emergency Training

14 CFR Section 121.417 addresses flight attendant and flightcrew emergency training requirements for both initial and recurrent training and applies to each "airplane type, model, and configuration, each required crewmember, and each kind of operation conducted insofar as appropriate for each crewmember and the certificate holder." It does not specify the minimum number of training hours for the various subjects. Emergency training must provide "instruction in emergency assignments and procedures, including coordination among crewmembers." Emergency training can be divided into three general categories: emergency equipment, emergency situations, and emergency drills.

Emergency training requires "individual instruction in the location, function, and operation" of emergency equipment, including emergency equipment used for ditching and evacuation, first aid, and fire fighting; portable oxygen systems; and "emergency exits in the emergency mode with the evacuation slide/raft pack attached (if applicable), with training emphasis on the operation of the exits under adverse conditions."

Emergency situation training addresses subjects, such as decompressions, fires, ditching, planned and unplanned evacuations ("including the evacuation of persons and their attendants, if any, who may need the assistance of another person to move expeditiously to an exit in the event of an emergency"), illness or injury, hijacking, bomb threats, turbulence, and other unusual circumstances and events. Flight attendant emergency training also requires a "review and discussion of previous aircraft accidents and incidents pertaining to actual emergency situations." For crewmembers who serve onboard airplanes that operate above 25,000 feet, instruction is required on respiration, hypoxia, length of consciousness

without oxygen, gas expansion, gas bubble formation, and incidents of decompression.

Emergency drills required under 14 CFR Section 121.417 must be performed or observed during initial and/or recurrent training. Two drills required during initial training are the performance of an emergency evacuation using at least one installed evacuation slide; and the extinguishing of a fire using an appropriate fire extinguisher while wearing protective breathing equipment (PBE).[7]

Some hands-on operational exercises are required of flight attendants during initial training and once each 24 calender months during recurrent training for each type of aircraft in which they are to serve. These drills require flight attendants to operate each type of emergency exit in the normal and emergency mode, "including the actions and forces required to deploy the emergency evacuation slides." They must operate each type of fire extinguisher, emergency oxygen system, PBE, and personal flotation equipment, and perform a ditching drill, if applicable to air carrier operations. The ditching drill must include cockpit/cabincrew communication and coordination, passenger briefing and cabin preparation, a review of life lines that are used to exit the airplane at overwing exits, and the boarding of passenger and crew into a slide or rafts.

Drills that flight attendants are required to observe during their initial and recurrent training are: the removal and the inflation from the airplane (or training device) of each type of life raft; and/or the transfer of a slide/raft from one door to another, and an emergency evacuation (including the use of an evacuation slide and/or slide raft).

Aircraft Specific and Transition Training

Section 121.421 requires 16 hours of "initial ground training" for the first turbojet type of airplane in which a flight attendant qualifies. Thereafter, any new type of aircraft for which a flight attendant receives training is considered transition training. Programmed hours are not specified for transition training. Flight attendants who are qualified on one type of airplane may be required to complete "differences training" if the FAA determines that airplanes of the same type certificate vary significantly. For example, DC-9-10, DC-9-30, and MD-80 are models of the same "type" airplane, but they differ in a number of ways. Differences training addresses the differences in exit location and operation, cabin configuration, and the location of emergency equipment. The FAA does not

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[7] Part 121.417 was amended on July 6, 1987, to require the performance of an approved fire fighting drill using PBE (effective July 6, 1989). The compliance date was extended to January 30, 1990, because of problems caused by the delayed certification and production of PBE units (54 FR 22270). The compliance date was further extended to July 31, 1992, because of "a misunderstanding concerning the requirements to fight an actual fire during the fire fighting drill required for PBE training" (55 FR 51079, December 11, 1990).

specify the minimum number of hours for differences training. Differences training need not be classroom sessions and may be accomplished by revisions to the flight attendant manual.

Recurrent Training

14 CFR Section 121.427 requires flight attendants to receive recurrent training and a competency check every 12 calendar months. Recurrent training covers all of the crewmember emergency training and aircraft-specific emergency equipment and procedures training (as described in the "Initial Training" section of this report). Recurrent training for flight attendants qualified on Group II (turbojet) airplanes must consist of at least 12 programmed hours, unless the hours are reduced in accordance with Section 121.405. Flight attendants who do not complete recurrent training, as specified, may no longer serve as required crewmembers.

Guidance to FAA Inspectors

Principal Operations Inspectors (POIs) approve training programs and grant waivers for reductions in training hours. The latest version of the Air Carrier Operations Inspector's Handbook (FAA Order 8400.10), which provides guidance to POIs on approving training programs, is currently being revised. Order 8400.10 Chg. 4, Chapter 14, Flight Attendant Training and Qualification Programs, dated August 31, 1990, provides "direction and guidance to FAA personnel responsible for the evaluation and approval of flight attendant training curriculums." Chapter 14 currently provides guidance for approval of Basic Indoctrination Training (121.415) and General Emergency Training (121.417), but the section of Chapter 14 with guidance for Recurrent Training (121.427) has not yet been issued. POIs are instructed to consider the complexity of the operation and the aircraft when evaluating the adequacy of the 40 hours specified in the regulations for basic indoctrination. It also provides guidance to POIs in approving the number of hours for the initial emergency training curriculum, and it instructs POIs to consider in the curriculum the complexity of the air carrier's operations, as well as the type of aircraft. The following chart gives information on "national norms" for general emergency training hours.

TABLE 3.14.4.1 INITIAL NEW-HIRE FLIGHT ATTENDANT GENERAL EMERGENCY TRAINING HOURS (NATIONAL NORMS)

TRAINING HOURS			
TYPE OF OPERATION	EMERGENCY EQUIP/SITUATIONS	EMERGENCY DRILLS	TOTAL HOURS
LAND OPERATIONS	10.0	4.0	14.0
EXTENDED OVERWATER OPERATIONS	4.0	3.0	7.0
OPERATIONS ABOVE 25,000 FEET	2.0	1.0	3.0

B. Table 3.14.4.1 lists three general levels of operational complexity. The basic level of complexity for the initial new-hire training category is considered to be "land operations." The national norm for land operations is 14 hours for the general emergency training curriculum segment, divided into 10 hours for emergency equipment/situations and the remaining 4 hours for emergency drills. The national norm for "extended overwater operations" is an additional 7 hours divided into 4 hours for emergency equipment/situations and the remaining 3 hours for emergency drills. The national norm for "operations above 25,000 feet" is an additional 3 hours, divided into 2 hours for emergency equipment/situations and the remaining 1 hour for emergency drills. For an operator conducting all three operational complexities, the national norm is a total of 24 hours for the general emergency training curriculum segment.

Source: FAA Order 8400.10, CHG 4
Chapter 14, August 31, 1990.

The previous handbook, FAA Order 8430.6C, issued on July 2, 1984, did not have a section on the approval of flight attendant training programs, but it had the following general guidance to approve reduced training hours: "The proposed reduction in training hours will be fully compensated for by the quality of the training given as evidenced by the results being achieved."

The new handbook (FAA Order 8400.10) states that emergency drill training should ensure that flight attendants are proficient in emergency situations and able to:

- Identify the type of emergency and correctly utilize the appropriate emergency equipment.
- Exercise good judgment in assessing an emergency situation.
- Implement the appropriate emergency procedures and coordinate actions and signals with other crewmembers.
- Operate emergency/safety equipment for each type of aircraft.
- Communicate effectively with crewmembers and passengers in an emergency situation.

Guidance for "Actual Opening of Each Type of Door Exit in Emergency Mode" during an emergency exit drill states that students must demonstrate the "Ability to open exit properly by assuming correct body/protective position; to use door controls correctly; to ensure door is in open and locked position; to use manual slide inflation system to accomplish or ensure slide or slideraft inflation."

In addition to the Inspector's Handbook, the FAA provides guidance to POIs and air carriers through ACs and ACOBs. AC 120-44, "Air Carrier First Aid Programs," issued on April 17, 1987, provides guidance about first aid program resources, subjects, equipment, and pertinent regulations. AC 121-31, "Training on Protective Breathing Equipment," was issued on March 14, 1989, and was rescinded within a year. AC 120-48, "Communication and Coordination Between Flight Crewmembers and Flight Attendants" issued on July 13, 1988, identified common communication problems and referenced the need for appropriate training for all crewmembers. In addition to the ACs, several ACOBs have been issued on subjects related to flight attendant training and provide guidance to POIs.

In 1984, the Secretary of Transportation directed the FAA to implement a special 90-day program of increased surveillance of air carriers operating under FAR Part 121 and FAR Part 135. One of the objectives of the National Air Transportation Inspection (NATI) Program was to "acquire information with which to assess the normal FAA surveillance and inspection procedures." The report noted problems in some regulatory areas, such as training, and stated that some requirements were not clear to either FAA inspectors or to air

carrier management. Cabin safety specialists provide guidance to POIs about flight attendant training; however, at the time of the NATI report, there was only one cabin safety specialist in field duty. The report observed that compliance with cabin safety-related regulations was better in the region where the cabin safety specialist was assigned. It recommended that a "cabin safety-inspector" position be established for each region "to assist all principal inspectors on air carrier certificates held by that region." Currently, the FAA has 11 cabin safety specialists in the field and 2 at FAA headquarters. The 11 specialists in the field are located in five of the FAA's nine regions.

Conferences and Workshops

The Flight Safety Foundation (FSF) conducted an FAA-sponsored Cabin Safety Conference and Workshop from December 11 through 14, 1984. The overall objective of the conference was "to foster better communication on safety matters between the different segments of the aviation community with a view toward further overall improvement of aircraft cabin safety." The FSF noted that many different methods were used for flight attendant training and that one of the "considerable" differences was the number of hours devoted to training, especially "hands-on" training. The FSF recommended that "Standardization of flight attendant training should be accomplished, to the extent possible, as a means of upgrading those training programs which fall short of the safety standard necessary to ensure complete and professionally trained flight attendants."[8]

In September 1985, the FAA held a Public Technical Conference on the Emergency Evacuation of Transport Airplanes. As a result of the conference, the FAA formed three working groups: Design and Certification, Training and Operations, and Maintenance and Reliability. The Training and Operations Working Group could not reach a consensus on the adequacy of the FARs and did not make any formal recommendations. The working group requested that the FAA issue an AC on flight attendant training. The task force report[9] stated:

> The proposed Advisory Circular on Flight Attendant Training will address several areas, including:
>
> -guidelines for the reduction of the number of programmed hours
> -time devoted to transition training
> -the meaning of "individual instruction"
> -the meaning of "competence check"
> -the meaning of "performed emergency drills"
> -the meaning of "actually operate"
> -the meaning of "deployment and use of fire extinguishers"

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[8] Proceedings: Cabin Safety Workshop, December 11-14, 1984 Final Report (DOT/FAA/ASF100-85/01) August 1985.

[9] Task Force Report on Emergency Evacuation of Transport Airplanes (DOT/FAA/VS-86/1, Vol. I) July, 1986.

-the management of subjects used in take-home materials
-the appropriate subjects for use in take-home materials
-guidance on training in the operation of slide/rafts
-guidance on training in prevention and control of in-flight fires
-training on the use of public address/interphones
-training on the use of megaphones
-anticipated types of passenger behavior in emergency situations
-crew coordination
-responsibility and authority of the pilot-in-command as they relate to cabin safety
-emphasis on all training programs to ensure that crewmembers stay adequately trained

As a result of the FAA Public Technical Conference in 1985, the FAA issued a proposed AC, "Crewmember Cabin Safety Training," on November 20, 1987. In its comments on the proposed AC, the Safety Board noted that the FAA failed to address all the subjects that it stated would be addressed in its final report, "Task Force Report on Emergency Evacuation of Transport Airplanes." The Safety Board further noted that the AC did not address four additional flight attendant training areas that had been the subjects of Safety Board recommendations: guidance on training in prevention and control of in-flight fires (Safety Recommendation A-84-076); training on the use of megaphones (A-81-128); training on the use of public address/interphones (A-85-101); and crew coordination (A-84-018). The Safety Board noted that the FAA had issued another Notice of Proposed Rulemaking (NPRM), "Communication and Coordination Between Crewmembers," on July 13, 1988, and suggested that it be referenced in the AC, "Crewmember Cabin Safety Training."

The proposed AC included the following guidance:

> The requirement of both quizzes and competency checks in the regulations demonstrates that all the subject areas in Section 121.417 should be covered in either a quiz or a competency check.
>
> Competency checks for flight attendants and proficiency checks for flight crewmembers on each aircraft and position on which they are qualified are required during initial, transition and recurrent training. These checks should be conducted to determine if an individual crewmember has the necessary knowledge and skills to meet the requirements of the FAR.
>
> For items required for the drills or for actual operation, the competency check should be the actual observation of the crewmember performing the drill or operation, and a record should be kept of each observation.
>
> With the exception of the drills and operations required during initial and recurrent training (every 24 months for operations conducted under Part 121), the checks may be written, oral, "hands

on" or any combination of the three. For those items required for the drills or for actual operation, the competency check should be actual observation of the crewmember performing the drill or operation, and a record should be kept of each observation. Other competency checks, quizzes, and reviews should be given so it can be easily determined if an individual crewmember knows the required material. Written "take-home" tests or oral or "hands on" tests administered to a group in the classroom cannot accomplish this objective.

Students should actually remove equipment from storage (it would be restrained during actual operations).

Many airlines operate several different types of aircraft. It is important that competency checks be given for each aircraft type and model. For example, a flight attendant qualified on the B-747, DC-10, L-1011, and B-727 should have satisfactorily completed a competency check on each of the four types of aircraft. These competency checks should be consistent with the competency checks given when the crewmember initially qualified on the equipment.

Programmed hours and subject matter should not be reduced to the extent that a program cannot meet program goals and objectives and in all cases the program should insure that the crewmember stays adequately trained. Reductions in classroom hours from the 12 hours set forth in the regulations [recurrent training] should be discouraged where there are several different types and models of aircraft in a fleet, except when showing exceptional, time-saving, and effective training techniques, such as separate mockups for each aircraft type and model.

When increases in recurrent or initial training are mandated by the FAA, as happened when security training was required, these increases should not be compensated for by decreases in the hours of existing training in other areas.

The Crewmember Cabin Safety Training AC had not been issued by the time of this report's publication.

The FAA contracted with the FSF to conduct the International Aircraft Occupant Safety Conference and Workshop in 1988. The FSF analyzed the technical presentations of the workshops and offered comments and recommendations, some of which related to flight attendant training. The FSF believed that the FAA AC-120-44, "Air Carrier First Aid Programs," issued April 17, 1987, failed to adequately set forth the necessary guidelines for first aid equipment or standards for training and proficiency. The FSF recommended that the FAA convene a task force to develop a "standard of care" for the aviation industry. It also recommended that, "Work should proceed cautiously on computer-based training (CBT) for

emergency procedures and should begin with an in-depth cost/benefit analysis.[10]

The FAA cosponsored the Southern California Safety Institute's Sixth and Seventh Annual Cabin Safety International Symposia in 1989 and 1990. Training was the subject of several papers presented at the symposia.

In 1991, the FAA established an Aviation Rulemaking Advisory Committee (ARAC). One of the working groups formed within the Training and Qualifications Subcommittee was the Cabin Training Working Group. The working group is reviewing regulations for flight attendant training and may recommend changes to those regulations. The working group formed a Cockpit Cabin Communications Task Force that is working on revising AC 121-48, "Communication and Coordination Between Flight Crewmembers and Flight Attendants."

The Air Transport Association (ATA) sponsors an Inter-Airline Training Conference each year. The conference is hosted by an ATA member airline and is attended by training departments from ATA airlines, as well as nonmember airlines. The purpose of the conference is to exchange ideas, information, and training techniques for flight attendant training.

Airplane Certification

Beginning in 1965, Part 121 operators were required to perform full-scale evacuation demonstrations on each new airplane they operated to show that their procedures and crewmember training could result in the evacuation of an airplane in 2 minutes or less. Beginning in 1967, airplane manufacturers were required under the certification process in Part 25 to conduct a full-scale evacuation demonstration to show the basic capability of a new airplane to be evacuated in 90 seconds or less. In 1978, the FARs were amended to allow a single 90-second evacuation demonstration by the manufacturer that would show compliance with both Part 25 and Part 121. The combined evacuation demonstrations are conducted to demonstrate the evacuation capability (cabin configuration, exits, evacuation slides, and emergency lighting) of the airplane and to demonstrate the effectiveness of the crewmembers' emergency training program and evacuation procedures. In the combined tests, training for crewmembers for the evacuation demonstration tests must be the same as that given to line crews and thereafter serves as a baseline for other operators. AC 25.803-1, Emergency Evacuation Demonstrations, issued in 1989 states:

> Training in exit operation and passenger management is especially important for a demonstration of a new model airplane; however, the crew should not be trained specifically in the conduct of a demonstration, or receive special training or be assigned duties not normally associated with a Part 121 crew training program.

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[10] Proceedings: International Aircraft Occupant Safety Conference and Workshop, October 31-November 3, 1988, Final Report DOT/FAA/OV-89-2, August 1989.

> This training should be similar in content and duration to the training received by a flight attendant when an operator adds a new model airplane to its certificate.
>
> If extensive training is required (or provided) for successful conduct of a demonstration, this additional information or training should be added to the training program of all operators utilizing that demonstration for compliance with 121.291(a)(1).
>
> If the demonstration is not successful and crew procedures are changed in order to successfully conduct a repeat demonstration, the changes in procedures should be fully documented.

The type of training given to flight attendants, and/or changes to training or procedures for an evacuation demonstration, are reported in a Flight Standardization Board (FSB) report, and POIs are required to ensure that approved operator training programs adhere to the provisions in the FSB report. The FAA issued Action Notice 8430.50, Approval of Emergency Evacuation Training Curriculums, on February 6, 1990, to all Regional Flight Standards Division Managers; Superintendent, FAA Academy; Manager, Flight Standards Staff; and all Flight Standards District Offices. The Action Notice stated:

> The training provided to crewmembers by the aircraft manufacturer in preparation for an emergency evacuation demonstration conducted in accordance with Federal Aviation Regulations (FAR) Section 25.803 for compliance with Section 121.291(a)(1) will be considered the "baseline" training against which all certificate holders' emergency evacuation training, for crewmembers who will serve in that aircraft thereafter, must be compared. A complete description of this "baseline" training will be included as a portion of the FSB report for any aircraft affected. If extensive training is required (or provided) for successful conduct of a demonstration, this additional information or training must be added to the training program of all certificate holders using that demonstration for compliance with Section 121.291(a)(1). POI's are requested to ensure that certificate holders to which they are assigned are aware of this Flight Standards Service safety position.
>
> This information and other pertinent material will be issued as an Air Carrier Operations Bulletin and program requirements are to be accomplished within available resources.

SAFETY BOARD REVIEW OF TRAINING PROGRAMS

During this special investigation, the Safety Board reviewed the FAA-approved training programs of twelve Part 121 operators and visited the flight attendant training facilities of seven operators. The review included the types of initial and recurrent training programs currently provided by the operators that are approved by the FAA. It includes operators of both domestic and international flights, operating from one to

seven types of airplanes and employing from 850 to 18,000 flight attendants who were qualified on as many as seven types of airplanes. No attempt was made to determine the number of different models within an airplane type. Two operators flew only domestic routes and did not operate extended overwater flights, and 10 operators flew a combination of domestic and international routes. Ten of the operators had either merged with or acquired other operators; therefore, some of their flight attendants had received initial training from other operators. Mergers can also result in a variety of locations for equipment within one type of airplane because some operators do not choose to standardize the location of equipment.

Initial Training

Initial training is by far the most extensive training given to flight attendants. The length of this training, which qualified flight attendants on as many as seven types of airplanes, varied from 4 weeks to 6 weeks. Ten operators conducted initial training on all types of airplanes in their fleets; one operator qualified new flight attendants on five of its seven airplane types; and another operator qualified new flight attendants on two of its five airplane types.

Two operators, each with a fleet of seven airplane types, conducted training programs that were significantly different from each other. One operator qualified its new flight attendants on all seven airplane types in its fleet (including the airplane types used for extended overwater operations) during the initial 5-week training program. The other operator qualified its new flight attendants on five of seven types of airplanes during a 6-week training program. Transition training was required for airplane types that were not included in initial training, and an additional 4 days of training were required for flight attendants if they were assigned to bases that operated extended overwater flights.

Four operators did not train all of their flight attendants for extended overwater operations during initial training. When flight attendants were eligible to work on overwater flights they received additional training to qualify them for extended overwater operations. This additional training ranged from 4 hours to 4 days. Of the 10 operators that employed flight attendants who were qualified for overwater flights, 8 of them conducted "wet drills" in a pool during initial ditching training. Two of those eight operators conducted periodic wet drills during recurrent training. One operator required an extra day of recurrent training for flight attendants who were qualified for overwater operations, while other operators conducted less than an hour of recurrent training for overwater operations.

Evacuation training devices varied among the airlines surveyed. Some operators conducted evacuation training using motion-based cabin simulators that had the capability to simulate tilt, fire, and cabin smoke. Several operators had full-scale cabin/cockpit evacuation trainers and/or cabin evacuation simulators, and other operators used actual airplanes for door opening drills and evacuation training. In addition to cabin trainers, most operators had door and window mockups for hands-on training. Motion-based evacuation simulators were used during initial training at the largest

operators and at smaller operators that had as few as 2,500 flight attendants.

Two operators used computer-assisted instruction (CAI) during portions of their flight attendant training. One operator used it for 30 percent of the coursework during initial training and for initial training "written" tests. The operator found it highly successful in preparing students for "hands-on" proficiency drills because it allowed students to study and review material at their own pace. With the introduction of CAI, the operator had a 40-percent reduction in retakes of door drill proficiency tests. The other operator maintained computer-equipped "Learning Resource Centers" at each flight attendant domicile. Flight attendants used the Learning Resource Centers to review training materials and complete assignments required for recurrent training.

Recurrent Training

The following chart illustrates recurrent training by the number of hours for the operators that were surveyed:

Flight Attendant Recurrent Training Hours

Operator	Airplane Types	Emergency Recurrent Training Hours	Security Recurrent Training Hours	Total Recurrent Training Hours	Total Classroom/ Mock-up Hours	Homestudy Hours	Additional Comments
"A"	B-737	8	2	10	8	2	
"B"	B-737, B-757	10	2	12	10	2	Additional recurrent training hours required for flight attendants qualified on: A-320, B-747 = 12 hrs.; DHC-8 = 5 hrs.
"C"	B-727, B-737, MD-80	12	2	14	10.5	3.5	
"D"	B-727, B-757, L-1011	12	4	16	12	4	
"E"	B-747, B-727, A-300, A-310	12	2	14	11	3	Recurrent training classes conducted every 6 months
"F"	B-747, B-767, B-727, L-1011, DC-9/MD-80	8	2	10	10	0	FAA-Approved Recurrent training = 5.5 hrs. emergency training + 2 hrs. security; however, currently conducting more than approved training
"G"	B-747, DC-10, B-757, B-727, A-320, DC-9/ MD-80	9	2	11	8	3	
"H"	B-767, B-727, B-737, DC-9/MD-80, F-100, F-28	6	2	8	8	0	Homestudy not required but homestudy distributed prior to recurrent – 98% of F/A's complete it
"I"	B-747, DC-10, A300, B-727, B-737, DC-9/ MD-80	10.5	2	12.5	9.5	3	
"J"	B-747, DC-10, B-767, B-757, DC-8, B-727, B-737	9	2	11	8	3	Security training video viewing required prior to class
"K"	MD-11, L-1011, B-767, B-757, B-737, B-727, DC-9/MD-80	8	2	10	8	2	
"L"	B-747, B-767, A300, B-757, B-727, MD-80, DC-10/MD-11	9	2	11*	10	1	*One additional day of recurrent for F/A's who are overwater qualified. F/A's initially trained on 5 types and F/A's remain qualified only on those airplanes flown at their base
Ranges	**1–7 Airplane Types**	**8–12 Hours**	**2–4 Hours**	**8–16 Hours**	**8–12 Hours**	**0–4 Hours**	

Three operators had flight attendants who were not qualified on all the types of airplanes in their fleets. Operator "H" had flight attendants who were not qualified on all types of airplanes because of a merger; however, it trained its new-hire flight attendants on all its airplane types and ensured that their qualifications were maintained during recurrent training. Operator "L" flight attendants received recurrent training only on the airplanes that were operated from their flight attendant bases. Operator "B" provided recurrent training based on the groups of airplanes for which the flight attendants were qualified. For example, some flight attendants were only qualified on B-737s and B-767s and therefore received 12 hours of recurrent training; others, who were also qualified on B-747s and A-320s, received an additional 12 hours of recurrent training.

The FARs specify a minimum of 12 hours of recurrent emergency procedures training and a minimum of 4 hours of recurrent security training. The FARs also have provisions for operators to seek FAA approval to reduce these hours. Only Operator "D", which operated three types of airplanes, conducted the specified 16 hours of training. The other operators had waivers to conduct recurrent training programs in less than 16 hours. Operator "H" operated six types of airplanes and conducted a 6-hour recurrent emergency training program, or 50 percent of the hours required by the FARs. Operator "F" had a recurrent emergency training program that was approved for 5 1/2 hours, but it conducted an 8-hour class, as well as a 2-hour recurrent security training class, for a total of 10 hours. Operator "E" conducted recurrent training classes every 6 months.

As shown in the chart, homestudy programs are a common practice. Ten operators used homestudy programs. Operator "F" did not use a homestudy program. Operator "H" provided one but did not require that it be completed. However, 98 percent of Operator "H's" flight attendants reportedly completed the homestudy prior to attending recurrent training.

The recurrent training syllabuses were presented in various styles, and it was not possible to compare all of the programs to determine the amount of time devoted to a specific subject, such as "equipment location." For example, the curriculums of some operators review topics by type of equipment, such as oxygen equipment and fire extinguishers. Other curriculums review subjects by groups of airplanes, such as wide body and narrow body types. Some operators address equipment location as part of a homestudy program rather than as a classroom subject. Some programs included scheduled breaks and others did not. At least one operator conducted recurrent training without lunch or other breaks. Without exception recurrent training programs changed each year and different subjects could receive more emphasis one year than in others.

The following recurrent training syllabus shows how time was allotted by Operator "H" who conducted an 8-hour recurrent training class for flight attendants who were qualified on seven aircraft types and who were overwater qualified. Security training, which was the only subject in recurrent training that had an hourly requirement, represented 25 percent of the training hours.

Topic	Hours/Minutes
Decompression	:10
Accident Review	:15
Smoke and Fire Procedures	:10
First Aid Review	:20
Hazardous Materials	:05
Evacuations--Crew Coordination/Equipment Locations	:25
Special Care Passengers	:30
Transfer/Removal/Deployment Slide Rafts	:15
Drug Use/Testing/EAP Program	:10
Emergency Equipment (Hands-On Proficiency Testing)	:35
First Aid/CPR (Hands-On)	:35
Proficiency Drills (Hands-On Testing)	:35
Door/Window Operation (Hands-On Testing)	:35
Water Ditching (Hands-On Testing)	:35
Cockpit Resources Management (CRM)	:25
Crewmember Security	2:00
Evaluations/Retakes	:25
Total Class Time (no scheduled breaks)	8:00

The following training syllabus shows how Operator "G" allotted classroom time. This operator's flight attendants were qualified on six types of airplanes and for overwater operations. A 3-hour homestudy program was required as part of this recurrent training program.

Topic	Hours/Minutes
Introduction (CRM, Training Goals)	:30
Unplanned Emergency (Communication, Leadership)	1:00
Break	:10
Planned Emergency	1:00
(Review emergency procedures; bomb detonation, in-flight fire, engine explosion, hydraulic failure)	
Decompression (Types, location of decompression oxygen)	:30
Door Operation (Review all aircraft)	1:00
Emergency Review	1:00
(Ditching, Hands-on use of fire extinguishers, PBE, megaphone, first aid kit, oxygen)	
First Aid	1:00
Break	:10
Security	1:00
Review Period	:10
Exam	:30
Total Class Time (including scheduled breaks)	8:00

The Safety Board found vast differences in methods that were used by operators to perform door-opening drills. The regulations require that flight attendants perform an emergency drill at each exit at least once every 24 months. All of the operators conducted hands-on door drills at least every 24 months, as required by the FARs, but four operators exceeded the FAR requirements and conducted hands-on drills to open exits (for all the airplanes for which a flight attendant is qualified) every 12 months. Operator "K" conducted hands-on exit opening drills for one-half of its

fleet every 12 months, thereby meeting the requirement for door drills every 24 months.

The instructor/student ratio during drills among the airlines ranged from a high of 1:9 to a low of 1:1. During a visit to one operator, Safety Board staff observed a drill in which a flight attendant attempted to open a door using the arm/disarm lever rather than the door operating handle. The student subsequently operated the proper handle, and the door opened. The improper action was apparently not observed by the instructor (who was observing four students during the drill), and the flight attendant was not asked to repeat the drill. Safety Board staff noted that another operator's door opening drills required an instructor to observe each student individually to ensure that every step on a checklist was accomplished in order to successfully complete the drill.

Many differences in operator procedures were noted when door opening or evacuation drills were conducted. Some operators conduct proficiency tests on each exit that flight attendants are qualified to operate, while other operators require flight attendants to operate each exit but only to conduct a proficiency test on one exit. Some operators practiced opening exits without power assist, some of their drills encouraged flight attendants to seek assistance with doors that were difficult to open, and other drills required the activation of emergency lights or notification of the cockpit before doors were operated. One operator's drill required flight attendants to open all the floor-level exits for which they were responsible. One operator conducted joint flightcrew/flight attendant evacuation training exercises; another operator conducted joint flightcrew/flight attendant exercises in its training for overwater operations. The most common practice (11 of the 12 operators) was a minimum of 2 hours for security recurrent training.

Some operators conducted part of their recurrent training at the home bases of flight attendants and then brought them to a central location for hands-on exit training. Other operators had training centers at several locations and brought flight attendants to these locations for recurrent training, exit opening drills and evacuation training. A few operators trained flight attendants at their bases and used airplanes for the required hands-on training.

ANALYSIS

The Safety Board's 1974 special study "Safety Aspects of Emergency Evacuations from Air Carrier Aircraft,"[11] cited examples of flight attendant inappropriate performance resulting from inadequate knowledge of emergency equipment and procedures. The study concluded that the adequacy of emergency training can be measured indirectly by analyzing crewmember performance during actual emergencies.

Knowledge and Skill Deficiencies

This investigation of flight attendant performance during actual emergencies has revealed that although improvements in training have been made since the 1974 study, training issues continue to be of concern. The Safety Board believes that some flight attendants may not have been given enough information about and/or practice with equipment and situations to master the skills they need in an emergency. Or conversely, they may be given so much information, such as multiple locations of equipment on several types of airplanes, that these locations cannot be readily recalled during an emergency. Some flight attendants did not demonstrate proficiency in their knowledge of exit operations, evacuation slide or slide/raft inflation and disconnection, location of equipment, knowledge of chemically generated oxygen systems, use of checklists during an emergency, crew communication, and ability to follow established or standard operating procedures.

Evacuation Slides and Slide/Rafts

During the B-737 evacuation in Bowery Bay, on September 20, 1990, the lead flight attendant disconnected the evacuation slide from the airplane. He stated that he knew there was a "disconnect handle"; however, when he first tried to disconnect the handle, he pulled the inflation handle. He stated that he had seen pictures of the disconnect handle but had not actually pulled one during training.

During the B-747 evacuation in Detroit, Michigan, on February 11, 1987 (See Appendix A, Case No. 20), a flight attendant disconnected the evacuation slide when she attempted to pull the manual inflation handle, causing the evacuation slide to disconnect from the airplane while passengers were on the slide. In the MD-80 evacuation in Atlanta, Georgia, on May 5, 1991, a flight attendant opened the pressure bulkhead door, which jettisoned the tailcone, and saw that the evacuation slide was not deployed. She pulled the tailcone release handle instead of throwing the slide pack out the tailcone. When she realized that this action did not deploy the slide, she took the proper action and inflated the slide.

In the 1984 evacuation of the DC-9 in Erie, Pennsylvania (See Case No. 15), the flight attendant inflated an evacuation slide inside the airplane when she pulled the inflation handle before the evacuation slide was fully

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[11] Special Study, November 13, 1974 (NTSB AAS-74-03)

deployed. In the DC-9 evacuation in Detroit, Michigan, on December 3, 1990, the lead flight attendant stated that although the door was not fully opened, she would have pulled the inflation handle if she could have found it. In these accidents, it is apparent that the flight attendants intended to take the proper action, such as inflating or disconnecting the slide or slide/raft, but took incorrect action, such as pulling the wrong handle. The Safety Board is concerned that these flight attendants did not have adequate knowledge of the operation of the evacuation slides and believes that flight attendants who fully understand the operation of an evacuation slide would better understand the risks associated with inflating an evacuation slide that is not fully deployed.

Exit Opening

Studies have shown that men are capable, on the average, of applying twice the rotational force as women. Edwards and Edwards concluded that "excessive force requiring the effort of several male personnel is likely to be necessary if the exit malfunctions for any reason."[12] There were several accidents in which flight attendants needed, requested and received assistance to open exits. Although some training centers have mockups that simulate the forces necessary to open an exit when the airplane is in an unusual or tilted attitude, it is understandable that flight attendants may need assistance opening exits when fuselage damage occurs because exact fuselage deformation cannot be duplicated in training. However, the Safety Board believes that the failure of flight attendants to open undamaged doors and exit hatches reflects a serious training problem. During the evacuation of the B-727 at Covington, Kentucky, on May 17, 1984 (See Case No. 14), in which the airplane was in its normal attitude and there was no damage to the fuselage or the exits, only one out of four flight attendants successfully opened a floor-level exit. Three other flight attendants were unable to open their assigned exits.

Two accidents in this special investigation that disclosed problems with inadvertent disarming of emergency exits were: the DC-10 in Los Angeles, California, in 1978 (See Case No. 8), and the DC-10 in San Juan, Puerto Rico, in 1985 (See Case No. 17). The arm/disarm lever and the door control handle are adjacent to each other. Upward movement on the arm/disarm lever disarms the exit and upward movement on the door control handle opens the door. Flight attendants do not normally have the opportunity to develop strong habit patterns associated with operating the door control handle because each door is not always opened, and doors are usually opened by ground service personnel from outside the airplane. However, flight attendants develop strong arm and disarm habit patterns because they regularly use the "arm/disarm" lever during taxi to and from the gates. The Safety Board believes that more emphasis should be placed upon the operation of this type of DC-10 door (or other doors with similar designs) to overcome this design-induced difficulty. Since the operating systems on some doors may predispose

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[12] Edwards, Mary and Elwyn, "The Aircraft Cabin: Managing the Human Factors," Gower Publishing Company, Aldershot, England, 1990.

operators to human error, flight attendant training should emphasize the potential for error and should reinforce the need for the correct action.[13]

Location of Equipment

Three accidents demonstrated that some flight attendants were unsure of, or could not recall without assistance, the location of emergency equipment. In two accidents, the flight attendants reacted immediately to the situations and sought but could not find the needed equipment. In the B-747 decompression (See Case No. 23), the flight attendant, who was qualified on seven airplane types, went to a location where she believed she would find an oxygen bottle; however, the accident airplane was not among the B-747 models that had an oxygen bottle at that location. In the B-737 accident in Bowery Bay, the lead flight attendant, who was qualified on five different airplanes, searched for his lifepreserver where it could be found on other models of the B-737. Another flight attendant eventually pointed out the correct location, and he donned a life preserver. In the DC-10 decompression (See Case No. 27), a flight attendant, who was qualified on seven types of airplanes, stated that she was aware of the location of emergency equipment in the area of the cabin that she had to preflight but that she was "not as familiar" with the location of emergency equipment in other areas of the cabin.[14] She asked the lead flight attendant about the location of the fire extinguisher in the forward cabin (which was found in the same location on all the DC-10s in the fleet) in order to "save time." She had difficulty removing the fire extinguisher from its brackets because she had not actually removed one before.

The Safety Board believes that the importance of knowing the whereabouts of fire extinguishers was vividly illustrated in an accident investigated by the Canadian Transportation Safety Board. An in-flight fire occurred on March 17, 1991, aboard an L-1011 en route from Frankfurt, Germany, to Atlanta, Georgia.[15] The fire was a serious threat to the safety of the airplane, and a delay in locating a fire extinguisher could have had serious consequences. However, a flight attendant with 22 years experience who was near the source of the fire quickly obtained a fire extinguisher, attacked the fire, and eventually extinguished it. The airplane made a precautionary landing at Goose Bay, Labrador, Canada.

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[13] Wiener, Earl and Nagel, David, Human Factors in Aviation, Harcourt Brace Jovanovich, San Diego, 1988, CH. 15 "Cockpit-Crew Systems Design and Integration," Sexton, George.

[14] "Preflight" refers to a check of cabin emergency equipment. The purpose is to determine if the equipment is serviceable and in its proper location. Operator procedures vary as to which equipment is checked and who checks it. Some flight attendants may not be required to preflight emergency equipment.

[15] Information on this accident was obtained from the U.S. accredited representative to the investigation.

In contrast, a major European air carrier standardized procedures, and the type and location of "movable emergency equipment" within its fleet.[16] The goals of its "Emergency Standardization Activities" were:

1. Three-aircraft qualification for flight attendants [flight attendants were qualified on two types of airplanes].

2. Less training effort through standardized procedures and equipment

3. Better motivation for flight attendants.

4. Saving costs by means of less storage and maintenance.

The Safety Board believes that each operator should strive for the standardization of equipment location in order to facilitate flight attendant recall of emergency equipment location. The Safety Board recognizes that a standardization program, such as the one described above, may represent a major expense. However, as was noted by the European air carrier, the initial costs were compensated for by long-term savings.

There are significant differences in the location and operation of emergency equipment and exits among airplanes operated in most operators' fleets. Flight attendants should know where emergency equipment is located in airplane cabins. Their knowledge of equipment location should not be restricted to areas where they are assigned or have preflighted. The stress of an emergency situation, and the infrequent use of emergency equipment, may cause a flight attendant to become confused about the location of equipment. Therefore, the more aircraft types for which flight attendants are qualified, the greater the need for standardized equipment location within aircraft types and the more stringent the training, testing, and proficiency drills should be to ensure that no confusion exists about the location and operation of emergency equipment.

Emergency Procedures

Each airline has its own standard operating procedures. When consistently applied, standard operating procedures provide a guaranteed form of communication. Accurate communication is beneficial in any situation and critical in emergency situations. The Safety Board recognizes that all accidents are different and that established procedures may not be appropriate for every situation. However, the Safety Board believes that when crewmembers deviate from established procedures, it should only be for unusual situations in which safety can be improved. In the following accidents, flight attendants who failed to follow procedures increased the risk of injury, or caused injuries, to themselves and passengers.

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[16] Norbert Wagner, "Emergency Procedures and Equipment Standardization" in Proceedings of Second Annual International Aircraft Cabin Safety Symposium, February 12-14, 1985, sponsored by the Institute of Safety and Systems Management, University of Southern California.

In the DC-9 ground collision with a B-727 in Detroit, Michigan, the lead flight attendant's failure to ensure the complete opening of the L-1 exit and inflation of the evacuation slide resulted in serious injuries to persons who jumped from the L-1 exit. In the MD-80 evacuation in Atlanta, a flight attendant in the aft cabin initiated an evacuation through the tailcone without first attempting to notify the cockpit and while the aft-mounted engines were still running. In the B-737 evacuation in Los Angeles, two flight attendants got out of their jumpseats after the ground collision but while the airplane was still moving. One flight attendant opened the L-2 door wide enough to deploy an evacuation slide, before impact with a building, and the other flight attendant opened the R-2 door "slightly" and was thrown to the floor by the impact. The flight attendant who opened the L-2 door stated that she had been taught that when fire was observed outside an exit she was not to open the door. She saw fire when she assessed conditions but opened the exit anyway. After she realized that her action was incorrect, she immediately closed the door. Fortunately, the door was not open when the airplane impacted the building because she could have been thrown out of the airplane and/or the open door could have permitted the immediate entry of fire into the rear cabin.

The lead flight attendant in the DC-10 that sustained a catastrophic failure of the No. 2 engine fan (See Case No. 26) stated that she knew emergency procedures required her to determine the amount of time available to prepare the passengers and the cabin. However, she chose not to ask the flightcrew about the time. Additionally, the second item on the flight attendant checklist was "Determine Time," but none of the flight attendants followed this checklist procedure.

In the B-737 evacuation in Tucson, Arizona (see Case No. 25), the operator's procedures, which are standard among operators, called for the flight attendant to direct passengers to assist at the bottom of the slide during the evacuation and direct passengers away from the airplane. However, fire fighters asked the flight attendant to exit and to help people off the bottom of the slide. As demonstrated during emergency evacuation demonstrations required by the FAA, flight attendants are more effective in managing the flow of passengers through an exit from inside the cabin; the Safety Board believes that they should remain aboard the airplane as long as they believe it is safe to do so.

In several accidents where emergency lights were not manually activated by flight attendants, it was determined that the operator did not have a procedure to do so or, if it had such a procedure, did not require flight attendants to practice the procedure during training drills. For operators who had flight attendants practice turning on the emergency light switch during drills, flight attendants were more likely to follow the procedure in an actual emergency.

Communication

Although airplane terminology is taught during initial training, the topic was not listed in the recurrent training syllabuses reviewed for this investigation. The DC-10 accident in Sioux City, Iowa, illustrated a communication problem between the cockpit and flight attendant crews. The lead flight attendant called the cockpit and told the flightcrew that there was damage to the "back wing." This was interpreted by the flightcrew to mean damage on a wing. The second officer proceeded to the cabin to evaluate the damage on a wing and found that the damage was to the horizontal stabilizer rather than a wing. In this accident, a cockpit crewmember was able to leave the cockpit and determine the location and extent of damage. While this is the only example of such a communication problem identified in this investigation, the Safety Board is concerned that flight attendant recurrent training does not review terminology that would allow cockpit and cabincrews to communicate accurately during an emergency. The increase in the number of two-person flightcrews decreases considerably the likelihood that a cockpit crewmember will be able to enter the cabin to evaluate reported damage during an emergency. This situation places more responsibilities upon flight attendants to locate and to accurately describe damage. Therefore, to ensure accurate communication between cabin and cockpit crewmembers, the Safety Board believes that recurrent training programs should review terminology of major parts of the airplane. Since these terms are seldom used by flight attendants during their normal duties, this review is needed to ensure that proper terminology is used during an emergency.

Oxygen Systems

In its 1976 special study on "Chemically Generated Supplemental Oxygen Systems in the DC-10 and L-1011,"[17] the Safety Board noted that passengers and flight attendants had erroneously concluded that oxygen was not flowing to masks because the reservoir bag attached to each mask did not inflate and because there was no other indication that oxygen was flowing. Some airlines have incorporated statements into their predeparture safety briefings that relate to the flow of oxygen and the appearance of the bag following the activation of the oxygen system. Although visual indicators on rebreather bags now make it easy to identify the flow of oxygen, some flight attendants were not trained to use these indicators. In the two DC-10 decompressions described in Case No. 21 and Case No. 27, a green band on the reservoir bags showed that oxygen was flowing, but flight attendants were not trained on the purpose of the green band. In these decompressions, flight attendants used fire extinguishers on some oxygen compartments because passengers were alarmed that the compartments were generating smoke. The FAA should ensure that flight attendant training programs include information on visual oxygen flow indicators and the probability of oxygen generators producing smoke.

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[17] Special Study: Chemically Generated Supplemental Oxygen Systems in DC-10 and L-1011 Aircraft (NTSB-AAS-76-1).

Risk Assessment

Following an accident or an emergency situation, flight attendants need information to assist them in evaluating risks to themselves and passengers. For example, many flight attendants stated that they thought the airplane was about to "explode" or "blow up." While flight attendant training should not minimize potential hazards, it should provide information about the greatest risks following an accident. Accident history reveals that the explosions rarely occur and that the greatest risks are fire and toxic smoke. The Safety Board believes that flight attendants who understand these risks during emergencies will be better prepared to make decisions about passenger safety and their own safety.

Training Programs and FAA Oversight

Accident investigations strongly indicate that, in some instances, flight attendants were knowledgeable about, but not proficient in, performing their duties. Some flight attendants may be deficient in certain areas, such as situational awareness, crew communication, time management, knowledge of equipment location and operation, management of passengers during emergencies, the ability to follow emergency checklists, and use of all possible resources and assistance during an emergency. Based on accident history, the Safety Board is concerned that some air carrier methods of determining proficiency may be inadequate. The FAA should ensure that flight attendant recurrent training programs include comprehensive testing of the knowledge and skills needed during emergencies. Further, the training and testing should account for performance degradation under stress.

Recurrent training programs review flight attendant emergency and security training and is the only flight attendant emergency training having specified hourly requirements. Accordingly, this discussion focuses on the differences between operators in flight attendant recurrent training programs approved and overseen by the FAA.

The most consistent number of training hours among air carriers was noted in the recurrent security training in which 11 operators had been granted waivers from 4 to 2 hours. The greatest differences were noted between air carriers in the number of hours approved for emergency recurrent training. One operator with five types of airplanes had a training program approved for 5.5 hours of recurrent emergency training (although the operator was conducting an 8-hour program at the time of this special investigation) and another operator with six types of airplanes had approval for a 6-hour recurrent emergency training program. Significant differences were noted in the types of emergency drills and exercises conducted and the methods used to demonstrate and evaluate proficiency.

Accident investigation findings graphically reveal the necessity of opening all available exits during an evacuation, especially when fire is involved. The Safety Board is concerned that, for some air carriers, the FAA has not ensured that there is sufficient time devoted to allowing flight

attendants to practice the skills and to develop confidence to open all types of exits in the types of equipment flown by their respective employers.

Although all operators conducted exit-opening drills at least every 24 months, not all operators conducted evacuation drills during recurrent training. The Safety Board believes that since training is the only opportunity to practice their skills outside of an emergency context, flight attendants should demonstrate proficiency in the operation of each exit they may be expected to operate. Flight attendants should also demonstrate proficiency in the use of verbal commands to manage passenger flow when competitive behavior is displayed. There are several airplanes in which flight attendants are responsible for opening more than one exit, but most recurrent training programs do not require flight attendants to practice opening more than one exit during drills. Flight attendants who are responsible for opening more than one floor-level exit, or a combination of floor-level exits and exit hatches, during emergency evacuations should demonstrate proficiency in methods they will use to open these exits, including managing the flow of passengers. Flight attendants who do not have opportunities to practice such skills may not be able to perform the appropriate emergency procedures in a timely manner when emergencies occur.

The Safety Board believes that the FAA should require evacuation drills and group exercises during recurrent training. These exercises are important in learning to perform and communicate as a team, gaining experience in situational awareness, and acquiring experience working with passengers. Students acting as passengers can role play to show how passengers may help or hinder a flight attendant during emergency situations by simulating helpful, panicked, or competitive behavior. By their very nature, accidents are violent and unpredictable and often result in equipment malfunctions. Recurrent training should include exercises with exits blocked, exits inoperable, and/or for which flight attendants need assistance to open the exit. The exercises should also include practice operating equipment, such as evacuation slide/raft backup inflation mechanisms or slide quick disconnect handles. The objective of these exercises would be to provide flight attendants with a thorough understanding of the operation and location of all emergency equipment so that they can assess situations quickly and take appropriate action. These exercises provide the experience that flight attendants need in gaining situational awareness. During these drills, it is also important that flight attendants who use improper procedures or take incorrect actions immediately receive remedial instruction.

The Safety Board strongly endorses joint cockpit/cabin emergency training (See Case No. 22). Many of the concepts in cockpit resource management (CRM) programs should be included in flight attendant training. A CRM approach to flight attendant training could stress the need to communicate completely and accurately and ensure that there is a complete communication loop; help assure that tasks are prioritized and delegated; and help assure that task focus is transitioned to the task that is appropriate for the situation. Accident investigations have repeatedly shown the valuable assistance that off-duty crewmembers have provided to cockpit and flight attendant crews during emergency situations. Just as CRM

teaches pilots to include flight attendants on their "team," flight attendants must learn when and how they may use passengers and off-duty crewmembers as part of their team during emergencies. With the proliferation of two-person cockpit crews, the Safety Board believes that emergency training should jointly involve both cockpit and cabincrews, in order to develop and practice skills as a team. Industry training is constantly evolving and, as noted earlier, some air carriers are currently conducting joint training.

Written examinations that are given during recurrent training should be comprehensive, and, where flight attendants are qualified on numerous types of airplanes, the examinations should be comprehensive enough to ensure that flight attendants are equally knowledgeable about aircraft-specific subjects, such as the location of emergency equipment, communication systems, slide/raft deployment and exit operation. Examinations should also thoroughly cover all of the general emergency subjects, such as decompressions, evacuations, ditchings, first aid, flotation equipment, fire fighting, portable oxygen containers, crew communication, and security.

The FAA has markedly improved its guidance to POIs for basic indoctrination training and general emergency training by including a chapter in the new Inspector's Handbook that addresses the review and approval of flight attendant training programs. The earlier edition of the handbook did not contain this guidance and, as this investigation has revealed, some approved flight attendant training programs did not ensure that flight attendants had the knowledge and skills needed in emergencies. Although the chapter was incomplete at the time of this report, the information that has been issued on Basic Indoctrination and General Emergency curriculum contains specific guidance for the skills or knowledge that should be achieved in each segment of training. For example, the objective of emergency drill training modules is "to train each flight attendant to proficiency by reinforcing the concepts developed in the instruction phase of emergency training."

Based on a comparison of the accidents cited in this investigation and the information above, the Safety Board has concluded that guidance to FAA inspectors approving flight attendant training programs is long overdue. We are optimistic that the remaining sections of Chapter 14 will be at least as informative, and that information on the approval of recurrent training programs will provide guidance on curriculum, drills, and national norms for the number of hours of recurrent training, similar to those established for general emergency training. However, the guidance should also account for the number of aircraft types that flight attendants are trained on and whether there is standardization of equipment location. The FAA should also require that flight attendants perform group exercises and proficiency tests in the operation of each type of exit for each type of aircraft in which they are qualified.

In 1987, the FAA issued a proposed AC on crewmember Cabin Safety Training with guidance on acceptable ways to develop flight attendant training programs. The proposed AC would clarify areas in which standardization in flight attendant recurrent training programs does not

exist. For example, the AC recognized that take-home tests, workbooks and study guides were valuable tools but should not be substituted for a one-to-one classroom hour ratio "since take-home material is a less effective teaching technique than classroom training."

While the Safety Board acknowledges that the FARs have hourly requirements for recurrent training, it does not believe that the quality of the recurrent training program can be determined solely on the number of hours of training provided. However, the regulations do require flight attendants to be proficient. The Safety Board questions how POIs can evaluate requests for reduced training hours in the absence of guidance. Further, there is no guidance on the means to determine whether knowledge retention and competency are degraded with reduced hours.

As early as 1972, the Safety Board issued a recommendation (A-72-073) that addressed the ability of air carrier training programs to ensure "adequate retention" of emergency procedures by a crewmember. Since then many changes have occurred in the airline industry. Mergers have combined airplane fleets and personnel from many different air carriers. As a result, flight attendants often have had dissimilar initial training. Fleets have expanded and flight attendants are qualified on numerous airplane types. In addition, many operators are conducting fewer hours of training. Because of these circumstances, the Safety Board believes that the FAA should review human factors research on the ability of flight attendants to retain knowledge and skills that are critical in an emergency. This research could provide valuable information to evaluate the adequacy of flight attendant training program approval.

The Safety Board believes that the FAA is inconsistent in its process by which POIs approve flight attendant training programs and that it is regulating by waiver rather than by adherence to the FARs. Further, the Safety Board does not understand the FAA's logic in granting waivers for reduced training hours. Apparently, the FAA grants waivers for recurrent training without regard for increases in the number of types of airplanes that flight attendants are qualified on, the lack of standardization of equipment location, and, in some cases, without regard for the sophistication of training devices and for devices that realistically duplicate the equipment and procedures that flight attendants will need in actual emergencies. The lack of uniform guidance regarding compliance with the current FARs would be minimized if the FAA would issue its proposed AC on flight attendant training.

The Safety Board is concerned that nearly 5 years have elapsed since the AC on flight attendant training was proposed and that the FAA has not yet issued a final AC. Therefore, the Safety Board strongly urges the FAA to update the AC and expedite its issuance. As a result of this special investigation, the Safety Board believes that the AC should more clearly define the type of training described in the proposed AC as "exceptional, time-saving, and effective training techniques, such as separate mockups for each aircraft type and model," which allows operators to reduce the 12-hour requirement for recurrent training. Further, the Safety Board believes that the FAA should provide specific guidance on whether cabin mockups and exit

mockups are equally weighted in granting a reduction in hours. The AC should also give specific guidance for granting waivers for reduced hours for recurrent training.

The Safety Board acknowledged the benefit of cabin safety specialists for oversight of air carrier training programs in its report on the runway incursion and collision of the DC-9 and B-727 at Detroit, Michigan, on December 3, 1990. The Safety Board noted, however, that the FAA did not provide specialized training for cabin safety specialists. The Safety Board believes that cabin safety specialists can provide valuable assistance to POIs in oversight of flight attendant training programs. Further, specialized training should be given to cabin safety specialists to ensure more consistent oversight of flight attendant training programs. Additionally, the Safety Board believes that the FAA should assign a cabin safety specialist to each of their 11 FAA regions to ensure oversight of flight attendant training programs. The FAA should also assign an additional Cabin Safety Specialist to each major carrier.

Flight attendant training and procedures for the control of passenger movement and the management of passenger response are critical to the successful completion of FAA-required evacuation demonstration tests. Because of this criticality, the Safety Board is concerned about the lack of emphasis in flight attendant handbooks, training, and procedures, especially regarding flight attendant assignments for optimum flow control of passengers during an evacuation.

The Safety Board believes that the training and procedures that were used to successfully complete evacuation demonstrations during the certification of an airplane, including flight attendant flow control responsibilities, should be included in crewmember training programs. It should be noted that Action Notice 8430.50 requires this for evacuation demonstration tests after 1990. For evacuation demonstrations prior to 1990, the FAA should review operator training programs to ensure that any procedures, assignments or training that were essential to the successful completion of an evacuation demonstration are required material in flight attendant initial, differences, and recurrent training.

Human Factors

The Safety Board examined accidents cited in this report from a human factors perspective, emphasizing the training and experience of flight attendants. The Safety Board recognizes the importance of other aspects of human factors, such as selection (the opportunity to screen candidates with regard to their decision-making abilities and their ability to perform well under stress), engineering (equipment design and location), and social interactions (communications between crewmembers). Although the Safety Board notes problems with communication, equipment design and location, this special investigation focused primarily on flight attendant training and experience.

Flight attendants are unique among airline personnel because they have a dual role. The FARs require flight attendants to be on aircraft for the

sole purpose of conducting safety-related duties. However, their duties are also directed toward passenger service, including revenue-generating activities, such as headset rental, liquor sales, or duty-free sales on international flights. The dichotomy of their roles can be shown by operator organizational charts. Unlike pilots, flight attendants may report to such diverse entities as marketing or finance departments that emphasize areas other than safety. Some operators have flight attendant departments, such as in-flight or customer services, with flight attendant safety training the responsibility of flight operations departments. During this survey of operators, the Safety Board found that the differences in the training programs, such as the number of flight attendant training hours, the ratio of classroom versus homestudy hours, the number of types of airplanes flight attendants were qualified on, or the types and fidelity of mockups and training devices, were not directly related to the corporate departments or organizations in which flight attendants were located.

In their review of human factors in the aircraft cabin, Edwards and Edwards discussed "The Management of Emergencies." They suggested that "Since panic results in the disintegration of previously learned skills, it follows that prior rehearsal will act as a deterrent to the development of panic in cabin staff. Familiarity induced by frequent rehearsal of emergency procedures will reduce the risk of any breakdown in performance under stress." They also suggested that "Strong powerful leadership is likely to reduce the incidence of panic by providing firm direction and showing by example the appropriate behavior to ensure survival."

Most flight attendants never encounter life-threatening emergencies during their careers. Other professionals that deal with life-threatening emergency situations, such as fire fighters, hone their skills during hands-on training, drills, and participation in actual emergencies. Conversely, flight attendants receive training to manage emergency situations but rarely have the opportunity to use the skills acquired during training. Emergency procedures, such as those required to prepare an airplane for an evacuation or a ditching, extinguish an in-flight fire, supervise the cabin following a decompression, handle a hijack situation, or manage passengers during an emergency evacuation, are rarely, if ever, used. Flight attendants must immediately change from passenger service-oriented roles to their critical safety-related roles in an emergency. Emergency situations typically require quick, assertive, and decisive action with little time for analysis of the situation. For most flight attendants, the only opportunity to practice skills needed in an emergency is during initial and recurrent training. These skills are perishable, and continuing and effective training is essential for maintaining them.

In many of the accidents examined in this investigation, the emergency situations were life threatening and extremely stressful. The Safety Board believes that these stresses may have led to ineffective and inappropriate flight attendant responses. Research by the U.S. Army Leadership Human Research Unit, at the Presidio, Monterey, California, "Performance Decrement Under Psychological Stress" attempted to evaluate situations that produced a "fear-effect" and "the contribution which this fear component makes to

effectiveness and persistence of performance in stress."[18] During three scenarios, test subjects were evaluated while performing tasks during normal and simulated life-threatening situations. One test scenario involved an actual flight with a simulated engine failure and anticipated ditching. The results of the tests showed statistically significant differences in the performance of tasks, including the correct completion of a complicated equipment repair. For subjects who uniformly believed that they were in *life-threatening situations, there was an average decrement in their* performance. Researchers noted that the subjects underwent a severe restriction in the perceptual field. For instance, relevant stimuli were not noticed, and inadvertent cues that the experimenters feared would compromise the deception failed to "register with the subjects." Some subjects reported becoming engrossed in tasks to the exclusion of other considerations. "All situations subsequently were characterized by a degradation of speed and accuracy." Data also indicated a difference between naive subjects and those more familiar with the context in which the "accident" occurred.

Another researcher examined the effects of stress on decision making and concluded that stress, (including time pressure, startle, loss of control, and fear) "prevented analytical decisions." Moreover, such stress can degrade decision making by blocking cues to gain situational understanding and by preventing a careful evaluation of risks associated with a course of action.[19] The researcher found that nonanalytical decision making, such as "recognitional decision making," can be efficient, even under time stress. He suggested that "Experience allows people to rapidly size up a situation and recognize it as familiar so that they can recognize reasonable courses of action." To help decision makers cope with these stresses, he recommends training to help students recognize the emergency, rapidly gain a sense of situational dynamics, and prepare them to anticipate pitfalls in their chosen courses of action. Training that places students in unpredictable situations and teaches them to recognize and evaluate the situation quickly is effective in coping with stress and can assist them in choosing the appropriate action.

Although the Safety Board found no research on the performance of flight attendants under stress, the research described above can be applied to flight attendant training programs. Since flight attendants are expected to deal with emergency situations that can be stressful and/or life threatening, flight attendant training programs should teach them to recognize, anticipate and accommodate the stresses that may accompany life-threatening situations. Skills that are needed during emergencies are only practiced during initial and recurrent training. Therefore, it is essential for flight attendants to be thoroughly trained and to be aware of how to focus on learned skills and procedures during times of stress.

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[18] Mitchell M. Berkum, "Performance Decrement Under Psychological Stress," Human Factors (22 February, 1964) p. 21.

[19] Gary A. Klein, "Effects of Stress on Decision Making" in Proceedings of the 3rd Topical Meeting on Emergency Preparedness and Response, sponsored by the American Nuclear Society, April 16-19, 1991.

Training programs must instill in flight attendants confidence in their abilities to handle emergencies.

The Safety Board recognizes that training can never truly duplicate the types of situations that may confront flight attendants, such as the DC-10 accident in Sioux City, Iowa, the DC-9 runway incursion in Detroit, Michigan, or the B-737 ground collision in Los Angeles, California. Nonetheless, training can instill the basic skills and confidence that will allow flight attendants to handle life-threatening situations. As the crashworthiness of transport-category airplanes improves and accidents become more survivable, flight attendants are assuming a more critical role for ensuring passenger safety. Because of these changes, FAA oversight should ensure that flight attendant training consistently results in no less than a minimum level of proficiency so that flight attendants can perform their duties effectively during emergencies.

FINDINGS

1. FAA Order 8400.10 offers guidance for Basic Indoctrination and General Emergency Training but does not provide guidance for the approval of flight attendant recurrent training programs or the granting of waivers for reduced hours of recurrent training. Thus, individual POIs frequently grant waivers for reduction in training hours in the absence of guidance and advisory material.

2. Prior to the issuance of FAA Order 8400.10, the FAA failed to provide adequate guidance to its inspectors on approving flight attendant training programs.

3. Some flight attendants are not proficient in their knowledge of emergency equipment and procedures, and the Safety Board believes that this deficiency is related to training. FAA approval reflects a lack of standardization.

4. Differences were noted in the number of hours approved for recurrent training, types of drills, instructor/student ratio during drills, and methods of assessing proficiency. These differences reflect a lack of FAA rationale for approving flight attendant training programs and granting waivers for reduced hours.

5. Most air carriers do not limit the number of airplane types for which flight attendants are qualified.

6. Most air carriers do not have standardized locations of removable emergency equipment within a type of airplane, such as life preservers, portable oxygen, or fire extinguishers.

7. Many air carriers do not perform evacuation drills during recurrent training.

8. Initial and recurrent training programs should address degradation of human performance that can be expected during stressful situations, especially life-threatening situations.

9. Current methods of determining flight attendant proficiency to handle an emergency situation may be inadequate.

10. The FAA has not issued the proposed Advisory Circular on Crewmember Cabin Safety Training that was published in 1987, and the lack of guidance is detrimental to POIs' ability to review and approve the program, as well as the air carriers ability to develop training programs.

11. Most flight attendants do not currently receive Crew Resource Management training during initial training and therefore it is not periodically practiced in group exercises during recurrent training.

12. The FAA has not adequately ensured that flight attendant manuals and training programs include flow control and other procedures that were used during joint 14 CFR Part 25 and Part 121 certification evacuation demonstrations.

13. There is a need for improved human engineering design of cabin safety equipment, such as exit arm/disarm systems.

14. There is a need for a cabin safety inspector in each of the FAA regions and for each major air carrier.

RECOMMENDATIONS

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

Update the proposed Advisory Circular (AC) on Crewmember Cabin Safety Training to include the safety recommendations from this report and previous Safety Board comments on the Notice of Proposed Rulemaking, and expedite the issuance of this AC that was published for comment at 52 FR 44664 on November 20, 1987. (Class II, Priority Action) (A-92-66)

Include in FAA Order 8400.10 procedures for approving the reduction in hours of flight attendant recurrent training programs. Specific guidance should be included for granting waivers to reduce hours that takes into consideration the number of types of aircraft for which flight attendants are qualified, the accuracy and effectiveness of training devices and simulators, and the methods used to test and evaluate proficiency. (Class II, Priority Action) (A-92-67)

Ensure that flight attendant training programs include instruction on human performance of crewmembers (flight attendants and pilots) and passengers under stressful situations, and on methods to compensate for such behavior. (Class II, Priority Action) (A-92-68)

Ensure that flight attendant training programs provide detailed guidance on the relative probability of hazards associated with emergency situations such as fire, toxic smoke, and explosion. (Class II, Priority Action) (A-92-69)

Require flight attendant hands-on proficiency drills for each type of airplane exit, and ensure that flight attendants are evaluated individually by an instructor and that a record is kept that they have performed and successfully completed such drills. (Class II, Priority Action) (A-92-70)

Require that flight attendant training include drills on methods to open exits and to manage flow control at more than one exit if procedures require a flight attendant to be responsible for opening more than one exit. (Class II, Priority Action) (A-92-71)

Ensure that flight attendant training and procedures for each type of airplane include appropriate consideration of the training and procedures used during joint Part 25 and Part 121 certification evacuation demonstrations. (Class II, Priority Action) (A-92-72)

Assign separate Cabin Safety Specialists to each major air carrier and to each FAA region. (Class II, Priority Action) (A-92-73)

Amend 14 CFR Part 121.417 to require an evacuation and/or wet ditching drill group exercise during recurrent training. Ensure that all reasonable attempts are made to conduct joint flightcrew/flight attendant drills, especially for crewmembers operating on airplanes with two-person cockpit crews. (Class II, Priority Action) (A-92-74)

Review existing human factors research for the purpose of issuing guidance to Principal Operations Inspectors on methods of evaluating training programs to ensure that flight attendants retain the skills and knowledge that are necessary in emergency situations. If the review of the research does not provide the needed information, the FAA should establish a research program on flight attendant knowledge and skill retention. (Class II, Priority Action) (A-92-75)

Update and reissue ACOB 76-4 regarding the operational characteristics of chemically generated passenger supplemental oxygen systems. (Class II, Priority Action) (A-92-76)

Require that flight attendants receive Crew Resource Management training that includes group exercises in order to improve crewmember coordination and communication. (Class II, Priority Action) (A-92-77)

Amend the Federal Aviation Regulations to include ergonomic design requirements for cabin safety equipment, including emergency exits. (Class II, Priority Action) (A-92-78)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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June 9, 1992

APPENDIX A

ACCIDENT/INCIDENT AND RECOMMENDATION HISTORY

Case No. 1

The evacuation of a B-727-100 in Springfield, Illinois, on November 4, 1968, resulted in a recommendation (A-68-031) to the Federal Aviation Administration (FAA) to require air carriers to fasten evacuation slide girt bars into floor brackets prior to departure of airplanes from the ramp for flight. The recommendation also called for air carriers to reemphasize during crew training the "basic philosophy of emergency evacuation that all cabin exits that are not blocked by fire, or otherwise rendered unusable (including ventral stairs), should be used to the extent reasonably possible." The recommendation was classified as "Closed--Acceptable Action" on November 21, 1968, when the FAA responded that it had required air carriers to engage the girt bar for door-mounted evacuation slides during taxi, takeoff, and landing; and instructed them to reemphasize to all crewmembers in initial and recurrent training the need to use all possible exits during emergency evacuations.

Case No. 2

The Safety Board conducted a Special Study, entitled "Passenger Survival in Turbojet Ditchings (A Critical Case Review)" in 1972.[20] The study examined the ditching of a DC-9 in the Caribbean Sea on May 2, 1972. The flight was en route from New York, New York, to St. Croix, Virgin Islands, carrying 57 passengers and a crew of 6, when it was forced to ditch because of fuel exhaustion. Forty persons were rescued from the sea, 22 passengers, and 1 flight attendant did not survive.

The Safety Board found that passengers were inadequately prepared for the ditching due to a combination of factors, including insufficient preparation time, inadequate preditching briefings, insufficient flight attendant training, and the lack of proper crew coordination. The Safety Board made 11 recommendations, including 2 recommendations to the FAA that dealt with training. Recommendation A-72-071 urged the FAA to require periodic crew training in evacuation and wet ditching drills. The recommendation was classified as "Closed--Unacceptable Action" on October 3, 1972, because the FAA responded that it did not agree that "wet" ditching drills were needed because the regulations currently required ditching drills and that "Many air carriers have developed sophisticated training programs utilizing modern training aids, mock-ups, simulators, audio-visual presentations, and other training devices which provide a level of training equivalent to the real world training. Each of these programs are evaluated to assure no degradation of crewmember competency." The Safety Board also recommended that "All air carriers make a critical review of their crew training practices and materials with a view toward expanding their

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[20] Special Study, April 5, 1972, (NTSB AAS-72-2).

training in the areas of crash survival and crew leadership and ensuring adequate retention of such knowledge." A-72-073 was classified as "Closed--No Longer Applicable" on June 4, 1975.

Case No. 3

A 1974 Safety Board Special Study entitled, "Safety Aspects of Evacuations from Air Carrier Aircraft," examined 10 air carrier accidents in which evacuations occurred. The study revealed the importance of crew performance in the success of an emergency evacuation and found that crew performance depended greatly upon the emergency training they had received. At the time of the study, air carrier training was conducted mainly through demonstration and audio-visual presentations rather than actual performance of emergency procedures and "hands-on" practice to open exits. The study noted, "Although the FAR's [Federal Aviation Regulations] require actual operation of the proper equipment during emergency training, deviations have been authorized, and much of the training is done by demonstrations." The study recognized that "The adequacy of emergency training can be measured indirectly by analyzing crewmember performance during an actual evacuation" and pointed out several examples of crewmember errors because of inadequate knowledge of equipment and procedures.

As a result of the study, the Safety Board recommended that the FAA "amend 14 Code of Federal Regulations (CFR) 121.417 (c)(4) to eliminate the provision which permits carriers to use demonstrations alone to train crewmembers for certain emergency situations, thus, requiring performance of drills in the operation and use of emergency exits." (A-74-114). 14 CFR 121.417 was revised, effective September 29, 1978, to require that each crewmember actually operate certain emergency equipment, including emergency exits, during initial training and once each 24 calendar months during recurrent training on each type of aircraft in which they are to serve.

Case No. 4

On March 31, 1975, a B-737 ran off the runway after landing at Casper, Wyoming.[21] During the accident, the airplane struck three approach light structures and an irrigation ditch and stopped 800 feet beyond the departure end of the runway. Two flight attendants experienced problems opening the left forward and left rear cabin doors. Both flight attendants had received initial and recurrent training opening an actual airplane door and a mockup of a B-737 door; however, neither flight attendant had ever opened a door that had an evacuation slide girt bar attached to the floor that would have required greater force to fully open the door. During the investigation of this accident, the Safety Board found that the forces required to operate the mockup door were noticeably less than those required to open an exit with the girt bar engaged in its floor brackets. The Safety Board concluded that the training had not prepared either flight attendant to anticipate the forces

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[21] Aircraft Accident Report: Western Airlines, Inc., B-737, Casper, Wyoming, (NTSB AAR-75-15).

that would have been required to open a cabin door with the evacuation slide armed.

Case No. 5

The Safety Board's investigation of a DC-10 evacuation in Seattle, Washington, on October 16, 1975, revealed that the flight attendants had inadequate knowledge of the operation of exits.[22] Two exits were not used during that evacuation when a flight attendant who attempted to open them concluded that they were inoperable because the door handle rotation distance was different than that of the handle on the mockup door she had used during recurrent training. The Safety Board found that the rotation distance on the airplane door handle was more than twice the distance needed to open the door in the training mockup. The Safety Board recommended that the FAA require air carriers to comply with the provisions of 14 CFR 121.417 (c)(4) by using realistic training devices and procedures which accurately simulate emergency conditions, including the manual forces required to open exits in the emergency mode; and require that during initial and recurrent training flight attendants operate emergency exits which duplicate the forces encountered and actions necessary when such exits are opened in the emergency mode. (A-75-084). The recommendation was classified as "Closed--Acceptable Action" on November 22, 1983, when the FAA issued Air Carrier Operations Bulletin (ACOB) No. 76-1.

Case No. 6

A B-727 crashed after takeoff from Denver, Colorado, on August 7, 1975,[23] and was successfully evacuated. However, the Safety Board found that the flightcrew's performance during the evacuation did not conform to the desired or expected standards of a well-trained flightcrew. The flight attendants were injured during the accident, and the flightcrew did not assist during the evacuation. In its report on the accident, the Safety Board concluded:

> Crewmember evacuation training should be conducted in an environment approximating that of an actual aircraft evacuation. Environmental factors, such as darkness, smoke, and confusion, should be introduced into the evacuation training. Training should be conducted in facilities which simulate an aircraft as closely as possible and should be conducted on a crew basis rather than on an individual basis so that each crewmember can become familiar with the duties and responsibilities of the others.

The Safety Board recommended that the FAA issue ACOBs to require that Principal Operations Inspectors (POIs) review emergency evacuation training programs to ensure that adequate emphasis is placed on the aspects of crew

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[22] NTSB Human Factors Group Chairman's Report: United Airlines, DC-10, Seattle, Washington, October 16, 1975.

[23] Aircraft Accident Report: Continental Airlines, Inc., B-727-224, Denver, Colorado, (NTSB-AAR-76-14).

coordination, team effort, and awareness of individuals' responsibilities as leaders of an evacuation (A-76-074); and that air carriers include the evacuation duty assignments of the entire crew in flightcrew and flight attendant manuals. (A-76-075). Recommendations A-76-074 and A-76-075 were classified as "Closed--Acceptable Action" on June 16, 1977, when the FAA responded that it was preparing to issue the ACOBs.

Case No. 7

Several rapid decompressions that involved DC-10 and L-1011 airplanes disclosed problems with flight attendant and passenger use of chemically generated supplemental oxygen systems, prompting the Safety Board in 1976 to conduct a special study. The study found that the problems primarily resulted from a lack of knowledge of the operation of the oxygen systems by both passengers and flight attendants, as well as inadequate instruction on their use. The Safety Board recommended that the FAA require operators of airplanes with these oxygen systems to include detailed information regarding the operational characteristics of these systems in training programs for crewmembers. (A-76-024). In response, the FAA issued ACOB 76-4 on August 17, 1976, that incorporated guidance on the operational characteristics of chemically generated passenger supplemental oxygen systems on DC-10 and L-1011 airplanes. The recommendation was classified as "Closed--Acceptable Action."

Case No. 8

A DC-10 with 186 passengers and a crew of 15 overran the departure end of the runway at Los Angeles, California, on March 1, 1978.[24] When the airplane departed the runway, the left main gear failed, causing the fuel tank to rupture. There was a significant fire, and an evacuation was initiated. When the airplane stopped, two flight attendants who had 18 years and 4 years experience respectively, seated at the L-1 exit unsuccessfully attempted to open the exit. The door was eventually opened with the selector handle in the "disarmed" position, and the slide remained in the container on the door. The flight attendant at R-3, with 18 years experience, stated that she "automatically" disarmed the slide before opening the exit. She realized what she had done, rearmed the exit and opened the door. Another flight attendant with 21 years experience at L-4, stated, "My first reaction, I just zeroed in on the panel, and the thing I saw was the disarming handle. I disarmed the slide. I realized what I did. I jammed it back in. Then I pulled the handle up from the door." The door opened and the slide inflated.

Case No. 9

The Safety Board's investigation of a DC-8 accident in Portland, Oregon, on December 28, 1978, revealed problems with crew coordination

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[24] NTSB Human Factors Group Chairman's Factual Report of Investigation: Continental Airlines, DC-10, Los Angeles, California, March 1, 1978.

during the preparation of a planned emergency landing.[25] The lead flight attendant was instructed by the captain to prepare for an emergency landing. She was neither told, nor did she ask, the amount of time available to prepare the cabin, and there was no evidence that the lead flight attendant gave the other flight attendants any timeframe for completing the preparations. The Safety Board found that the captain and lead flight attendant did not follow the air carrier's procedures for a planned emergency landing. The Safety Board recommended that the FAA issue an ACOB with guidance and criteria to enable FAA inspectors to determine the scope, quality, and effectiveness of training programs with respect to communication and coordination among and between crewmembers. (A-79-066). In its recommendation letter to the FAA, the Safety Board cited seven previous accident reports that discussed problems with communication and coordination between cockpit and cabincrews. The recommendation was classified as "Closed--Acceptable Action" on January 4, 1980, when the FAA notified the Safety Board of its intention to issue such an ACOB.

Case No. 10

On November 21, 1980, a B-727 landed short of the runway at YAP Airport, YAP, Western Caroline Islands.[26] As the airplane skidded to a stop, a fire engulfed the right wing and most of the right side of the fuselage. All the occupants in the cabin escaped through the two left overwing exits. A flight attendant attempted unsuccessfully to deploy the ventral (aft) airstairs. She and several passengers in the aft cabin were nearly overcome by smoke before they could exit from the left overwing exits. The Safety Board found that neither of the flight attendants onboard were trained on the emergency operation of the ventral stairs. The flight attendant emergency procedures handbook did not address the emergency system to deploy the ventral stairs, although flightcrew manuals did. The Safety Board recommended that the FAA require air carriers to include in B-727 flight attendant training the procedures for the emergency deployment of the ventral airstair. (A-81-061). The recommendation was classified as "Closed-Acceptable Action" on March 24, 1983, when the FAA responded that it had surveyed its Regional Flight Standards Divisions and confirmed that the training was being accomplished.

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[25] Aircraft Accident Report: United Airlines, Inc., McDonnell Douglas DC-8-61, Portland, Oregon, (NTSB-AAR-79-7).

[26] Aircraft Accident Report: Continental Airlines/Air Micronesia, Inc., B-727, Yap, Western Caroline Islands, November 21, 1980 (NTSB-AAR-81-7).

Case No. 11

On September 19, 1981, a flight attendant sustained fatal injuries in the personnel lift of a DC-10 en route from Baltimore, Maryland, to Gatwick, England.[27] Safety Recommendation A-81-127, issued to the FAA on September 21, 1981, recommended that the FAA review its DC-10 operator training programs to assure that crewmembers are trained in the galley lift system, including the electrical circuitry, location of circuit breakers, function of door interlock switches, and emergency operating procedures. The FAA issued a General Notice (GENOT) to all regions requesting that each POI review the training programs and procedures for all airplanes with lower galleys. The recommendation was classified as "Closed-Acceptable Action" on June 21, 1982.

Case No. 12

On May 5, 1983, an Eastern Airlines L-1011 en route from Miami, Florida, to Nassau, Grand Bahama Island, experienced a loss of oil pressure in the No. 2 engine, and the engine was shut down.[28] The captain elected to return to Miami and notified the senior flight attendant of his decision. The No. 1 and No. 3 engines then flamed out, and the flightcrew instructed the flight attendants to prepare for a ditching; however, the flight attendants were neither told the nature of the problem nor the amount of time available to prepare the cabin and the passengers for the ditching. The senior flight attendant briefed the other flight attendants, and they instructed the passengers to don their lifepreservers. Flight attendants assisted passengers in donning their lifepreservers, and they selected and briefed able-bodied persons (ABPs) who were relocated to seats by the exits. The flightcrew announced that a ditching was imminent, and flight attendants instructed passengers to assume the protective brace position. The passengers and flight attendants stayed in the brace position for about 9 minutes before the flightcrew announced that they would be landing in Miami.

The Safety Board found that the preditching instructions contained in the flightcrew manual were inconsistent with the instructions found in the flight attendants' manuals. The Safety Board concluded that, in general, the preparation of the cabin and the passengers for ditching was adequate; however, the absence of information from the flightcrew regarding the amount of time available for preparing the cabin caused unnecessary problems for the flight attendant crew.

The Safety Board issued recommendations to the FAA and to Eastern Airlines. The Safety Board recommended that the FAA require air carrier POIs to review and require modification, as needed, of flightcrew manuals, flight attendant manuals, and training programs to assure that emergency procedures and checklists were compatible. The Safety Board specifically

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[27] Aircraft Accident Report: World Airways, Inc., McDonnell Douglas, DC-10-30CF, Over North Atlantic Ocean (NTSB/AAR-82/01).

[28] Aircraft Accident Report: Eastern Airlines, Inc., Lockheed L-1011, Miami, Florida, (NTSB/AAR-84/04).

asked that attention be given to communications among crewmembers during emergencies, including a requirement that the cockpit crew inform the flight attendants of the nature of the emergency and the approximate time available for cabin preparation, and a standardized signal to flight attendants to direct passengers to assume the brace position. (A-84-018). The FAA issued ACOB No. 1-76-19, entitled "Flight and Cabin Crewmember Coordination and Communication, and Safety During Potentially Hazardous Conditions of Flight," and the recommendation was classified as "Closed--Acceptable Action" on November 16, 1984.

The Safety Board's recommendation to Eastern Airlines asked that it assure the compatibility of manuals and training programs and require joint cockpit and cabincrew training with respect to emergency procedures; and that specific attention be given to conducting periodic emergency drills in which cockpit/cabincrew coordination and communication are practiced and passenger briefings are simulated regarding events that may be expected during such emergencies. Eastern Airlines produced a video that emphasized crew coordination, and the video was shown during pilot and flight attendant training. The recommendation was classified as "Closed--Acceptable Action" on February 18, 1986.

Case No. 13

On June 2, 1983, a DC-9 made an emergency landing at the Greater Cincinnati Airport following an in-flight fire.[29] Five crewmembers and 18 passengers evacuated the airplane. The remaining 23 passengers were unable to evacuate and died in the fire. The Safety Board issued several recommendations, two of which were directed to flight attendant training. The Safety Board recommended that the FAA issue ACOBs to require POIs to review their respective air carrier training programs to ensure that flight attendants are trained to recognize the urgency of informing flightcrews of the location, source and severity of any fire or smoke within the cabin; and that flightcrews and flight attendants are knowledgeable in the proper methods of aggressively attacking a cabin fire by including hands-on-training in the donning of protective breathing equipment (PBE), the use of the fire ax to gain access to the source of the fire through interior panels which can be penetrated without risks to essential aircraft components, and the discharge of an appropriate hand fire extinguisher on an actual fire.

The Safety Board also recommended that air carrier flight operations manuals and flight attendant manuals be amended to include comprehensive discussions and illustrations showing the proper use of a fire ax and the locations of each model aircraft operated where a fire ax can be used safely to gain access to a fire or smoke emission source. (A-84-076). The FAA amended the FARs to require the installation of crewmember PBEs in airplane cabins after May 26, 1987. Regulations requiring flight attendants to perform a one-time fire fighting drill while wearing PBEs were issued with a compliance date of July 6, 1989. (Two "spot" amendments have extended the compliance date to July 31, 1992.) The FAA did not issue an ACOB for the

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[29] Aircraft Accident Report: Air Canada, McDonnell Douglas DC-9-32, Covington, Kentucky, (NTSB/AAR-86/02)

proper use of a fire ax to gain access to the source of a fire through interior panels. The recommendation was classified as "Closed--Unacceptable Action" on May 12, 1986.

Case No. 14

On May 17, 1984, a B-727, which was a scheduled passenger flight en route from Nashville, Tennessee, to Detroit, Michigan, diverted to Greater Cincinnati International Airport in Covington, Kentucky, after the No. 2 engine fire warning light illuminated.[30] While the airplane was taxiing to the gate, the tower notified the captain of smoke coming from the No. 1 engine. The captain stopped the airplane and ordered an emergency evacuation during which all of the overwing exits and three of the four floor-level exits were used. The No. 1 flight attendant with 23 years experience stated that she "cracked" the L-1 door but did not see the evacuation slide's inflation handle. She then decided not to "open the door all the way so as to avoid the possibility of an unusable primary exit." A passenger stated that the flight attendant at the L-1 door "was not familiar with the operation of the emergency exit." The door was later fully opened by the first officer, and the exit was used during the evacuation. The No. 3 flight attendant with 3 years experience opened the R-1 door and inflated the evacuation slide; she later stated that the door was "much harder to open when the slide is attached." Flight attendant No. 4 with 3 years experience stated that she was unable to open the R-2 door all the way and that the exit was not used; the L-2 door was opened by a passenger. The Safety Board's investigation found that none of these doors was damaged and that all of the doors operated without difficulty; however, although all 4 flight attendants tried to open an exit, only one of the four floor-level exits was actually opened by a flight attendant.

Case No. 15

On October 14, 1984, a DC-9 charter flight with 71 passengers and 5 crewmembers onboard landed off the runway at Erie, Pennsylvania.[31] The captain ordered the "A" flight attendant to open the main cabin door (L-1) and lower the airstairs. The airstairs jammed and could not be fully lowered, and the captain instructed the flight attendants to deploy the forward evacuation slides. The "C" flight attendant who had been a flight attendant for 14 months and had attended recurrent training 1 month prior to the accident, opened the R-1 exit door and inflated the evacuation slide. The slide was not fully deployed outside the airplane, and the evacuation slide inflated inside the cabin, blocking the exit.

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[30] NTSB Survival Factors Specialist's Report: Republic Airlines, Inc., B-727, Covington, Kentucky, May 17, 1984.

[31] NTSB Survival Factors Group Chairman's Factual Report: USAir, Inc., McDonnell Douglas DC-9, Erie, Pennsylvania, October 14, 1984.

Case No. 16

In 1985, a Safety Board Safety Study found that the emergency procedures and equipment used at the time of the study were primarily focused on planned ditchings and not on the more common inadvertent water contacts.[32] The study, which reviewed air carrier water contact accidents between 1959 and 1984, found that most of the accidents were inadvertent water contacts with insufficient time to prepare the occupants, resulting in substantial damage to the airplanes and a high risk of injury to the occupants.

The Safety Board concluded that "the ability of flight and cabin crewmembers to assist passengers effectively during ditchings and following inadvertent water impacts may be the single most important factor in the survival outcome," and "crewmembers' ability to assist effectively in water accidents could be improved by better training and requirements for demonstrations of continued proficiency in handling survival equipment; joint flightcrew/cabin crew 'wet' evacuation drills not only help meet these goals but also would promote better coordination in carrying out their respective duties." The Safety Board recommended that the FAA "amend relevant emergency training sections of 14 CFR 121, 125, and 135 to require that cockpit and cabin crewmembers be given periodic training, including 'hands-on' wet drills, in the skills relevant to inadvertent water impact which may increase the chances of post-crash survival." (A-85-49) The FAA responded that it was preparing an Advisory Circular (AC) on Crewmember Emergency Training that it planned to issue in July, 1987, and the recommendation remains classified as "Open--Acceptable Action."

Case No. 17

On June 27, 1985, a DC-10 with 257 passengers and 13 crewmembers overran the departure end of the runway at Luis Munoz International Airport, San Juan, Puerto Rico.[33] The forward fuselage was partially submerged in the lagoon at the end of the runway. Flight attendants at unusable exits shouted commands to manage passenger "flow control" between four of the eight exits that were used during the evacuation. The L-4 and R-4 exits were the only exits that were over land. The Safety Board's investigation determined that the R-4 was rendered unusable when the door was disarmed and opened about 2 inches in the electrical (rather than emergency) mode. When electrical power was shut down the exit could not be moved further. The Safety Board concluded that "The flight attendant (with 13 years experience) probably disarmed the door from habit and opened it in the electrical mode."

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[32] Safety Study: "Air Carrier Overwater Emergency Equipment and Procedures" (NTSB/SS-85/02).

[33] NTSB Aircraft Accident Report: American Airlines, Inc., San Juan, Puerto Rico, DC-10, June 27, 1985. (NTSB/AAR-86/01/SUM).

Case No. 18

On October 25, 1986, a B-737 ran off the end of the runway at Charlotte, North Carolina, struck a localizer antenna and a chain link fence and came to rest with the nose of the airplane 8 inches from a railroad track.[34] Airport rescue and fire fighting units arrived after the evacuation, and a fuel leak was found inboard of the No. 2 engine. Fortunately, there was no postcrash fire. The 5 crewmembers and 114 passengers evacuated the airplane using three of the four floor-level exits, two overwing exits, and the two cockpit windows. According to the "C" flight attendant, the forward R-1 exit was very difficult to open because of the attitude of the airplane. She made two or three attempts to open the door before she was able to do so. The "B" flight attendant, the only flight attendant in the aft cabin, was responsible for both the L-2 and R-2 floor-level exits. She opened the L-2 door without difficulty, but she did not open the R-2 "because the movement of passengers from the L-2 exit was adequate," and she did not believe it was necessary to open another exit.

Case No. 19

The Safety Board investigated three evacuations in which it was determined that some flight attendants were not in compliance with regulations that required them to be at their duty stations with their restraints fastened during taxi. The Safety Board issued Safety Recommendation A-87-94 to the FAA on July 22, 1987, which recommended that POIs review with their respective air carriers the requirement for flight attendants to remain seated during taxi except when required to perform safety-related duties. The recommendation was classified as "Closed--Acceptable Action."

Case No. 20

On February 11, 1987, a B-747 en route from Chicago, Illinois, to Newark, New Jersey, diverted to and landed at Detroit, Michigan, following a bomb threat.[35] The flight attendants briefed the passengers for an emergency evacuation before landing. An evacuation was initiated after the airplane stopped on the runway. The flight attendant with 13 years experience who opened the R-5 exit stated that she rotated the door handle. However, because she believed that the power assist was not operating properly, a passenger helped her open the door all the way. She stated that the slide "seemed to take a long time to inflate, and when it finished, it didn't look completely filled to me....I held onto the right handle and groped for the manual inflation handle with my left hand. I couldn't readily find the manual inflation handle." She eventually found and pulled a handle, and when the first two passengers jumped into the slide it separated from the

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[34] NTSB, Survival Factors Group Chairman's Factual Report: Piedmont Airlines, Boeing 737-222, Charlotte, North Carolina, October 26, 1986.

[35] NTSB Survival Factors Specialist's Factual Report: United Airlines, Inc., Boeing 747-122, Detroit, Michigan, February 11, 1987.

airplane. The second passenger to use the slide was injured seriously when he jumped onto the R-5 slide/raft and it separated from the airplane. The investigation found that the slide's red manual inflation handle was in its proper stowed position on the right side of the girt flap and that the white handle used for slide/raft separation was missing. The flight attendant had pulled the "disconnect" handle instead of the slide/raft inflation handle. The flight attendant at door R-4, with 4 months experience, opened her exit with the assistance of two passengers. The evacuation slide did not inflate automatically, and she did not inflate it manually because "people were still in the way of me getting to my inflation handle." She redirected passengers to other exits. Testing revealed that the slide would have inflated if the manual inflation handle had been pulled.

Case No. 21

On June 26, 1987, a DC-10 experienced a decompression as it began its descent into Miami, Florida, from flight level 370.[36] One flight attendant fainted after she ran from the aft galley to the overwing area to assist a passenger instead of obtaining oxygen as required by procedures. Flight attendants stated that many of the passengers believed that their solid state oxygen systems failed to operate because they could not see the reservoir bags attached to the oxygen masks inflate. The senior flight attendant, who had 21 years experience, instructed passengers whose reservoir bags were not inflating to remove their oxygen masks. These instructions were given before the captain made an announcement that they had reached a safe altitude. The Safety Board's investigation found that flight attendant training did not instruct flight attendants that a green indicator band on each reservoir bag was a visual indicator of oxygen flow. Training also failed to instruct flight attendants that oxygen mask reservoir bags would not inflate. Finally, flight attendants were not trained to expect the amount of heat in the cabin that resulted from the ignition of the solid state oxygen generators. Several generator compartments began to smoke, and flight attendants used fire extinguishers on them and removed unused masks from their storage locations. [See previous discussion of the Safety Board's Special Study on the use of solid state oxygen systems].

Case No. 22

On December 3, 1988, a fire occurred in the cargo compartment of a DC-9-83 en route from Dallas/Fort Worth International Airport (DFW), Texas, to Nashville, Tennessee.[37] A flight attendant and a deadheading first officer notified the cockpit of smoke in the cabin, and flight attendants moved passengers away from the area where the passenger cabin floor had

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[36] NTSB Survival Factors Specialist's Factual Report: Eastern Airlines, Inc., DC-10, Miami Florida, June 26, 1987, (DCA-87-1A-037).

[37] NTSB Hazardous Materials Incident Report: American Airlines, Inc., McDonnell Douglas DC-9-83, Nashville, Tennessee, February 3, 1988, (NTSB/HZM-88/02).

become hot and soft. The airplane was evacuated about 2 minutes and 8 seconds after the airplane landed at DFW. The Safety Board recommended that the FAA require joint cockpit cabin crew training on emergency procedures and to conduct periodic emergency drills in which cockpit/cabin crew coordination and communication are practiced. (A-88-126) The recommendation was classified "Closed-Reconsidered" on July 20, 1990.

Case No. 23

On February 24, 1989, nine passengers were killed during a rapid decompression in a B-747, after a cargo door and part of the fuselage separated in flight. The airplane was en route from Honolulu, Hawaii, to New Zealand.[38] Flight attendants had been taught to don an oxygen mask from a portable oxygen bottle following a decompression, and a flight attendant in the aft cabin went to the L-5 exit to retrieve a portable oxygen bottle. Although some of the air carrier's B-747 models had an oxygen bottle at L-5, that particular model B-747 did not have a portable oxygen bottle at that location. She subsequently went to the L-4 exit and obtained an oxygen bottle.

Case No. 24

On October 14, 1989, a fire erupted during maintenance on the flightcrew's supplemental oxygen system on a B-727 that was parked at a gate at Salt Lake City International Airport, Salt Lake City, Utah.[39] There were 7 crewmembers and 12 passengers onboard at the time, and other passengers had not yet boarded. Within seconds, thick black smoke began to fill the cabin, and the flight attendants began evacuating passengers through the aft airstair, which was already deployed. The second officer entered the cabin to assist the lead flight attendant with two older passengers seated in row 11 who were having difficulty exiting the airplane. As the second officer and the lead flight attendant moved the older couple toward the aft airstairs at the rear of the cabin, the second officer was engulfed by the thick black smoke. He dropped to his hands and knees and attempted to crawl to the aft airstair. When he realized that he would not make it all the way to the airstair, he attempted to find the overwing exits.

Because the floor proximity emergency escape-path lights were not illuminated, the second officer could not find the overwing exit. He eventually located the left overwing exit by crawling across rows of seats and feeling for the window exit latch. He opened the exit hatch and was the last person to evacuate the airplane. The emergency light switch, which would have illuminated the floor path emergency lights, was located at the

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[38] Aircraft Accident Report: United Airlines, Flight 811, Boeing 747-122, N47134, Honolulu, Hawaii, February 24, 1989, (NTSB/AAR-90/01 superseded by NTSB/AAR-92/02).

[39] NTSB Survival Factors Group Chairman's Factual Report: Delta Air Lines, B-727-232, Salt Lake City, Utah, October 14, 1989, (Accident No. DCA 90 MA 002).

aft flight attendant station. However, none of the three flight attendants who exited at the aft airstairs activated the emergency light switch. The air carrier's procedures did not require flight attendants or pilots to turn on the emergency lighting system during an evacuation. The Safety Board believed that this accident demonstrated the rapidity with which smoke and fire can spread and endanger the lives of passengers and crewmembers and recommended that the FAA require air carriers to implement procedures requiring that all emergency lighting be illuminated during an evacuation. (A-90-95). The FAA agreed with the recommendation and will issue an ACOB. The recommendation was classified as "Open--Acceptable Action."

Case No. 25

On December 30, 1989, a B-737 experienced a wheel well fire that resulted in the loss of hydraulic flight control systems during the descent for landing at the Tucson International Airport, Tucson, Arizona.[40] The airplane ran off the runway and struck an abandoned concrete arresting gear/cable structure. The nose gear sheared off, and the airplane came to rest about 3,803 feet beyond the departure end of the runway. The 133 occupants evacuated through the forward left and right exits.

According to a passenger who occupied seat 1A, the flight attendant who opened the L-1 door could not "get the main door open." The passenger assisted her in opening the exit, and the evacuation slide deployed. He said that a fireman asked the flight attendant to get off the airplane and move passengers away from it. Contrary to the "unplanned evacuation" procedures, the flight attendant, with 2 years and 9 months experience, did not command two passengers to assist at the bottom of the evacuation slide. She complied with the fireman's request and exited. The passenger stayed at the door and assisted other passengers at the L-1 exit.

Case No. 26

On July 19, 1990, a DC-10, en route from Denver, Colorado, to Chicago, Illinois, made an emergency landing at Sioux City, Iowa, following a catastrophic failure of the fan on the No. 2 engine.[41] The flight attendants were serving a meal when the engine failed. The lead flight attendant, with 12 years experience, was summoned to the cockpit and instructed to prepare the cabin for an emergency landing. She stated that when she left the cockpit she thought that there "was a possibility that we were going to spiral out of control and plunge to earth." Although the air carrier's flight attendant emergency procedures and evacuation checklist required it, she did not ask the cockpit crew the amount of time available to prepare the cabin because "the cockpit crew was working so hard" that she did not want to ask any questions. Rather than gather the flight attendants

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[40] NTSB Survival Factors Specialist's Report: America West Airlines, Inc., B-737, Tucson, Arizona, December 30, 1989.

[41] NTSB Survival Factors Group Chairman's Factual Report: United Airlines, Inc., DC-10-10, Sioux City, Iowa, July 19, 1989, (NTSB/AAR-90/06).

together--as was called for in the evacuation checklist--and brief them on the emergency, she briefed them individually so as not to alarm the passengers.

Because the lead flight attendant failed to ask the captain the amount of time available, she could not provide the other flight attendants with a timeframe, and the flight attendants did not question her about it. She stated to Safety Board investigators that because "time" was not an issue until the flight attendants had cleared the cabin of the meal service items, she wanted to keep the cabin "normal" as long as possible. The flight attendants completed retrieving meal trays in a normal, although hurried manner. Although off-duty flight attendants and flight crewmembers were aboard, they were not requested to assist with clearing the meal service or with preparing the cabin.

The Safety Board determined that although "prelanding preparation improved the prospects of survivability," it was accomplished without adequate "time management." The airplane crashed about 44 minutes after the engine fan failed. The lead flight attendant notified the passengers of the need to prepare for the emergency landing after the cockpit informed her that they were about 10 minutes from touchdown. The captain, who assumed that the passengers had been briefed on the emergency landing, made an announcement about the brace-for-impact signal before the lead flight attendant notified the passengers of the need for an emergency landing. The Safety Board issued Safety Recommendation A-90-173 which called for the FAA to issue an ACOB for inspectors to reiterate the importance of time management in the preparation of the cabin for an impending emergency landing. The FAA issued ACOB 1-91-1 on July 29, 1991, and the recommendation was classified as "Closed--Acceptable Action" on October 9, 1991.

Case No. 27

On October 28, 1991, a DC-10 experienced a rapid decompression at 35,000 feet.[42] In accordance with the air carrier's procedures, the flight attendants immediately sat down, donned oxygen masks, fastened their restraints, and remained seated until they received instructions from the cockpit that they could safely move about the cabin. With the assistance of off-duty flight attendants, they quickly secured the cabin and briefed passengers about procedures for an emergency evacuation. One flight attendant changed seats when she believed that oxygen was not being provided to her mask. The Safety Board found that these flight attendants had not received training on the function of the oxygen flow indicator, which is the green band on the oxygen bag showing that oxygen is being delivered. Some passengers became alarmed when smoke appeared in the seatback compartment that housed the oxygen system. Flight attendants used fire extinguishers to eliminate the smoke emanating from the oxygen compartments mounted in the seatbacks. A flight attendant (who had been flying for about 1 year and had

[42] Accident Report: United Airlines, Inc., DC-10, McDonnell Douglas DC-10, Las Vegas, Nevada, (LAX-92-IA-027).

attended recurrent training 3 months prior to the decompression) stated that although she was familiar with the location of emergency equipment in the area of the cabin she had preflighted, she was "not as familiar with the rest of the cabin" and "to save time," she asked the lead flight attendants where a fire extinguisher was located in the forward cabin. She further stated that she had a "little problem" getting the extinguisher out of its brackets. She had never removed a fire extinguisher from its brackets during initial or recurrent training.

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