NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

January 3, 2003

Group Chairman's Factual Report

HUMAN PERFORMANCE

DCA02MA054

A. ACCIDENT

Operator:	Federal Express Corporation (FedEx)
Location:	Tallahassee, Florida
Date:	July 26, 2002
Time:	0537 eastern daylight time
Airplane:	Boeing B-727-200, N497FE

B. HUMAN PERFORMANCE GROUP

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C. SUMMARY

On July 26, 2002, about 0537 eastern daylight time, a Boeing B-727-232, N497FE, operating as FedEx flight 1478, crashed into trees on short final approach to Runway 9 at the Tallahassee Regional Airport (TLH), Tallahassee, Florida.[1] The flight was operating under provisions of Title 14 Code of Federal Regulations Part 121, as a scheduled cargo flight from Memphis, Tennessee (MEM) to TLH. Night visual meteorological conditions prevailed at the time of the accident. The three flight crewmembers were injured, two seriously, and the aircraft was destroyed by the impact and resulting fire.

D. DETAILS OF THE INVESTIGATION

Two Safety Board members of the Human Performance Group participated in on-scene activities of the Operations Group.[2]

The operations group convened at 1800 on July 26, 2002 in TLH. Interviews were conducted with FedEx ramp personnel who had been contacted by the accident flight crew on the company radio, and with others who witnessed the approach and subsequent crash of the airplane. The group performed a review of weight and balance calculations for the accident flight. On July 27, 2002 the operations group interviewed the accident flight engineer at Tallahassee Memorial Hospital. The following day, the operations group interviewed the accident captain at the hospital and visited a B-727-200 (N486FE) on the FedEx ramp. The purpose of the aircraft visit was to familiarize the operations group with the airplane, its systems and flight instruments, and to familiarize the group with the operation of the Aircraft Performance Laptop Computer (APLC). On July 30, 2002, the operations group visited the accident site to inspect the accident airplane, flight path, and runway orientation. On July 31, 2002, the Board's two human performance group member's interviewed the first officer's (F/O's) wife at the hospital. The operations group departed TLH on July 31, 2002.

On August 1, 2002, the operations group reconvened at the FedEx Flight Air Operations Complex to conduct interviews with pilots who had flown with the accident crew. Also interviewed were the Chief Pilot, Manager of Crew Scheduling, Manager of B-727 Flight Standards and Technical Support, Manager of B-727 Flight Training, and the B-727 Aircraft Program Manager (APM) for the FAA.[3] In addition, the Board's two human performance group members interviewed a FedEx crew member who shared an apartment with the accident F/O in Memphis, Tennessee. A simulator visit was made to see an approach with a PAPI on the left hand side of the runway and no approach lighting. The Operations Group concluded its activities in Memphis on August 3, 2002.

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[1] All future times are expressed in central daylight time, the time zone in which all three crew members were based in the three days preceding the accident.

[2] Members of the Human Performance Group attached to the Operations Group during the early stages of the investigation were Malcolm Brenner and William Bramble. Summaries of the interviews conducted between July 27 and August 26 are attached to the Operations Group Chairman's Factual Report.

[3] The inspector was attached to the Memphis Flight Standards District Office.

The Operations Group reconvened in Brunswick, Maine on August 26, 2002, to interview the accident first officer at his residence.[4] The group's activities concluded the same day.

The Human Performance Group convened at FedEx headquarters in Memphis, Tennessee on September 3, 2002. The group observed a 2-hour presentation on fatigue, delivered to a group of newly hired FedEx flight engineers participating in FedEx's Baseline Crew Resource Management (CRM) class. FedEx's crew resource management training staff provided the group with a 1-hour presentation on the hazards of controlled flight into terrain (CFIT), which had been delivered previously as CRM recurrent training for FedEx pilots in 1999. The group interviewed the lead instructor for CRM Training, a FedEx CRM flex instructor, and FedEx's Managing Director of Flight Training. Last, the group observed the company's scheduling and crew rest facilities at the Memphis Aircraft Operations Center (AOC) building. The Human Performance Group concluded its activities in Memphis on September 5, 2002.

E. FACTUAL INFORMATION[5]

1.5. Personnel Information

1.5.1. The Captain

The captain, age 55, was married (29 years), with one adult child no longer living at home. His residence was in Cordova, Tennessee.

He served in the U.S. Air Force in the late 1960s, but not as a pilot. He flew recreationally during his time in the military, obtaining a private pilot certificate in 1967 and a commercial pilot certificate in 1969. He obtained multi-engine and instrument ratings in 1970, a flight instructor certificate in 1971, and an airline transport pilot (ATP) certificate in 1982. He had to retake each of the following tests one time to pass: the practical test for the instrument rating, the oral exam for the flight instructor certificate, and the practical test for the airline transport pilot certificate.

During the 1970s and 1980s, the captain worked as a pilot for a photo mapping company, and was employed as a corporate pilot for two different companies. As a corporate pilot, he flew the Cessna Citation 501 and Canadair Challenger. He joined FedEx's corporate flight department in 1989.

In 1992, he accepted a position as a FedEx B-727 line flight engineer. He upgraded to first officer on the B-727 in August 1995, then upgraded to captain in August 1999. Since 1992, he had flown about 2,100 hours on the B-727: 1,060 hours as flight engineer, 240 as F/O, and 900 as captain. He served as F/O on the DC-10 for a period in

[4] William J. Bramble was the sole member of the Human Performance Group represented at this interview.
[5] Section numbers follow ICAO factual report numbering convention and, therefore, may not be sequential.

the mid 1990s, flying 700 to 800 hours on that aircraft.[6]

Two FedEx F/Os who flew with the captain during the week before the accident said he was a competent pilot who used standard procedures and callouts. One said the captain was good at making everyone feel comfortable, and had a "standard cockpit style with good CRM skills." The captain's proficiency check records were satisfactory.

The captain did not recall participating in any formal training on fatigue management at FedEx, but said the company had provided handouts on the topic. He said he had never turned down a trip because of fatigue. He stated that he did not personally know any FedEx pilots who had turned down a trip because of fatigue but he had heard that it did happen.

The captain said his health was "good," with no significant changes in the previous 12 months. He did not take prescription medications. He used alcohol occasionally. He did not smoke. His most recent FAA medical certificate, dated June 17, 2002, included a limitation that he wear corrective lenses. The captain reported that, in the 72 hours before the accident, he had not drunk alcohol or taken any medications, prescription or nonprescription, except a couple Excedrin pills for a headache.

With respect to changes in his personal life, the captain reported that he and his wife brought a family dog to their veterinarian's office on July 25, 2002, to have the dog euthanized. The couple had owned the dog for fifteen years and its health had recently deteriorated. The captain stated that having the dog euthanized was upsetting for both of them. However, they both felt it was appropriate, because of the dog's deteriorating health. The captain reported no other significant changes in his personal life in the twelve months before the accident.

When he was not working, the captain usually went to bed between 2200 and 2230 and awoke between 0700 and 0730.

A search of records at the National Driver Registry found no history of driver's license revocation or suspension

1.5.1.1 Captain's 72-Hour History

On Tuesday, July 23, 2002, about 0430, the captain received a call from FedEx scheduling. He was told to report to the AOC between 0700 and 0720. From there, he was to deadhead on Northwest Flight 5951 from MEM to Shreveport Regional Airport (SHV), Louisiana, and serve as captain on FedEx Flight 1380, which would return to MEM later the same day. The captain departed MEM at 0845 on the Northwest flight, arriving SHV at 1010. In Shreveport, he checked into a hotel and slept from 1100 to 1400. After 1400, he engaged in routine activities around the hotel. The captain returned to the airport about 2030. After a one-hour standby period, he reviewed departure

[6] For additional details on the captain's career with Federal Express, see the Operations Group Chairman's Factual Report.

paperwork. Adverse weather in the area resulted in a small delay. Flight 1380 departed SHV at 2242 and arrived MEM at 2353. After arrival at MEM on July 23, 2002, the captain was released from duty and returned to his residence.

On July 24, 2002, the captain stayed awake for a couple of hours after midnight, taking care of a family dog which was in deteriorating health. After caring for the dog, he went to sleep on a downstairs couch. He slept on the couch so he could more easily let the dog outside during the night. He let the dog out three times during the night, interrupting his sleep period which ended about 0730. The captain's sleep quality was "not good" that night. During the day on July 24, 2002, the captain engaged in routine activities. He went to bed about 2130, sleeping on the downstairs couch again to more easily let the dog out. He got up a couple of times during the night to let the dog out, interrupting his sleep period.

On Thursday, July 25, 2002, the captain awoke about 0730. He described his sleep quality as, "marginal, not really good." That morning, the captain and his wife took the dog to a veterinarian's office on July 25, about 1000, to have it euthanized. The captain engaged in routine activities with his wife during the afternoon. Between 1800 and 1830, the captain checked company scheduling using his home computer, and received notification of the trip to Tallahassee. He was familiar with the route, having flown the same trip previously on July 17, 2002. He went to sleep in his normal bed about 2100, and slept for about three and a half hours.

On July 26, 2002, the captain awoke at 0030. He described the quality of his sleep as "pretty good." The captain got dressed and drove to the airport to report for his flight. He did not recall feeling fatigued at that time. He met the F/O in the AOC, where they reviewed departure paperwork for Flight 1478, then he proceeded to the aircraft. Departure was delayed because one pallet loaded on the aircraft at MEM exceeded maximum weight requirements. The load was adjusted, and the crew proceeded with pushback at 0324, twelve minutes behind schedule.[7]

1.5.2. The First Officer

The F/O was 44, married (23 years), with two children (ages 15 and 19). He lived in Brunswick, Maine.

The F/O learned to fly in the U.S. Navy in 1981, obtaining a civilian commercial pilot's license with multi-engine and instrument ratings based on military competence the same year. For the next 15 years, he served as a Navy pilot accumulating approximately 5,000 hours flight experience in Lockheed P-3 Orion aircraft, including 3,500 as pilot-in-command.

The F/O was hired by FedEx as a B-727 flight engineer in 1997. He upgraded to F/O in July, 2001. He had about 2,500 hours total flight experience on the B-727,

[7] See the Operations Group Chairman's factual report for a detailed account of the remainder of the flight.

including about 1,000 hours as F/O.[8] Two captains who flew with the F/O in the days before the accident said he was personable and professional, with solid flying skills. Neither recalled any deficiencies in his performance as a flight crewmember. The F/O's proficiency check records were satisfactory.

The F/O recalled taking FedEx's computer managed instruction section on physiology which included guidance on fatigue issues. This instruction was part of recurrent training he received in June 2002. The F/O provided no opinions about the instruction he received. He had never turned down a shift for fatigue and he did not know anyone who had. He said he thought that turning down shifts for fatigue was unofficially discouraged and that there might be repercussions for calling in fatigued.

The F/O characterized his health as "good," with no significant changes in the previous 12 months. His most recent medical certificate contained a waiver for defective color vision.[9] It contained no other restrictions. He was not taking any prescription medications and had not taken any medications, prescription or nonprescription, in the 72 hours before the accident. The F/O drank alcohol at social events and smoked about half a pack of cigarettes per day on trips, less when he was at home in Brunswick. He was not aware of having any medical conditions before the accident.

The F/O had called in sick July 17-19, 2002 because of a minor knee injury suffered while playing sports. The injury recovered sufficiently for him to return to duty by July 20.

The F/O reported no major changes in his personal life in the previous 12 months.

The F/O's preferred work schedule was to fly one week on, one week off, with early morning launches (departures between 0200 and 0300). When he was not working, the F/O typically went to bed about 2100, fell asleep about 2200, and awoke about 0600.

A search of records at the National Driver Registry found no history of driver's license revocation or suspension.

1.5.2.1. First Officer's 72-Hour History

On Tuesday, July 23, 2002, the F/O finished a trip he considered very difficult because the trip consisted of three legs, was long, and was conducted during the early morning hours, between 0330 and about 1100. After the trip, he went to an apartment he leased with a few other FedEx pilots, then went to sleep around 1130. He did not recall how long he slept but he recalled waking in the evening and going out for dinner. He went to sleep again later that evening, but he could not recall the time.

[8] For additional details on the F/O's career with Federal Express, see the Operations Group Chairman's Factual Report.
[9] For additional details on the F/O's waiver for defective color vision, see the Medical Factors Group Chairman's Factual Report.

On Wednesday, July 24, 2002 the F/O awoke in the morning. He could not recall the time of his waking. He engaged in routine activities around his apartment during the day and ate dinner with his landlord in the evening. He went to bed around 2100, getting "a couple hours of sleep" before he left for the airport after midnight.

On Thursday, July 25, 2002, the F/O checked in at the AOC at 0300. The F/O departed MEM on Flight 0134 at 0356, arriving YWG at 0645. He went to a hotel and slept five or six hours. He got up in the early evening and had dinner. The quality of his sleep was "no better or worse than most day sleeps." The F/O reported for duty in Winnipeg at 1818. He departed YWG on Flight 0137 at 1902, arriving Grand Forks, North Dakota, (GFK) at 1935. He departed GFK on Flight 0137 1 hour and 22 minutes later at 2057, and arrived at MEM at 2303. After arriving at MEM, the F/O received notification that he had been scheduled to work Flight 1478 to TLH, departing at 0312.

Because he was notified about the trip to TLH with less than 24 hours notice, he inquired with a company duty officer about the legality of the assignment. After speaking with the duty officer, and reviewing a section of the union's bargaining agreement pertaining to R24 reserve scheduling, he accepted the trip. The F/O slept for about an hour and a half in a private sleep room in AOC crew rest facilities. After sleeping, the F/O had coffee, met the captain, reviewed departure paperwork for Flight 1478, and then proceeded to the aircraft. Departure was delayed because one pallet loaded on the aircraft at MEM exceeded maximum weight requirements. The load was adjusted, and the crew proceeded with pushback at 0324, twelve minutes behind schedule.[10]

1.5.3. The Second Officer

The S/O was 33, married (12 years), with three young children. He lived in Hagaman, New York.

The S/O learned to fly in the U.S. Navy in 1994 where he flew Lockheed P-3 Orion aircraft. He was hired by FedEx on September 3, 2001, and continued to serve as a pilot in the U.S. Navy reserves at the time of the accident. He reported 2,600 hours total flight experience, with approximately 300 hours as a flight engineer on the B-727.[11] A FedEx captain who had flown with the S/O on a four-leg trip on July 25, 2002 described him as very professional and courteous, with good CRM skills, adding that he knew his job and was proactive. The S/O's proficiency check records were satisfactory.

The S/O recalled taking fatigue management training at FedEx. He said it addressed the "sleep bank" and other issues. According to the S/O, the training encouraged pilots to speak up when tired, to stretch, and suggested asking the captain turn on the lights in flight as necessary to maintain alertness. After receiving this instruction, the S/O began taking naps. He had never turned down a trip because of

[10] See the Operations Group Chairman's factual report for a detailed account of the remainder of the flight.
[11] For additional details on the S/O's career with Federal Express, see the Operations Group Chairman's Factual Report.

fatigue.

The S/O was in good health. His last medical certificate, dated July 8, 2002, contained no restrictions. He had visited a chiropractor for back pain during the previous twelve months, but reported no other changes to his health. He was not taking prescription medications at the time of the accident, and stated that he had not taken any medications in the 72 hours before the accident. He drank alcohol occasionally, but had not had any alcohol since July 21.

Changes in his personal life during the previous twelve months included: leaving military active duty, starting a new job, and making preparations to purchase a home. He also had a job interview coming up. He had applied for a position as a FedEx line check airman and was scheduled to be interviewed for that position in Memphis on the morning of July 26, 2002. The F/O reported no other major changes in his personal life.

When he was not working, the S/O typically went to sleep around 2230 and awoke around 0630.

A search of records at the National Driver Registry found no history of driver's license revocation or suspension.

1.5.3.1. Second Officer's 72 Hour History

On Tuesday, July 23, the S/O awoke between 0900 and 0930. He spent the day relaxing around the house because he had been experiencing back pain. That evening he went to bed about 2200.

On Wednesday, July 24, the S/O awoke around 0800. His back was feeling better, so he went boating from 0900 to 1100. He took a nap from 1300 to 1550, then engaged in routine activities at home until it was time to go the airport. He had a 2100 show time for a deadhead trip to Memphis. On this flight, he took a 30 minute nap. He arrived in Memphis at 2330, found a recliner in FedEx's crew rest facilities, and slept about 90 minutes.

On Thursday, July 25, the S/O had a show time of 0248 for a trip to Ottawa International Airport (YOW). Flight 0180 departed Memphis at 0358, stopped at Buffalo Niagara International Airport (BUF), New York for 28 minutes. The flight departed BUF at 0626, arriving YOW at 0714. The S/O was in his hotel approximately 20 minutes after arrival. He slept approximately six and a half hours. After waking, he received notification of his assignment to the trip to TLH. As a result, he postponed a job interview for a FedEx B-727 second officer line check airman's position, originally scheduled to take place in Memphis the next morning. He engaged in routine activities around the hotel during the late afternoon and early evening, returning to the airport by 1806. After a two-hour delay waiting for a shipment, the S/O departed YOW at 2139 on Flight 0181, arriving at MEM at 2359.

On Friday, July 26, after arrival at MEM, the S/O had his fingerprints taken to

satisfy a new security policy around midnight. Next, he relaxed in a recliner chair for 30 to 60 minutes, but "probably did not sleep." He began preparing paperwork for Flight 1478 in the AOC building at 0135. He recalled feeling fairly rested. He saw the captain in the flight operations center, but did not talk with him or with the first officer until they met in the airplane. After preparing the departure paperwork he went out to the aircraft to perform a preflight inspection. He greeted the other two crew members there. Departure was delayed because one pallet loaded on the aircraft at MEM exceeded maximum weight requirements. The load was adjusted, and the crew proceeded with pushback at 0324, twelve minutes behind schedule.[12]

1.5.4. Flight & Duty Time

Before Flight 1478, each crewmember had a different schedule for flight and duty time. A listing of each pilot's flights in the last 24 hours is provided in Table 1.

Table 1.
Flights in previous 24 hours for the crew of Flight 1478 (central daylight time).

Crew	Date	Flight	Showtime	Actual Departure	Actual Arrival	Block	Turn
Captain	7/26/02	1478	0212	0324	0447	1:23	
F/O	7/25/02	0134	0300	0356	0645	2:49	12:17
	7/25/02	0137	1818	1902	1935	0:33	01:22
	7/25/02	0137		2057	2303	2:06	04:21
	7/26/02	1478		0324	0447	1:23	
S/O	7/25/02	0180	0236	0358	0553	1:55	00:28
	7/25/02	0180		0626	0714	0:48	11:52
	7/25/02	0181	1806	2139	2359	2:20	03:25
	7/26/02	1478		0324	0447	1:23	

Based on these data, the crew members had accumulated varying flight and duty times since their last rest period during the day on July 25, 2002. Cumulative flight and duty times at the time of the accident are shown in table 2, below.

Table 2. Flight and duty times since last rest period for the crew of FedEx Flight 1478.

Crew Member	Flight Time	Duty Time
Captain	01:23	02:35
First Officer	04:02	10:29
Second Officer	03:43	10:41

FedEx complies with the regulations contained in 14 CFR Part 121, Subpart S (Flight Time Limitations: Supplemental Operations). These regulations allow the scheduling of crew members for no more than 8 hours of flight time in a 24 hours period

[12] See the Operations Group Chairman's factual report for a detailed account of the remainder of the flight.

without a rest period within those 8 hours. Pilots must be relieved from duty for at least 24 consecutive hours at least once during any seven consecutive days. Pilots working in three-person crews can be scheduled for no more than 18 hours of duty in a 24-hour period. FedEx's scheduling practices also abide by a union bargaining agreement, relevant excerpts of which are contained in Attachment A.[13] This agreement is more restrictive in some respects than 14 CFR 121, Subpart S. For example, the agreement limits scheduled domestic duty periods to between 9 and 13 hours, depending on a duty period's start time.

FedEx has three pilot reserve periods. Two are twelve-hour reserve periods. Pilots assigned to these twelve-hour reserve periods must be notified of a trip either 1 hour 30 minutes before show time, or 3 hours before show time, depending on prior arrangements. Reserve Period A (RP-A) is one of the twelve hour reserve periods. Pilots working RP-A can be assigned trips that begin between 0130 and 1329 and end no later than 1729. Reserve Period B (RP-B) is also a twelve hour reserve period. Pilots working RP-B can be assigned trips that begin between 1330 and 0129 and end no later than 0529. Reserve Period 24 (RP-24) is a 24-hour reserve period lasting from 0130 to 0129 the next day. Pilots working RP-24 must receive at least 24 hours notice for each new trip assignment. However, if a pilot on RP-24 returns to his domicile on a trip and can complete a follow-on trip without violating flight and duty time limitations, that pilot can be assigned a follow-on trip with less than 24 hours notice.[14] If he is not assigned a follow-on trip within thirty minutes after arrival at his domicile, he is released from duty for a legal rest period.

The captain of FedEx flight 1478 was working RP-A. He had the first week of July off. He was scheduled to be on RP-A four days per week thereafter (Tuesday through Friday), for three consecutive weeks leading up to the accident. The F/O and S/O were both working RP-24. The F/O had the first week of July off. He was scheduled to be on RP-24 four days per week thereafter (Tuesday through Friday), for three consecutive weeks leading up to the accident.[15] The S/O began the month of July with five days on RP-24 (July 1 through July 5, 2002), followed by six days off. He worked another five days of RP-24 (July 12 through July 16), followed by three more days off. He was scheduled to work nine consecutive days on RP-24 beginning July 20, 2002. The accident occurred seven days into this period, on July 26, 2002.

The captain of Flight 1478 told investigators that the F/O expressed dissatisfaction with his reserve scheduling before the departure of Flight 1478. In an interview with Safety Board investigators on August 26, 2002, the F/O also expressed dissatisfaction with his scheduling. The F/O had not been on reserve for several years prior to July 2002. He bid reserve that month because he wanted some specific days off. He told investigators that he was used to working several early morning departures

[13] Agreement between Federal Express Corporation and the Airline Pilots in the service of Federal Express Corporation, as represented by the FedEx Pilots Association. Dated May 31, 1999.
[14] Agreement between Federal Express Corporation and the Airline Pilots in the Service of Federal Express Corporation, as represented by the FedEx Pilots Association. Dated May 31, 1999. SEC. 25. M. 6. f.
[15] The F/O did not work all of these days. He called in sick July 17 through July 19, 2002.

(around 0300) in a row, which allowed his sleep/wake cycle to adjust to the demands of night work. On the RP-24 reserve schedule, the work was more sporadic, making it more difficult to adjust to a night work schedule and placing his sleep-wake cycle in "constant flux." The RP-24 schedule turned out to be more difficult than he had anticipated. Also, when he decided to bid RP-24 for the month of July, he had not realized that trips could be added to the end of a duty period without 24 hours advance notice.

The F/O first learned that a trip could be added to the end of a duty period with less than 24 hours notice on July 26, 2002, when he discovered he was assigned to Flight 1478. When he received notification of this assignment, shortly after midnight, he contacted a company duty officer to ask if the trip assignment was permitted under the union bargaining agreement. The duty officer said that the assignment was permitted. He directed the F/O to a question-and-answer document distributed with the union bargaining agreement for further clarification of scheduling rules. After the F/O reviewed his copy of the bargaining agreement and the question-and-answer document, he accepted the assignment, but he decided to file a grievance later, seeking further clarification of scheduling rules.

1.13. Medical and Pathological Information

Official reports of the toxicological test results for each pilot were provided by the manager of the FAA's Toxicology and Accident Research Laboratory. These reports are contained in Attachment B.

Blood and urine specimens were collected from the captain at 0614 and 0714, respectively, on July 26, 2002, by emergency room personnel at Tallahassee Memorial Hospital. The blood specimen tested negative for ethanol and a wide range of drugs, including major drugs of abuse.[16] The urine specimen tested positive for morphine (1.306 ug/ml) and acetaminophen (15.57 ug/ml). However, a review of emergency room hospital records indicated that the captain was administered morphine intravenously at 0640, as part of his medical treatment on July 26, 2002.

Blood and urine specimens were collected from the F/O on July 26, 2002, by emergency room personnel at Tallahassee Memorial Hospital. These specimens tested negative for ethanol and a wide range of drugs, including major drugs of abuse.

Blood and urine specimens were collected from the S/O on July 26, 2002, by emergency room personnel at Tallahassee Memorial Hospital. These specimens tested negative for ethanol and a wide range of drugs, including major drugs of abuse.

[16] The drugs of abuse tested in the post accident analysis were marijuana, cocaine, opiates, phencyclidine, amphetamines, benzodiazapines, barbiturates, and methaqualone.

1.17. Organizational and Management Information

1.17.1. Crew Resource Management Training

Crew resource management (CRM) training had been provided to FedEx pilots since 1989. CRM instruction modules were developed by a staff of seven company instructors, based in Memphis, who reported to the Senior Manager of Training. Six were seniority-holding pilots. Four were captains, two were F/Os, and one was an S/O. Two flew the A-300, two flew the DC-10, and two flew the B-727.

Each year since 1989, FedEx CRM instructors had developed a CRM presentation, to be included as part of recurrent training. Recurrent training was provided in a lecture format, with interactive case studies. No exams were given as part of this training. Past topics included fatigue management; conflict management; "hurry up syndrome"; black hole approaches; situational awareness; decision making in critical situations; mediated debriefs; controlled flight into terrain (CFIT) awareness; monitoring and challenging; and threat and error management. When each recurrent training module was replaced by a newer presentation, parts of the old presentation were integrated into a baseline indoctrination course for new S/Os. At the time of the accident, CRM instructors were developing a new recurrent training module ("Flight Deck Distractions") for the 2002-2003 training year.

In 1993, a two-day CRM presentation was developed for inclusion in training programs for line check airmen and simulator instructors. In 1997, a CRM module was included in a new two-day captain's upgrade course. At the time of the accident, a module was under development for inclusion in a new "Second in Command" upgrade course the company was interested in providing to new F/Os.

From 1989 to 1995, FedEx's CRM instructors personally delivered all courses they developed. In 1996 and subsequent years, CRM materials included in recurrent training were delivered by simulator instructors belonging to aircraft-specific training departments. The simulator instructors provided the training in a similar fashion, using computerized slides prepared by the CRM instructors. Company CRM instructors continued to deliver CRM training material in the baseline indoctrination course for new second officers, in the captain's upgrade course, and in the training courses for line check airmen and simulator instructors.

1.17.1.1. Fatigue Management

Fatigue management training was developed by FedEx CRM instructors when the company participated in a study of fatigue in aviation conducted by scientists at the National Air and Space Administration. The company's two-hour course on sleep and fatigue management was introduced as recurrent training for all pilots in 1990, and added to the baseline indoctrination course for new second officers thereafter. The course addressed causes of fatigue, circadian rhythms, sleep-loss, and the physical, social, emotional, and safety-related consequences of fatigue. Strategies for minimizing and managing fatigue were discussed.

Fatigue management strategies recommended for the home environment included taking steps to prevent interruptions, and ensuring adequate rest before a trip. Recommended strategies for use during trips included: making sleep a priority on layovers, sleeping two or more times per day, developing a regular pre-sleep routine, using relaxation techniques, creating a good sleep environment, and maintaining exercise and a healthy diet. In-flight strategies included interacting with other crew members, stretching, turning on lights, maintaining proper temperature, use of caffeine, and napping (in cooperation with other crew members). Pilots were encouraged to keep a sleep journal and to learn about their own circadian rhythms and keep notes on what strategies worked best for them.

As part of FedEx fatigue management training, pilots were instructed to "call in fatigued" if they were unable to get adequate rest. It was suggested that this would occur sometimes due to circumstances beyond a pilot's control, such as a sick child at home, or construction at the layover hotel. The company preferred for pilots to call in fatigued rather than calling in sick, if fatigue was the reason they were not fit for duty. If they called in fatigued, the company would put them into a 12-hour rest period, then return them to duty. If they called in sick, the company would not schedule them for duty again until they called back to report that they were fit for duty. Company policy for calling in fatigued is described in the union bargaining agreement, relevant excerpts of which are contained in Attachment C.

In 2000, FedEx CRM instructors developed a fatigue management card, using in a format that could be inserted in Jeppesen binders, that was distributed to all FedEx pilots.

1.17.1.2. Controlled Flight Into Terrain Awareness

FedEx's CRM instructors developed a recurrent training module on "black hole approach" hazards for the 1995-1996 training year. The training explained that visual approaches over water or dark, featureless terrain can be hazardous because of poor and misleading cues for evaluating one's flight path and height above the ground. Without additional glide slope information, these misleading cues were known to result in characteristically low, concave (from above) approaches. Additional risk factors for black hole approach phenomena included aspects of airport location (on the edge of a small city, at a lower elevation than a nearby city, near city lights on a hillside), as well as bright runway lighting.

To counter the hazards of black hole approaches, the black hole approach training encouraged pilots to consider the potential for black hole illusions at specific airports. The training also encouraged pilots to utilize all available glide slope information, perform a thorough approach briefing addressing potential black hole approaches, and ensure adequate cross-check and monitoring. Pilots were also encouraged to monitor glide slope using altitude and distance from the runway during non-precision approaches, and to monitor sink rate using the vertical speed indicator.

FedEx CRM instructors developed a recurrent training module called "Controlled

Flight Into Terrain: A Precision Approach to Awareness" for the 1999-2000 training year. This training defined CFIT as "an accident in which an aircraft, under the control of the crew, is flown (unintentionally) into terrain, obstacles, or water with no prior awareness on the part of the crew of the impending collision." Continental Airlines own CFIT awareness training course provided a prototype for the FedEx course. Additional material was drawn from an extensive study of CFIT crashes conducted by the Flight Safety Foundation. FedEx simulator instructors actually presented the material.

FedEx's CFIT awareness training pointed out that half of all CFIT crashes occurred on the extended runway centerline within one mile of the runway threshold, and that 75 percent of CFIT accidents involved non-precision approaches. The training highlighted the Flight Safety Foundation finding that the CFIT/Approach and Landing accident rate was higher for night flying, and for freight carriers. Crew factors found to be related to CFIT accidents in the Flight Safety Foundation study included poor decision making; deviations from standard operating procedures; crew member failure to challenge and monitor the performance of others; lack of positional awareness; and flight handling difficulties. In order to reduce the risk of CFIT crashes, crews were encouraged to identify CFIT risks prior to each approach, conduct a thorough approach briefing, monitor each other's performance, and reduce any hesitation associated with go-around maneuvers.

Simultaneously with the development of CFIT awareness training, FedEx's CRM instructors developed a summary card pilots could use to evaluate CFIT risk at individual airports. The card was provided in Jeppesen card format. Using the same criteria printed on the card, FedEx's CRM instructors rated all airports served by the company's regularly scheduled flights in terms of CFIT risk. The resulting CFIT risk ratings were not runway-specific. For example, if the approach to any runway had a glide slope available, the airport was classified as having a glide slope for the purposes of the CFIT risk rating system. CFIT risk ratings were grouped into categories (e.g., moderate versus high) and the APLCs used by all FedEx crew for calculating landing distances and other parameters prior to each approach were programmed to display the CFIT risk category of a destination airport. In addition, the company also began printing CFIT risk categories on all flight releases.[17]

FedEx presented its CFIT training module and associated CFIT awareness cards at a quarterly meeting of the Air Transport Association's Human Factors Committee in 2000, where it was favorably received by other airline representatives. FedEx managers believed they were the first major American airline to develop a CFIT risk card, and to include CFIT risk information on on-board landing computers and flight releases.

[17] The CFIT risk category for TLH was "moderate," because the airport was uncontrolled at night.

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