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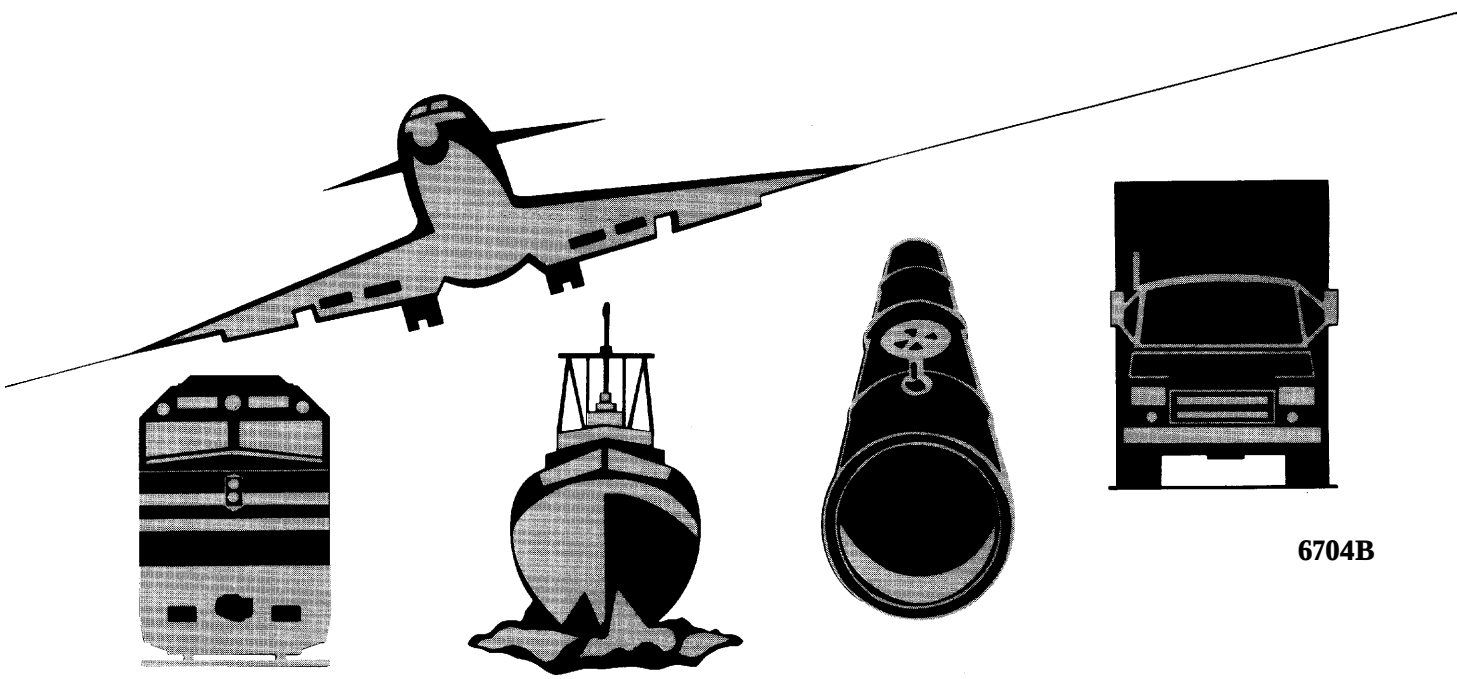
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

IN-FLIGHT FIRE AND IMPACT WITH TERRAIN
VALUJET AIRLINES FLIGHT 592
DC-9-32, N904VJ
EVERGLADES, NEAR MIAMI, FLORIDA
MAY 11,1996



6704B

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IN-FLIGHT FIRE AND IMPACT WITH TERRAIN
VALUJET AIRLINES FLIGHT 592, DC-9-32, N904VJ
EVERGLADES, NEAR MIAMI, FLORIDA
MAY 11, 1996

- **Page 54 has been updated to correctly describe type K and type B thermocouples**. *(4 Jan 00)*
  Original descriptions were transposed.

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NTSB/AAR-97/06 PB97-910406

NATIONAL TRANSPORTATION SAFETY BOARD

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AIRCRAFT ACCIDENT REPORT

IN-FLIGHT FIRE AND IMPACT WITH TERRAIN
VALUJET AIRLINES, FLIGHT 592
DC-9-32, N904VJ
EVERGLADES, NEAR MIAMI, FLORIDA
MAY 11,1996

Adopted: August 19, 1997
Notation 6704B

Abstract: This report explains the in-flight fire and impact with terrain of ValuJet Airlines flight 592, a DC-9-32, N904VJ, in the Everglades near Miami, Florida, on May 11, 1996. Safety issues discussed in the report include minimization of the hazards posed by fires in class D cargo compartments; equipment, training, and procedures for addressing in-flight smoke and fire aboard air carrier airplanes; guidance for handling of chemical oxygen generators and other hazardous aircraft components; SabreTech's and ValuJet's procedures for handling company materials and hazardous materials; ValuJet's oversight of its contract heavy maintenance facilities; the Federal Aviation Administration's (FAA) oversight of ValuJet and ValuJet's contract maintenance facilities; FAA's and the Research and Special Programs Administration's (RSPA) hazardous materials program and undeclared hazardous materials in the U.S. mail; and ValuJet's procedures for boarding and accounting for lap children. Safety recommendations concerning these issues were made to the FAA, RSPA, the U.S. Postal Service, and the Air Transport Association.

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EXECUTIVE SUMMARY

On May 11, 1996, at 1413:42 eastern daylight time, a Douglas DC-9-32 crashed into the Everglades about 10 minutes after takeoff from Miami International Airport, Miami, Florida. The airplane, N904VJ, was being operated by ValuJet Airlines, Inc., as flight 592. Both pilots, the three flight attendants, and all 105 passengers were killed. Visual meteorological conditions existed in the Miami area at the time of the takeoff. Flight 592, operating under the provisions of 14 CFR Part 121, was on an instrument flight rules flight plan destined for the William B. Hartsfield International Airport, Atlanta, Georgia.

The National Transportation Safety Board determines that the probable causes of the accident, which resulted from a fire in the airplane's class D cargo compartment that was initiated by the actuation of one or more oxygen generators being improperly carried as cargo, were (1) the failure of SabreTech to properly prepare, package, and identify unexpended chemical oxygen generators before presenting them to ValuJet for carriage; (2) the failure of ValuJet to properly oversee its contract maintenance program to ensure compliance with maintenance, maintenance training, and hazardous materials requirements and practices; and (3) the failure of the Federal Aviation Administration (FAA) to require smoke detection and fire suppression systems in class D cargo compartments.

Contributing to the accident was the failure of the FAA to adequately monitor ValuJet's heavy maintenance programs and responsibilities, including ValuJet's oversight of its contractors, and SabreTech's repair station certificate; the failure of the FAA to adequately respond to prior chemical oxygen generator fires with programs to address the potential hazards; and ValuJet's failure to ensure that both ValuJet and contract maintenance facility employees were aware of the carrier's "no-carry" hazardous materials policy and had received appropriate hazardous materials training.

Safety issues discussed in the report include minimization of the hazards posed by fires in class D cargo compartments; equipment, training, and procedures for addressing in-flight smoke and fire aboard air carrier airplanes; guidance for handling of chemical oxygen generators and other hazardous aircraft components; SabreTech's and ValuJet's procedures for handling company materials and hazardous materials; ValuJet's oversight of its contract heavy maintenance facilities; FAA's oversight of ValuJet and ValuJet's contract maintenance facilities; FAA's and the Research and Special Programs Administration's (RSPA) hazardous materials program and undeclared hazardous materials in the U.S. mail; and ValuJet's procedures for boarding and accounting for lap children. Safety recommendations concerning these issues were made to the FAA, RSPA, the U.S. Postal Service, and the Air Transport Association.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

IN-FLIGHT FIRE AND IMPACT WITH TERRAIN VALUJET AIRLINES, FLIGHT 592, DC-9-32, N904VJ, EVERGLADES, NEAR MIAMI, FLORIDA, MAY 11, 1996

1. FACTUAL INFORMATION

1.1 History of Flight

On May 11, 1996, at 1413:42 eastern daylight time,[1] a Douglas DC-9-32 crashed into the Everglades about 10 minutes after takeoff from Miami International Airport (MIA), Miami, Florida. The airplane, N904VJ, was being operated by ValuJet Airlines, Inc., as flight 592. Both pilots, the three flight attendants, and all 105 passengers[2] were killed. Visual meteorological conditions existed in the Miami area at the time of the takeoff. Flight 592, operating under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121, was on an instrument flight rules flight plan destined for the William B. Hartsfield International Airport (ATL), Atlanta, Georgia.

ValuJet flight 591, the flight preceding the accident flight on the same aircraft, was operated by the accident crew. Flight 591 was scheduled to depart ATL at 1050 and arrive in MIA at 1235; however, ValuJet's dispatch records indicated that it actually departed the gate at 1125 and arrived in MIA at 1310. The delay resulted from unexpected maintenance involving the right auxiliary hydraulic pump circuit breaker.[3]

Flight 592 had been scheduled to depart MIA for ATL at 1300. The cruising altitude was to be flight level 350,[4] with an estimated time en route of 1 hour 32 minutes. The ValuJet DC-9 weight and balance and performance form completed by the flightcrew for the flight to ATL indicated that the airplane was loaded with 4,109 pounds of cargo (baggage, mail, and company-owned material (COMAT)). According to the shipping ticket for the COMAT (see

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[1] Unless otherwise indicated, all times are eastern daylight time, based on a 24-hour clock.

[2] ValuJet passenger records indicated that 104 passengers boarded the airplane. A 4-year-old child also was aboard; however, the presence of this child was not shown on the passenger manifest or on the weight and balance and performance form.

[3] Section 1.6.6 discusses the recent maintenance activity on N904VJ.

[4] Assuming a standard atmospheric pressure, flight level 350 is 35,000 feet.

appendix C), the COMAT consisted of two main tires and wheels, a nose tire and wheel, and five boxes that were described as "Oxy Cannisters [sic]-'Empty.'"[5] According to the ValuJet lead ramp agent on duty at the time, he asked the first officer of flight 592 for approval to load the COMAT in the forward cargo compartment, and he showed the first officer the shipping ticket. According to the lead ramp agent, he and the first officer did not discuss the notation "Oxy Cannisters [sic]-'Empty.'" on the shipping ticket. According to the lead ramp agent, the estimated total weight of the tires and the boxes was 750 pounds, and the weight was adjusted to 1,500 pounds for the weight and balance form to account for any late arriving luggage.[6] The ramp agent who loaded the COMAT into the cargo compartment stated that within 5 minutes of loading the COMAT, the forward cargo door was closed. He could not remember how much time elapsed between his closing the cargo compartment door and the airplane being pushed back from the gate.

Flight 592 was pushed back from the gate shortly before 1340. According to the transcript of air traffic control (ATC) radio communications, flight 592 began its taxi to runway 9L about 1344. At 1403:24, ATC cleared the flight for takeoff and the flightcrew acknowledged the clearance. At 1404:24, the flightcrew was instructed by ATC to contact the north departure controller. At 1404:32, the first officer made initial radio contact with the departure controller, advising that the airplane was climbing to 5,000 feet. Four seconds later, the departure controller advised flight 592 to climb and maintain 7,000 feet. The first officer acknowledged the transmission.

At 1407:22, the departure controller instructed flight 592 to "turn left heading three zero zero join the WINCO transition climb and maintain one six thousand." The first officer acknowledged the transmission. At 1410:03, an unidentified sound was recorded on the cockpit voice recorder (CVR), after which the captain remarked, "What was that?" According to the flight data recorder (FDR), just before the sound, the airplane was at 10,634 feet mean sea level (msl), 260 knots indicated airspeed (KIAS), and both engine pressure ratios (EPRs) were 1.84.

At 1410:15, the captain stated, "We got some electrical problem," followed 5 seconds later with, "We're losing everything." At 1410:21, the departure controller advised flight 592 to contact Miami on frequency 132.45 mHz. At 1410:22, the captain stated, "We need, we need to go back to Miami," followed 3 seconds later by shouts in the background of "fire, fire, fire, fire." At 1410:27, the CVR recorded a male voice saying, "We're on fire, we're on fire."

At 1410:28, the controller again instructed flight 592 to contact Miami Center. At 1410:31, the first officer radioed that the flight needed an immediate return to Miami. The

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[5] Section 1.1.2 discusses the COMAT and how it was loaded in the forward cargo bin.

[6] The takeoff weight calculated by the flightcrew was 105,206 pounds, about 3,000 pounds under the DC-9-32 maximum takeoff weight.

controller replied, "Critter[7] five ninety two uh roger turn left heading two seven zero descend and maintain seven thousand." The first officer acknowledged the heading and altitude. The peak altitude value of 10,879 feet msl was recorded on the FDR at 1410:31, and about 10 seconds later, values consistent with the start of a wings-level descent were recorded.

According to the CVR, at 1410:36, the sounds of shouting subsided. About 4 seconds later, the controller queried flight 592 about the nature of the problem. The CVR recorded the captain stating "fire" and the first officer replying, "uh smoke in the cockp… smoke in the cabin." The controller responded, "roger" and instructed flight 592, when able, to turn left to a heading of two five zero and to descend and maintain 5,000 feet. At 1411:12, the CVR recorded a flight attendant shouting, "completely on fire."

The FDR and radar data indicated that flight 592 began to change heading to a southerly direction about 1411:20. At 1411:26, the north departure controller advised the controller at Miami Center that flight 592 was returning to Miami with an emergency. At 1411:37, the first officer transmitted that they needed the closest available airport. At 1411:41, the controller replied, "Critter five ninety two they're gonna be standing (unintelligible) standing by for you, you can plan runway one two when able direct to Dolphin [an electronic navigational aid] now."[8] At 1411:46, the first officer responded that the flight needed radar vectors. At 1411:49, the controller instructed flight 592 to turn left heading one four zero. The first officer acknowledged the transmission.

At 1412:45, the controller transmitted, "Critter five ninety two keep the turn around heading uh one two zero." There was no response from the flightcrew. The last recorded FDR data showed the airplane at 7,200 feet msl, at a speed of 260 KIAS, and on a heading of 218°. At 1412:48, the FDR stopped recording data. The airplane's radar transponder continued to function; thus, airplane position and altitude data were recorded by ATC after the FDR stopped.[9]

At 1413:18, the departure controller instructed, "Critter five ninety two you can uh turn left heading one zero zero and join the runway one two localizer at Miami." Again there was no response. At 1413:27, the controller instructed flight 592 to descend and maintain 3,000 feet. At 1413:37, an unintelligible transmission was intermingled with a transmission from another airplane. No further radio transmissions were received from flight 592. At 1413:43, the departure controller advised flight 592, "Opa Locka airport's about 12 o'clock at 15 miles."

The accident occurred at 1413:42. Ground scars and wreckage scatter indicated that the airplane crashed into the Everglades in a right wing down, nose down attitude. The

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[7] According to a pre-existing agreement between the FAA and ValuJet, air traffic controllers use the term "Critter" as a call sign when addressing ValuJet aircraft.

[8] The last part of this transmission and subsequent radio transmissions were recorded at the ATC facility. Beginning at 1411:45, a 1 minute 12 second interruption in the CVR recording occurred.

[9] See discussion in section 1.16.2, "Airplane Flight Performance."

location of the primary impact crater was 25° 55' north latitude, 80° 35' west longitude, or approximately 17 miles northwest of MIA. (See figure 1.)

1.1.1 Statements of Witnesses

Two witnesses fishing from a boat in the Everglades when flight 592 crashed stated that they saw a low-flying airplane in a steep right bank. According to these witnesses, as the right bank angle increased, the nose of the airplane dropped and continued downward. The airplane struck the ground in a nearly vertical attitude. The witnesses described a great explosion, vibration, and a huge cloud of water and smoke. One of them observed, "the landing gear was up, all the airplane's parts appeared to be intact, and that aside from the engine smoke, no signs of fire were visible."

Two other witnesses who were sightseeing in a private airplane in the area at the time of the accident provided similar accounts of the accident. These two witnesses and the witnesses in the boat, who approached the accident site, described seeing only part of an engine, paper, and other debris scattered around the impact area. One of the witnesses remarked that the airplane seemed to have disappeared upon crashing into the Everglades.

1.1.2 Chemical Oxygen Generators Carried as Cargo on Flight 592— Events Preceding the Accident

On January 31, 1996, ValuJet agreed to purchase two McDonnell Douglas MD-82s (N802VV and N803VV) from McDonnell Douglas Finance Corporation (MDFC), and on February 1, 1996, agreed to purchase a Model MD-83 (N830VV) from MDFC. All three airplanes were ferried from the locations where they had last been operated to the Miami maintenance and overhaul facility of the SabreTech Corporation for various modifications and maintenance functions.[10] SabreTech was a maintenance facility with which ValuJet had an ongoing contractual relationship for line maintenance and heavy aircraft maintenance.

One of the maintenance tasks requested by ValuJet was the inspection of the oxygen generators on all three airplanes to determine if they had exceeded the allowable service life of 12 years from the date of manufacture.[11]

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[10] SabreTech, Incorporated, of Miami, Florida, was an FAA-certificated 14 CFR Part 145 domestic repair station. (See additional information regarding SabreTech in section 1.17.2.2.)

[11] See next section for information on oxygen generators.

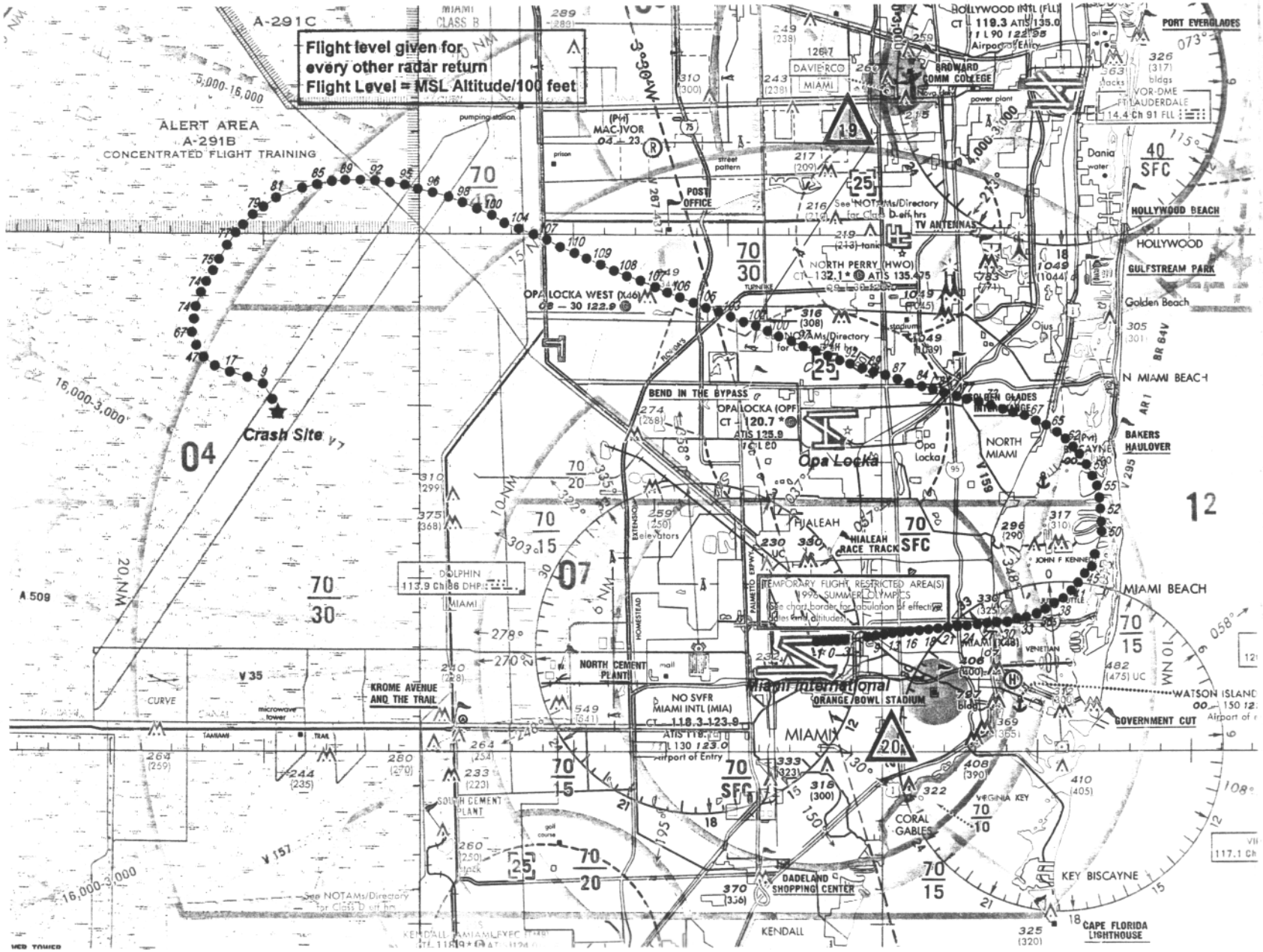

Figure 1—Map of accident site

After inspecting the oxygen generators on all three MD-80 airplanes, SabreTech determined that all of the generators on N830VV had expiration dates of 1998 or later, but that the majority of oxygen generators on N802VV and N803VV were past their expiration date. Because the few oxygen generators on N802VV and N803VV that had not reached their expiration date were approaching it in the near future, ValuJet directed SabreTech to replace all of the oxygen generators on these two airplanes. Specifically, ValuJet directed SabreTech to accomplish the following maintenance tasks on both N802VV and N803VV:

- Modify the existing right-hand three (3) oxygen mask passenger unitized oxygen insert assemblies to four (4) oxygen mask passenger unitized oxygen insert assemblies[12] in accordance with ValuJet engineering order (E.O.) 15-3520-B0820.

- Remove and replace all cabin chemical oxygen generators per ValuJet routine work card[13] #0069 (CHEMICAL OXYGEN GENERATOR-REMOVE/INSTALL). (See appendix D.)

1.1.2.1 Description of Chemical Oxygen Generators[14]

The MD-80 passenger emergency oxygen system[15] is composed of oxygen generators that upon activation provide emergency oxygen to the occupants of the passenger cabin if cabin pressure is lost.[16] The oxygen generators, together with the oxygen masks, are mounted behind panels above or adjacent to passengers. If a decompression occurs, the panels are opened either by an automatic pressure switch or by a manual switch, and the mask assemblies are released.

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[12] These generators come in three sizes and are referred to in this report as two-mask, three-mask, or four-mask generators, referring to the number of oxygen masks the generator is designed to supply. This report discusses only the two sizes removed from the MD-80 aircraft—the two- and three-mask generators.

[13] A routine work card is a pre-printed step-by-step listing of the key steps for a particular maintenance task; mechanics are to sign by each step to indicate completion of the task. ValuJet's work card 0069 was taken from a McDonnell Douglas-generated work card for that task and was part of the maintenance package ValuJet purchased from McDonnell Douglas. The contents of the work card had not been changed by ValuJet, nor had ValuJet used the work card before the removal of the oxygen generators from the MD-80 airplanes at SabreTech.

[14] Before discussing the mechanics' activities related to the removal and replacement of the oxygen generators, this report provides some background information on the description of the chemical oxygen generators and the guidance provided for the removal and disposition of the oxygen generators.

[15] The accident airplane, N904VJ (a DC-9), did not have a chemically generated oxygen system installed in its cabin. None of the DC-9-30 series airplanes use chemically generated oxygen systems.

[16] Chemical oxygen generators are also used in first aid portable oxygen units carried by some airlines.

Each mask is connected to its generator in two places. A plastic tube through which the oxygen will flow is connected from the mask assembly reservoir bag to an outlet fitting on one end of the oxygen generator. Additionally, a lanyard, or slim white cord, connects each mask to a pin that restrains the spring-loaded initiation mechanism[17] (retaining pin). (See figures 2a and 2b.) The lanyard and retaining pin are designed such that a 1- to 4-pound pull on the lanyard will remove the pin, which is held in place by a spring-loaded initiation mechanism.

When the retaining pin is removed, the spring-loaded initiation mechanism strikes a percussion cap containing a small explosive charge mounted in the end of the oxygen generator. The percussion cap, when struck, provides the energy necessary to start a chemical reaction in the generator oxidizer core, which liberates oxygen gas. A protective shipping cap that prevents mechanical activation of the percussion cap is installed on new generators. The shipping cap is removed when the oxygen generator has been installed in the airplane and the final mask drop check has been completed.

The oxidizer core is sodium chlorate ($NaClO_3$), which is mixed with less than 5 percent barium peroxide (BaO_2) and less than 1 percent potassium perchlorate ($KClO_4$). The explosives in the percussion cap are a lead styphnate and tetracene mixture.

When heated to its decomposition temperature by the action of the percussion cap, a chemical reaction begins in the core whereby the $NaClO_3$ is reduced to sodium chloride (NaCl) and the oxygen is liberated as a gas. The oxygen flows through the granular insulation between the chemical core and the outlet shell of the generator toward the outlet end of the generator. At the outlet end, the oxygen flows through a series of filters, through the outlet manifold, and into the plastic tubes connected to the reservoir bags on the mask assembly.

The chemical reaction is exothermic, which means that it liberates heat as a byproduct of the reaction. This causes the exterior surface of the oxygen generator to become very hot; the maximum temperature of the exterior surface of the oxygen generator during operation is limited by McDonnell Douglas specification to 547 °F when the generator is operated at an ambient temperature of 70 to 80 °F. Manufacturing test data indicate that when operated during tests, maximum shell temperatures typically reach 450 to 500 °F.

The amount of oxygen required to be produced by a generator as a function of time is not constant; it is specified by the aircraft manufacturer in accordance with the emergency descent profile the aircraft is expected to follow after a loss of cabin pressure to reach an altitude where supplemental oxygen is no longer required. The amount of oxygen required at higher altitudes is greater than the amount needed at lower altitudes. Therefore, the chemical core has a larger diameter at the initiation end than at the outlet end to provide more oxygen at the beginning of the reaction. Performance testing by the generator manufacturer (Scott

[17] There are two types of spring-loaded initiation mechanisms, a lever arm and a plunger. The lever arm mechanism was the type on the generators being transported on the accident airplane.

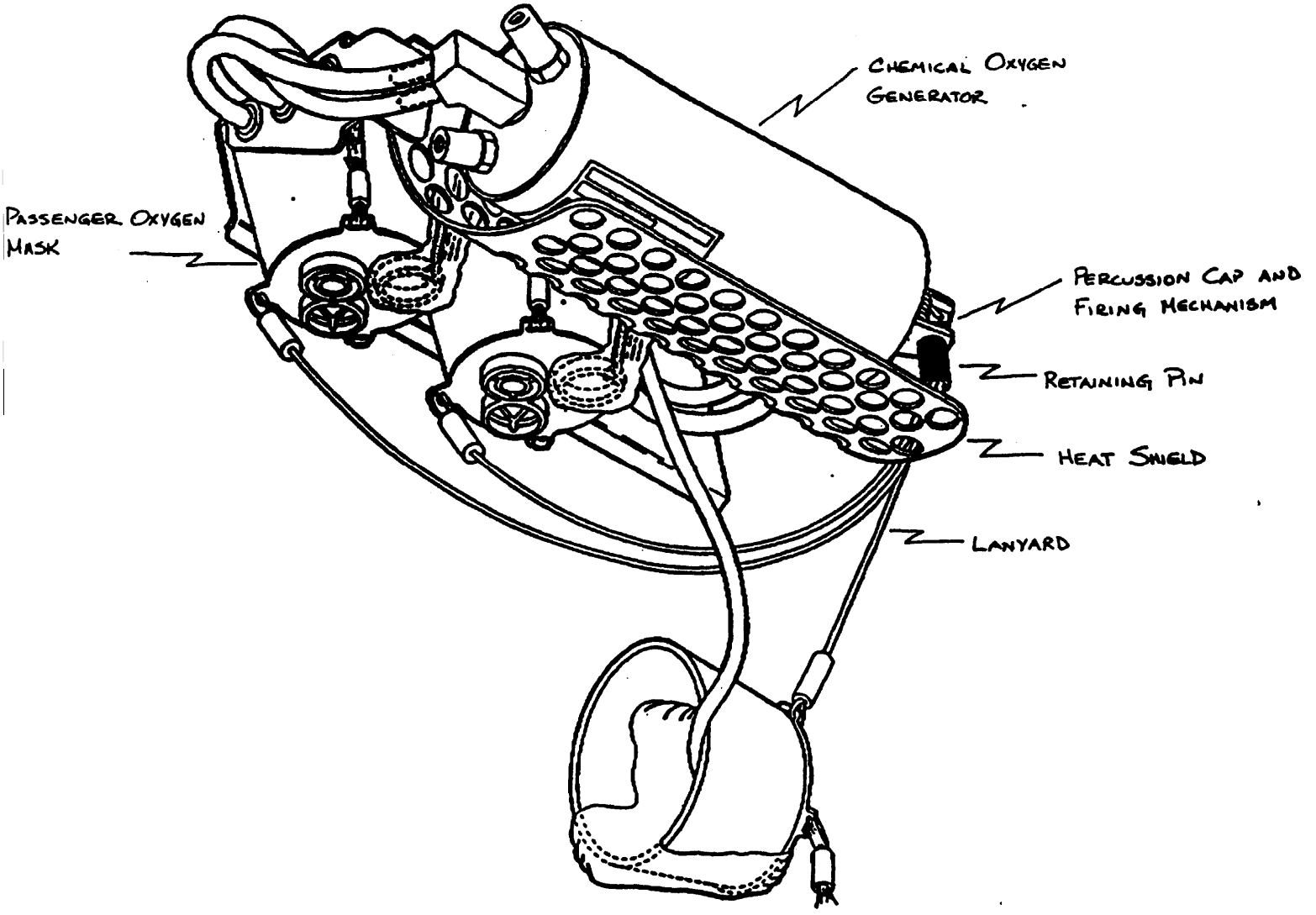

Figure 2a—Diagram of passenger oxygen generator/mask installation

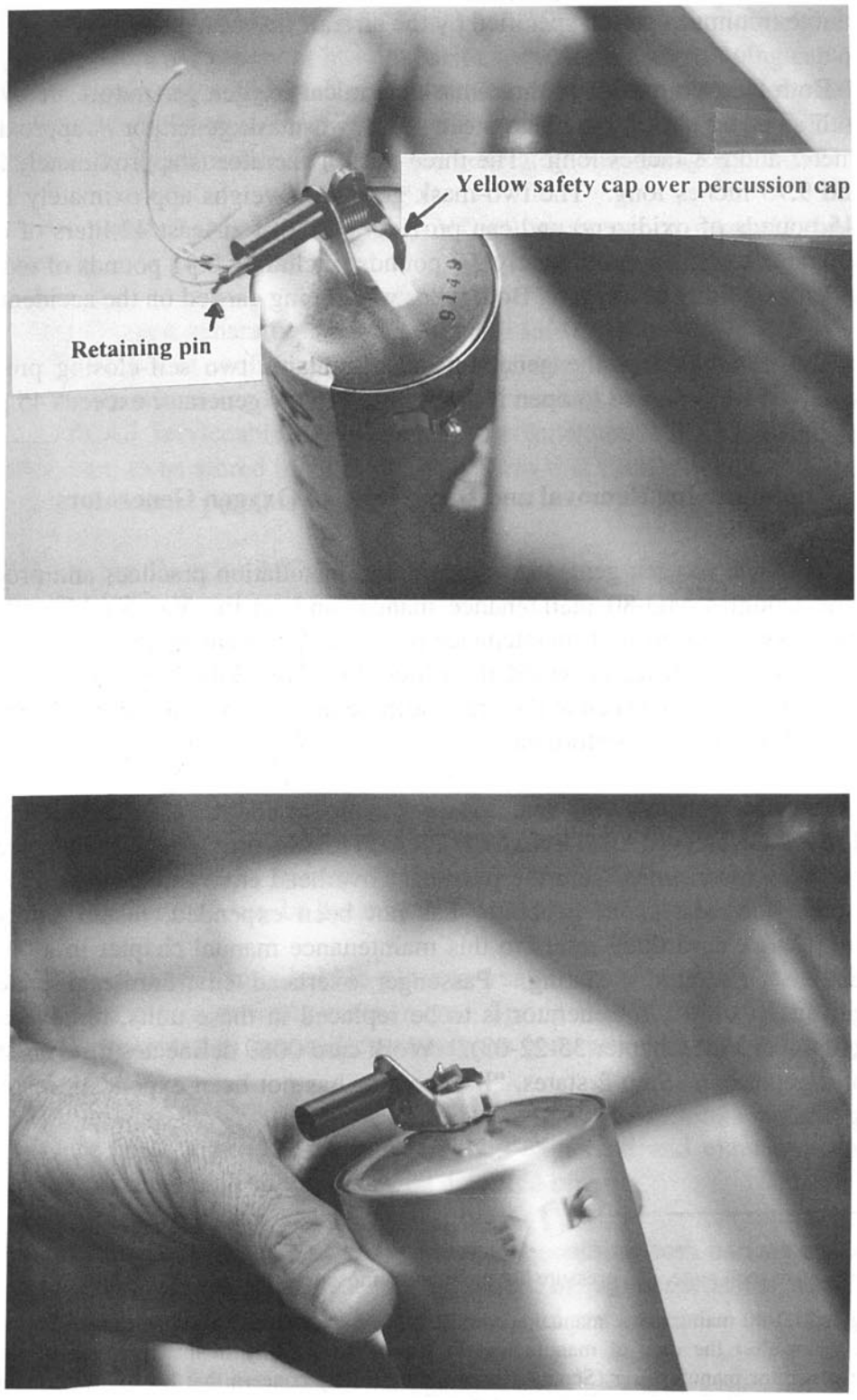

Figure 2b—Photographs of passenger oxygen generator unit

Aviation) indicates that generators might produce oxygen for as long as 18 to 20 minutes, rather than the 15-minute minimum period specified by the aircraft manufacturer.

Both the two-mask and three-mask chemical oxygen generators are cylindrical in appearance with an outer skin of stainless steel. The two-mask generator is approximately 2.5 inches in diameter and 8.8 inches long. The three-mask generator is approximately 2.75 inches in diameter and 9.75 inches long. The two-mask generator weighs approximately 1.25 pounds (including 0.45 pounds of oxidizers) and can provide a total of at least 42 liters of oxygen; the three-mask generator weighs approximately 1.7 pounds (including 0.81 pounds of oxidizers) and can produce at least 62 liters of oxygen. Both types were being carried on the accident airplane.

The outlet end of the generators also contains two self-closing pressure relief valves. These valves are designed to open if the pressure in the generator exceeds 45 psig.[18]

1.1.2.2 Guidelines for Removal and Disposition of Oxygen Generators

Chemical oxygen generator removal and installation practices and procedures are contained in the Douglas MD-80 maintenance manual and on the ValuJet MD-80 work card 0069. Passenger oxygen insert unit maintenance practices are delineated in the Douglas MD-80 maintenance manual.[19] ValuJet provided these documents to SabreTech, and copies of each document were present at SabreTech at the time the generator removal and configuration changes on N802VV and N803VV were performed.

The Douglas MD-80 maintenance manual, chapter 35-22-03 (PASSENGER OXYGEN INSERT UNITS--MAINTENANCE PRACTICES), provides a six-step procedure for removing the oxygen insert units from the passenger overhead environmental panels. Step 2 of that removal procedure states, "If generator has not been expended, install safety cap over primer." ValuJet work card 0069 refers to this maintenance manual chapter in a "Note" under step #1 ("Remove Generator"), stating, "Passenger overhead environmental panels contain unitized oxygen insert units. If generator is to be replaced in these units, remove and replace insert unit (Reference: MM Chapter 35-22-03)." Work card 0069 delineates a seven-step process for removal of a generator. Step 2 states, "If generator has not been expended, install shipping cap[20] on firing pin."

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[18] Pounds per square inch gage, i.e., pressure not including atmospheric pressure.

[19] The Douglas MD-80 maintenance manual specifies that non-expended oxygen generators are to be removed from service 12 years after the date of manufacture to maintain reliability in the operation of the generators. According to the generator manufacturer (Scott Aviation), the primary concern that led to establishing the 12-year service life was the continued mechanical integrity of the core and its support structure, not changes to the chemical composition of the core. The 12-year limit was established based on tests conducted by Scott Aviation.

[20] The term "safety cap" as used in chapter 35-22-03 of the Douglas MD-80 maintenance manual will be used in this report rather than the term "shipping cap" used on work card 0069.

The Douglas MD-80 maintenance manual chapter 35-22-01 (CHEMICAL OXYGEN GENERATOR--MAINTENANCE PRACTICES) provides an eight-step removal procedure. Step 2 states, "If generator has not been expended, install shipping cap on firing pin." The first seven steps of this removal procedure are contained on ValuJet work card 0069. However, work card 0069 does not contain the eighth step listed in the Douglas MD-80 maintenance manual, "Store or dispose of oxygen generator (Ref. paragraph 2.C. or 2. D.)."

Paragraph 2.C. of the Douglas MD-80 maintenance manual, chapter 35-22-01 states the following:

> (1) Oxygen generators must be stored in safe environment.
> (2) Each unit shall be checked before placing it in storage to assure that release pin restraining firing mechanism is correctly installed.
> (b)All serviceable and unserviceable (unexpended) oxygen generators (canisters) are to be stored in an area that ensures that each unit is not exposed to high temperatures or possible damage.

Paragraph 2.D. of the Douglas MD-80 maintenance manual, chapter 35-22-01, provides the following steps for disposal of the oxygen generators:

> (1) No oxygen generator (canister) is to be disposed of until it is initiated and chemical core is fully expended.
> (2) Initiation and expending of an oxygen generator may be accomplished as follows:
> (a) Secure generator (canister) with holding device that is nonflammable.
>
> (b) Area and adjacent surrounding must be free of oil or other combustible substances that may be hazardous in an oxygen enriched atmosphere.
>
> (c) With canister firmly held in place and safety considerations satisfied, pull release pin from firing mechanism. Spring-loaded mechanism will now strike percussion cap and cause oxygen generator to ignite internally and expend.
>
> (d) Once oxygen generator has been fully expended and exterior (canister) temperature has cooled, it may be disposed of.
>
> (e) An expended oxygen generator (canister) contains both barium oxide and asbestos fibers and must be disposed of in accordance with local regulatory compliances and using authorized procedures.
>
> (3) In [the] event oxygen generator cannot be ignited and expended through normal means, or if user has additional questions, they are directed to contact manufacturer for information.

Work card 0069 and both relevant chapters of the Douglas MD-80 maintenance manual (chapters 35-22-01 and 35-22-03) also contained warnings that unexpended generators contain live ignition trains that, when activated, generate case temperatures up to 500 °F. The warnings also advised individuals to use extreme caution while handling the generators to prevent inadvertent removal of the firing pin and to immediately place any activated canister on a noncombustible surface. Additional warnings in chapter 35-22-01 of the Douglas MD-80 maintenance manual call for individuals to "obey the precautions" and to refer to the applicable material safety data sheet (MSDS) for more precautionary data and approved safety equipment. According to SabreTech, the MSDS for the Scott Aviation oxygen generator, part No. 801386-04, 05, 06, 07, 08, was not on file at SabreTech's Florida facility at the time the generators were removed.

Work card 0069 and the applicable portions of the Douglas MD-80 maintenance manual did not contain a "required materials list" and were not marked with a hazardous materials identification symbol, nor were they required to be. Also, work card 0069 did not require an inspector's signature, because the task it described was not a ValuJet required inspection item (RII)[21] task. Neither the work card nor maintenance manual chapter 35-22-03 (the only maintenance manual chapter referenced by ValuJet work card 0069) gave instructions on how to store unexpended generators or dispose of expended canisters.

Following the accident, the Safety Board reviewed another air carrier's work card (Alaska Airlines), issued before the ValuJet accident, for the task of removing chemical oxygen generators from MD-80s. The card contained a warning about the dangers of the unexpended generators[22] and instructions to discharge the generators before disposal. This air carrier's work card called for the discharge of all removed generators, and included instructions about the method for discharging them. It also identified the discharged generators as hazardous waste. The air carrier's card stated, "Expended canisters are hazardous waste and require a hazardous waste label on the canister or on the container holding the expended canisters." The card also called specifically for the expended generators to be held at the location where they were removed and directed the individuals performing the removal task to "…immediately notify the environmental affairs manager."

The other U.S. manufacturer of chemical oxygen generators, Puritan Bennett Aero Systems, issued a service information letter in September 1991 that provided information and warnings on the handling and disposition of oxygen generators. The service information letter

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[21] Title 14 CFR 121.369 requires all Part 121 operators to list in their general maintenance manuals, "A designation of the items of maintenance and alteration that must be inspected (required inspections), including at least those that could result in a failure, malfunction, or defect endangering the safe operation of the aircraft, if not performed properly or if improper parts or materials are used."

[22] The warning stated, "Unexpended oxygen generators in the insert units contain live ignition trains, and when activated, generate case temperatures in excess of 500 degrees F. (260 degrees C.). Use extreme caution while handling to prevent inadvertent removal of firing pin. If generator should become active, immediately place on a noncombustible surface."

provided instructions on how to expend an unused generator and advised that generators reaching the end of their useful life should be routinely discharged and discarded.

1.1.2.3 Accomplishment of Maintenance Tasks Involving Oxygen Generators

About the middle of March 1996, SabreTech crews began removing the passenger oxygen insert units from both N802VV and N803VV and replacing the expired and near-expired generators with new generators. These units contained the oxygen generator, generator heat shield, mask retainer, and masks. The inserts were reinstalled after the masks were inspected, and the old generators were replaced with new generators. The new generators had a label[23] that contained the following information:

"WARNING
THIS UNIT GETS HOT!
WHEN REMOVING UNIT
INSTALL SAFETY CAP OVER PRIMER
DO NOT PULL LANYARD
IF ACTIVATED PLACE ON SURFACE THAT WON'T BURN"

According to the SabreTech mechanics, almost all of the expired or near-expired oxygen generators removed from the two airplanes were placed in cardboard boxes, which were then placed on a rack in the hangar near the airplane. However, some of these generators (approximately a dozen) were not put in boxes, but rather were left lying loose on the rack.

According to the mechanics who worked on the task, when an oxygen generator was removed from an insert, a green SabreTech "Repairable" tag (Form MO21) was attached to the body of the generator (although one mechanic stated that he ran out of green tags and put white "Removed/Installed" tags on four to six generators).[24] In the "reason for removal" section, near the bottom of the green "Repairable" tag, the mechanics made various entries such as "out dated," "out of date," and "expired," all indicating that the generators had been removed because of a time limit or date being exceeded. According to the SabreTech mechanics, all work at SabreTech was to have been completed[25] by April 24, 1996, for N802VV, and April 30, 1996,

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[23] According to the manufacturer (Scott Aviation), oxygen generators manufactured since 1988 have this warning label affixed to the generator.

[24] A discussion of SabreTech's tagging procedures is contained in section 1.17.2.3.

[25] According to the Aircraft Maintenance Services Agreement between ValuJet and SabreTech, SabreTech agreed "to credit ValuJet the amount of $2,500 per calendar day as liquidated damages for each day the aircraft is delayed beyond the redelivery date…."

for N803VV. The passenger cabin oxygen system maintenance tasks were ultimately completed and signed off as completed on April 30 for N803VV and on May 5 for N802VV.[26]

SabreTech maintenance records indicated a total of 72 chemical oxygen generators were removed from N802VV. Sixty-seven (identified as Douglas part No. BWM7001-503/Scott part No. 801386-06) were three-mask generators, and five (identified as Douglas part No. BWM7001-501/Scott Aviation part No. 801386-05) were two-mask generators. The serial numbers of these generators, as recorded in the maintenance records, were checked against Scott Aviation factory records. The records indicated that most[27] of the generators were manufactured in 1979 and 1980; although some three-mask generators were manufactured in 1982.

Although the available records did not indicate the total number of generators that were removed from N803VV, interviews with various SabreTech employees indicated that about the same number of generators were removed from N802VV and N803VV. No record of the serial numbers of the generators removed from N803VV was located.

SabreTech maintenance records did indicate that six three-mask oxygen generators were removed from N830VV because they had been accidentally expended and required replacement but that the remaining generators on this airplane were not removed.

Of the approximately 144 oxygen generators removed from N803VV and N802VV, approximately 6 were reported by mechanics to have been expended. There is no record indicating that any of the remaining approximately 138 oxygen generators removed from these airplanes were expended.

Six oxygen generators were located during a thorough search of the SabreTech facility in Miami, Florida, after the accident. The markings on the tags attached to these generators indicated that they had been removed from the MD-80 series airplanes (N802VV, N803VV, and N830VV).

1.1.2.4 Mechanic and Inspector Signoffs on Work Cards

The mechanic who signed the "MECH SIGNOFF" block on work card 0069 for N802VV (see appendix D) certifying that the removal and installation procedures outlined on the card had been completed stated that he had personally removed and installed approximately 30 to 35 generators in N802VV and had installed an undetermined number of generators in N803VV and N830VV. (He signed the work card on May 5, 1996.) The mechanic who signed the

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[26] N830VV was added to ValuJet's operations specifications on April 26, 1996, and departed SabreTech on April 28. N803VV was added to the operations specifications on May 1, 1996, and departed SabreTech on the same day. N802VV was added to the operations specifications on May 7, 1996, and departed SabreTech on May 9, 1996.

[27] Because of the age of the generators, Scott did not have records for all serial numbers found in SabreTech maintenance records.

"MECH SIGNOFF" block on work card 0069 for N803VV stated that he was completing a job that had been started on the previous shift, and that he personally removed only about 10 generators, all from N803VV. He stated that he did not install any of the new generators. (He signed the work card on April 30, 1996.)

According to the corporate director for quality control and assurance at SabreTech, 72 individuals logged about 910 hours against the work tasks described on work card 0069. SabreTech followed no consistent procedure for briefing incoming employees at the beginning of a new shift, and had no system for tracking which specific tasks were performed during each shift

The mechanic who signed work card 0069 for N802VV stated that after removing a generator from its bracket, he wrapped the loose end of the lanyard around the cylinder, and secured it with tape. He then taped a green "Repairable" tag on the generators (except for the few units on which he taped white "Removed/Installed" tags after he ran out of green tags), and placed them in one of two or three available cardboard boxes. He said that most of the oxygen generators placed in the boxes were laid on their side, one on top of the other, and a few were put on end to fill in the open space in the box. Some of the generators were placed in the boxes from which the new replacement generators had been taken, and some were placed in other boxes that had been located around the facility. The mechanic stated that because he assumed these boxes were not the final packing containers for the generators, no packaging material was placed between any of the units in the box. He said that he remembered placing one of the full boxes on the parts rack near the airplane, but that he did not have anything to do with the subsequent movement of the boxes from the rack to the shipping hold area.

The mechanic who signed work card 0069 for N802VV further stated that he was aware of the need for safety caps and had overheard another mechanic who was working with him on the same task talking to a supervisor about the need for caps. This other mechanic stated in a postaccident interview that the supervisor told him that the company did not have any safety caps available.[28] The supervisor stated in a postaccident interview that his primary responsibility had been issuing and tracking the jobs on N802VV and that he did not work directly with the generators. He stated that no one, including the mechanics who had worked on the airplanes, had ever mentioned to him the need for safety caps.

The mechanic who signed work card 0069 for N802VV said that some mechanics had discussed using the caps that came with the new generators, but the idea was rejected because those caps had to stay on the new generators until the final mask drop check was completed at the end of the process. He also said that he had witnessed both the intentional and

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[28] According to SabreTech's director of logistics, this was the first time that the Miami facility had performed this task. Safety caps were, therefore, not carried in SabreTech's inventory and, according to SabreTech, were considered "peculiar expendables" defined in the Aircraft Maintenance Services Agreement between ValuJet Airlines, Inc., and SabreTech as "those Components and Expendables which are used on the Aircraft but which are not carried in the SELLER's inventory." The agreement provided, "Peculiar expendables will be provided by ValuJet or, upon mutual agreement, by SELLER [SabreTech] at the rates specified in Exhibit II." (See appendix E.)

accidental activation of a number of oxygen generators and was aware that they generated considerable heat. When asked if he had followed up to see if safety caps had been put on the generators before the time he signed off the card, he said that he had not.

According to this mechanic, there was a great deal of pressure to complete the work on the airplanes on time, and the mechanics had been working 12-hour shifts 7 days per week.[29] He said that on the morning of May 4, 1996, 5 days before the date N802VV departed SabreTech, one of the SabreTech supervisors assigned him the task of signing off work card 0069 for N802VV. He said that they did not discuss or focus on the safety caps at the time of this request or the signoff. He also said that when he decided to sign the card, his focus was entirely on the airworthiness of the plane on which the new generators were installed.

The mechanic who signed work card 0069 for N803VV stated that he and another mechanic cut the lanyards from the 10 generators that he removed to prevent any accidental discharge, and then attached one of the green "Repairable" tags. He stated that he did not put caps on the generators but placed the generators into the same cardboard tubes from which the new ones had been taken. He then placed the cardboard tubes containing the old generators into the box in which the new generators had arrived. He said that he placed them in the box in the same upright position in which he had found the new generators. He said that although he did not see any of the generators discharge, he had worked with them at a previous employer and was aware that they were dangerous. This mechanic stated that his lead mechanic instructed him to "go out there and sell this job," which the mechanic interpreted as meaning he was to sign the routine and non-routine work cards and get an inspector to sign the non-routine work card.[30] He said he looked at the work that had been done on N803VV, focusing only on the airworthiness of that airplane.

Of the four individuals who signed the "All Items Signed" block on the subject ValuJet 0069 routine work cards and the "Accepted By Supervisor" block on the SabreTech non-routine work cards for N802VV and N803VV, three stated that at the time the generators were removed and at the time they signed off on the cards, they were unaware that the need for safety caps was an issue. However, the SabreTech inspector who signed off the "Final Inspection" block of the non-routine work card for N802VV, said that at the time he signed off he was aware that the generators needed safety caps. He further stated that he brought this to the attention of the lead mechanic on the floor at the time (but could not recall who that was), and was told that both the SabreTech supervisor and the ValuJet technical representative were aware of the

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[29] A SabreTech interoffice memorandum of April 26, 1996, stated, "Effective immediately due to the present workload all Maintenance Personnel including Management are required to work 7 days (including days off). We will return to regular work schedule when the three (3) MD-80's are delivered."

[30] Non-routine work cards are customized documents that list the general maintenance tasks to be accomplished, and refer (either in the original description or the mechanic's subsequent signoff) to more detailed instructions, such as those contained in routine work cards. All non-routine work cards are signed by an inspector. Routine work cards typically do not have an inspector signoff, unless an RII is involved.

problem and that it would be taken care of "in stores."[31] According to him, after being given this reassurance, he signed the card.

1.1.2.5 Role of ValuJet Technical Representatives

Two of the three ValuJet technical representatives[32] assigned to SabreTech and a ValuJet quality assurance inspector, who was at SabreTech from April 28 to May 8, said that they did not observe any of the oxygen generators during removal or after they had been removed and were not aware of an issue concerning the lack of safety caps at the SabreTech facility. However, one of the technical representatives said that on or about April 10, he was watching the SabreTech mechanics remove several oxygen generators and later noticed generators sitting on a parts rack near one of the ValuJet airplanes. He said that he specifically recalled, "...these generators did not have safety caps installed." He said that although he did not specifically discuss the need for caps to be installed, he advised the mechanics that the generators were hazardous when set off, and later advised a lead mechanic that the generators should be "disposed of with the rest of SabreTech's hazardous waste." He also stated that at a later date he talked with a SabreTech inspector about the danger presented by the box of generators sitting on the parts rack near the airplanes, and asked that the box be moved from that location. According to this technical representative, when he later saw that the box had not been moved, he talked with a SabreTech supervisor about the issue and then later talked with the SabreTech project manager after the box still had not been removed. He said that the box was finally moved a little more than 3 weeks after his initial discussion with the mechanics but that he did not know where it had been taken or what had been done with the generators.

The SabreTech inspector, supervisor, and project manager all denied during interviews about being approached by the technical representative or knowing anything about an issue having to do with a need for safety caps on the oxygen generators.

1.1.2.6 Packaging and Shipping of Oxygen Generators

By the first week in May 1996, most of the expired and near-expired oxygen generators had been collected in five cardboard boxes. Three of the five boxes were taken to the ValuJet section of SabreTech's shipping and receiving hold area by the mechanic who said that he had discussed the issue of the lack of safety caps with his supervisor. According to the mechanic, he took the boxes to the hold area at the request of either his lead mechanic or supervisor. He said that he placed the boxes on the floor, near one or two other boxes, in front of shelves that held other parts from ValuJet airplanes. He stated that he did not inform anyone in the hold area about the contents of the boxes. It could not be positively determined who took the other two boxes to the hold area.

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[31] Stores refers to an air carrier's parts and components department.

[32] The technical representatives were responsible for overseeing the contractor's compliance with the terms of the service agreement and are discussed further in section 1.17.6.

According to the director of logistics at SabreTech,[33] at the time the five boxes were placed in the hold area for ValuJet property, no formal written procedure required an individual who took items to the shipping and receiving hold area to inform someone in that area what the items were or if the items were hazardous.[34]

None of the SabreTech mechanics remembered seeing any type of hazardous materials warning label on any of the boxes that contained the old generators, although some individuals had noticed that the boxes in which the new generators were shipped did have such warnings.

On either May 7 or May 8, 1996,[35] SabreTech's director of logistics went to the shipping and receiving area and directed the employees to clean up the area and to remove all of the items from the floor. This action was being taken because a potential customer was coming to the facility to conduct an audit/inspection, and in a previous audit by another customer, the "housekeeping" in the shipping and receiving area had been written up by the customer as unacceptable. The director of logistics said that he did not know the contents of any of the boxes in the area and that he did not give any specific instructions as to their disposition.

According to the director of logistics, on either May 7 or 8, he talked with one of the ValuJet technical representatives concerning the disposition of parts in the ValuJet hold area.[36] Although no firm date was agreed upon during this discussion, the director of logistics stated that he had expected that someone from ValuJet's stores in Atlanta would be coming to SabreTech on either May 9 or May 10 to decide on the disposition of the parts. According to the technical representative, on May 9, he called ValuJet's stores in Atlanta to coordinate such a visit and was told that a decision had been made to wait until Monday, May 13, to determine when and who would do the inventory. The director of logistics subsequently was informed of this decision by the ValuJet technical representative.

According to a SabreTech stock clerk,[37] on May 8, he asked the director of logistics, "How about if I close up these boxes and prepare them for shipment to Atlanta." He

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[33] The director of logistics was responsible for overseeing SabreTech's shipping and receiving department and storage department.

[34] Most large repair facilities performing heavy maintenance for air carriers have procedures requiring identification of items that are brought into shipping or storage areas.

[35] The date was May 7, according to the stock clerk who later repacked the oxygen generators, and May 8, according to the director of logistics.

[36] The Aircraft Maintenance Service Agreement between ValuJet and SabreTech stated, "Any material removed and not to be reinstalled during the performance of Services must be retained by SELLER [SabreTech] for ValuJet's Customer Representative to authorize disposal in writing. Should such authorization not be provided within thirty (30) days of inspection of the material removed and not to be reinstalled the SELLER will provide written notice to ValuJet of its intent to dispose of such material."

[37] Although he held the title, "stock clerk," the stock clerk indicated to Safety Board investigators that his duties were primarily those of a shipping clerk.

stated that the director responded, "Okay, that sounds good to me." The stock clerk then reorganized the contents of the five boxes by redistributing the number of generators in each box, placing them on their sides end-to-end along the length of the box, and placing about 2 to 3 inches of plastic bubble wrap in the top of each box. He then closed the boxes and to each applied a blank SabreTech address label and a ValuJet COMAT label with the notation "aircraft parts." According to the clerk, the boxes remained next to the shipping table from May 8 until the morning of May 11.

According to the stock clerk, on the morning of May 9, he asked a SabreTech receiving clerk to prepare a shipping ticket for the five boxes of oxygen generators and three DC-9 tires (a nosegear tire and two main gear tires). According to the receiving clerk, the stock clerk gave him a piece of paper indicating that he should write "Oxygen Canisters - Empty" on the shipping ticket. The receiving clerk said that when he filled out the ticket, he shortened the word "Oxygen" to "Oxy" and then put quotation marks around the word "Empty." He then completed the ticket and put the date (5/10/96) on the date line at the top of the form. He also said that after finishing the ticket, he was asked to put ValuJet's Atlanta address on eight pieces of paper and to attach one to each of the boxes and tires. The receiving clerk stated that when the stock clerk asked for his assistance, the boxes were already packaged and sealed, and he did not see the contents.

According to the stock clerk, he identified the generators as "empty canisters" because none of the mechanics had talked with him about what they were or what state they were in, and that he had just found the boxes sitting on the floor of the hold area one morning. He said he did not know what the items were,[38] and when he saw that they had green tags on them, he assumed that meant they were empty. The stock clerk stated in postaccident interviews that he believed green tags indicated that an item was "unserviceable," and that red tags indicated an item was "beyond economical repair" or "scrap." When asked if he had read the entries in the "Reason for Removal" block on these tags, he said that he had not.

According to the stock clerk, he weighed the boxes and determined that each one was 45-50 pounds. He stated he asked a SabreTech driver, once on May 10, and again on the morning of May 11, to take the items listed on the ticket over to the ValuJet ramp area. He said that the driver was busy on May 10, and was not able to load and deliver the items until May 11.

According to the SabreTech driver, on May 11, the stock clerk told him to take the three tires and five boxes over to the ValuJet ramp area. He said that he then loaded the items in his truck, proceeded to the ValuJet ramp area, where he was directed by a ValuJet employee

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[38] Information provided by the FAA indicates that SabreTech had previously returned oxygen generators to VASP Airlines: 3 generators in 1995 and 15 generators in May 1996. FAA security inspectors later located the 3 generators returned in 1995 at VASP's Miami office. The FAA inspectors determined that each generator had been actuated although they did not determine when this occurred. The FAA was unable to locate the generators returned in 1996. The SabreTech shipping tickets prepared in conjunction with the return of these generators identified them as oxygen generators. They were not described as hazardous materials. The generators that were returned to VASP were picked up by VASP at the SabreTech facility.

(ramp agent) to unload the material onto a baggage cart. He put the items on the cart, had the ValuJet employee sign the shipping ticket, and returned to the SabreTech facility.

According to the ValuJet ramp agents who loaded cargo bins 1 and 2 of the forward cargo compartment on flight 592, bin 2 was loaded with passenger baggage until full. Bin 1 was loaded with passenger baggage and U.S. mail (62 pounds), which included a mailing tube, a film box, and one priority mail bag. These items were followed by the three tires and the five cardboard boxes of oxygen generators. According to the lead ramp agent, who remained outside the airplane when the tires and boxes were loaded, "[the boxes] were placed on the side of the tires, facing the cargo door." According to the ramp agent inside the cargo compartment when the boxes were being loaded, "I was stacking—stacking the boxes on the top of the tires." The ramp agent testified at the Safety Board's public hearing that he remembered hearing a "clink" sound when he loaded one of the boxes and that he could feel objects moving inside the box. He told Safety Board investigators that when the loading was completed, one of the large tires was lying flat on the compartment floor, with the small tire laying on its side, centered on top of the large tire. He further indicated that the COMAT boxes were also loaded atop the large tire, positioned around the small tire, and that the boxes were not wedged tightly. He stated that the second large tire was standing on its edge between the compartment sidewall and the two other tires and was leaning over the two tires and COMAT boxes. The ramp agent said that the cargo was not secured, and that the cargo compartment had no means for securing the cargo. It could not be determined whether any other items, such as gate-checked baggage, were subsequently loaded into bin 1 before flight 592 departed.

1.2 Injuries to Persons

Injuries	Flightcrew	Cabin Crew	Passengers	Other	Total
Fatal	2	3	105	0	110
Serious	0	0	0	0	0
Minor	0	0	0	0	0
None	0	0	0	0	0
Total	2	3	105	0	110

1.3 Damage to the Airplane

The airplane was destroyed. The estimated value of the airplane was $4 million.

1.4 Other Damage

According to information provided by officials of Metro-Dade County (the county in Florida in which the accident occurred) and the State of Florida, the cost for recovery and cleanup operations totaled more than $10 million.

1.5 Personnel Information

1.5.1 Captain

The captain, age 35, held an airline transport pilot (ATP) certificate, No. 565299934, issued by the FAA with an airplane multiengine land rating and type ratings in the DC-9, B-737, SA-227, and BE-1900. She also held flight instructor, ground instructor, and ATC tower operator certificates.

The captain was issued an FAA class I airman medical certificate on April 12, 1996, with no limitations. FAA records indicated that the captain had a history of hypothyroidism, for which she was taking the medication Synthroid.[39]

In an October 12, 1993, letter, ValuJet made a conditional offer of employment to the captain, stating that the captain would be hired by ValuJet upon the successful completion, at her expense, of the ValuJet initial pilot training program conducted by FlightSafety International (FSI). Records at the FSI Miami Training Center indicated that the captain attended ValuJet ground school for basic company indoctrination, initial DC-9, and general emergency training from October 24 through November 25, 1993. As part of this training, she attended sessions on hand-held fire extinguishers, portable breathing equipment (PBE), and portable oxygen systems, in which students were given hands-on experience discharging each type of fire extinguisher installed on the DC-9. Records indicated that she received 2 hours of training in ValuJet's hazardous materials policies, including the recognition and handling of dangerous articles, on October 24, 1993.

The captain became an employee of ValuJet on November 25, 1993. By December 19, 1993, she had completed the ValuJet initial qualification requirements, including a captain's proficiency check and a DC-9 type rating check. She completed initial operating experience (IOE) and a line check on December 21, 1993, for the position of captain.[40] She was assigned as a DC-9 first officer on that date. She was assigned as a DC-9 captain on May 1, 1994.

ValuJet training records indicated that the captain completed the company's crew resource management (CRM) training, provided by FSI, on November 15 and 16, 1994. Records of the captain's pilot-in-command (PIC) proficiency checks at ValuJet indicated no unsatisfactory results. Her last line check was successfully accomplished on January 27, 1996.

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[39] According to the FAA, hypothyroidism treated with thyroid replacement medication (such as Synthroid) is not a medically disqualifying condition.

[40] ValuJet's practice was to qualify most of its newly hired pilots as captains, through the DC-9 type rating, initial pilot-in-command proficiency check required by 14 CFR 121.441, IOE, and line check, regardless of the pilot's initial assignment as a captain or first officer.

According to company records, the captain had accumulated 8,928 total flight hours before the accident flight, of which 2,116 hours were in the DC-9 and 1,784 hours were as the PIC. She had flown 854 hours during the 12 months before the accident, 188 hours in the previous 90 days, 43 hours in the past 30 days, and 24 hours in the 7 days immediately preceding the accident.

According to ValuJet records, the captain's most recent 24-hour period free from duty before the accident ended at 0720 on May 8, 1996. She worked morning-to-midafternoon day trips beginning and ending at DFW on the 3 days before the accident. Her duty period on May 10 was 7.8 hours, ending at 1500. She accumulated 4.1 hours of flight time on May 10. On May 11, the day of the accident, she reported for duty in DFW at 0704. At the time of the accident, she had accumulated about 7.2 hours of duty time and 3.7 hours of flight time (including the accident flight).

ValuJet records indicated that on September 23, 1995, while serving as PIC of a ValuJet flight that departed DFW, the captain experienced an emergency that was later determined to have involved an overheated air conditioning pack. According to the incident report filed by the captain, flight attendants notified the flightcrew of smoke in the cabin shortly after takeoff. The captain stated in her report that the flightcrew could smell smoke in the cockpit. She stated, "the crew suspected a bleed air problem, but had no time to troubleshoot, since smoke was reported and the threat of a fire existed. It was felt [believed] that the safest course of action was to get on the ground as soon as possible." According to the first officer of that flight, he and the captain discussed whether to don their oxygen masks and smoke goggles as they maneuvered to descend and return to the airport. They decided that the situation did not warrant donning the masks or goggles. According to the first officer, no visible smoke was in the cockpit, although they could smell smoke. The airplane returned safely to DFW.

1.5.2 First Officer

The first officer, age 52, held an ATP certificate issued by the FAA, certificate No. 261682625, with ratings for airplane single-engine and multiengine land, and a type rating in the DC-9. He also held flight engineer and airframe/powerplant (A&P) mechanic certificates issued by the FAA.

The first officer held a restricted FAA class I airman medical certificate, issued on March 7, 1996, by the FAA Civil Aeromedical Institute pursuant to the FAA's special issuance authority with the limitation, "Valid for 6 months following the month examined." FAA records indicated that the FAA Aeromedical Certification Division was monitoring the first officer for a self-reported history of diabetes (a disqualifying condition for an unrestricted medical certificate). [41] These records also indicated that he was taking the medication Diabeta, to lower his blood sugar levels.

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[41] The first officer was required to undergo a complete medical re-evaluation of his condition every 6 months to identify any worsening or potential complications of his diabetes.

The first officer's FAA airman certification records indicated that he successfully completed the DC-9 type rating check on December 15, 1993, while serving as an MD-80 pilot for a 14 CFR Part 121 supplemental air carrier. He then served as an "International Relief Captain" for that air carrier.

After receiving a conditional offer of employment from ValuJet, the first officer began ground training at the FSI facilities in Miami on October 6, 1995. FSI records indicated that on October 9, the first officer received 2 hours of training on ValuJet's hazardous materials policy, including the recognition and handling of dangerous articles—the same 2 hours of training that the captain had received. On October 14, he received training in hand-held fire extinguishers and portable oxygen systems, including the actual discharge of each type of extinguisher used by ValuJet. On November 12, he performed a firefighting drill while using PBE.

The first officer successfully completed the simulator-based portion of his proficiency check, conducted by FSI, on November 12, 1995, and became an employee of ValuJet on November 13. He finished his training and successfully completed a PIC proficiency check in the DC-9 in Atlanta on November 14. The first officer completed 25.6 hours of IOE in the first officer position (including 14 landings) on December 2, 1995, and he was assigned as a DC-9 first officer on that date.

The first officer's training records at ValuJet did not indicate that he had received CRM training. However, his partner during initial training stated that he and the first officer had received 2 days of CRM training, including classroom lectures, tapes, discussions, and role playing (crewmembers and passengers). He said that CRM had not been integrated into the simulator sessions that he and the first officer received.

According to company records, the first officer had accumulated 6,448 total flight hours as a pilot before the accident flight. (His ValuJet employment application also cited 5,400 hours as a military and civilian flight engineer.) He had 2,148 hours of DC-9 experience, including 400 hours as the MD-80 international relief captain. He had flown 348 hours during the 12 months before the accident, 204 hours in the previous 90 days, 82 hours in the past 30 days, and 24 hours in the 7 days immediately preceding the accident.

According to ValuJet records, the first officer reported for duty at 0703 on May 8. He then worked morning-to-midafternoon day trips beginning and ending at DFW, on the 3 days before the accident. His flight and duty times on May 10 and May 11 were approximately the same as those of the captain.

1.5.3 Flight Attendants

Three flight attendants were on board flight 592.

One flight attendant, age 22, completed ValuJet's flight attendant training program and was hired on January 31, 1995. She completed recurrent training on February 21, 1996.

The second flight attendant, age 36, completed ValuJet's flight attendant training program and was hired on October 26, 1995. She had not attended any annual recurrent training because she had been employed by ValuJet for less than a year.

The third flight attendant, age 22, completed ValuJet's flight attendant training program and was hired on March 15, 1996. She had not attended any annual recurrent training because she had been employed by ValuJet for less than a year.

1.6 Airplane Information

1.6.1 General

The accident airplane, N904VJ, was a Douglas DC-9-32, fuselage No. 496, serial No. 47377. It was delivered new to Delta Air Lines in 1969. In 1992, the airplane was sold to McDonnell Douglas. In 1993, the airplane was purchased by and delivered to ValuJet Airlines, Inc. At the time of the accident, the airplane had 68,400.7 hours and 80,636 cycles since new and was registered to and being operated by ValuJet Airlines, Inc.

The investigation determined that flight 592 was within the maximum takeoff weight applicable to the DC-9-32 (108,000 pounds) and center of gravity limitations for the calculated takeoff weight (9.3 to 15.4 percent mean aerodynamic chord).

1.6.2 Engines

Both engines were Pratt & Whitney (P&W) JT8D-9As. Engine No. 1, serial number (S/N) 665732, had accumulated 37,759.3 hours since new and 35,566 cycles since new. Since last overhaul, engine No. 1 had accumulated 1,874.3 hours and 1,492 cycles. The engine was installed on N904VJ on September 20, 1995, after an overhaul performed by Greenwich Air Services, Miami, Florida.

Engine No. 2, S/N 666262, had accumulated 44,242.7 hours since new and 27,075 cycles since new. Since last overhaul, engine No. 2 had accumulated 2,639.7 hours and 2,178 cycles. This engine was installed on N904VJ on June 13, 1995.

1.6.3 Cargo Compartment Information

The accident airplane was equipped with two class D cargo compartments. (See figure 3—forward cargo compartment.) The volume of the forward cargo compartment in the DC-9 airplane is about 560 cubic feet.

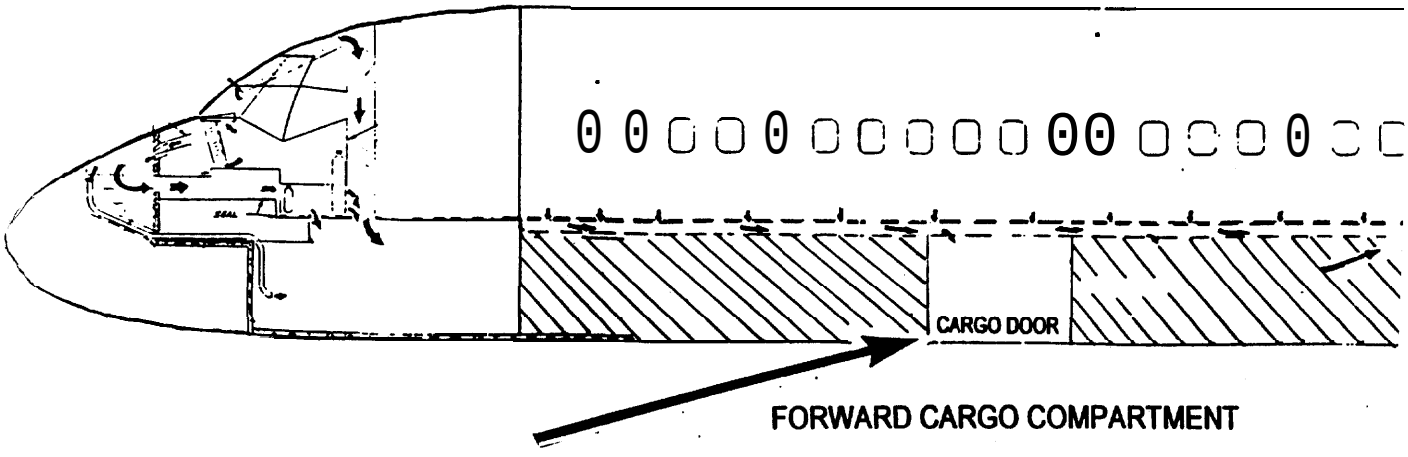

Figure 3—Forward cargo compartment

1.6.3.1 Federal Regulations

Requirements for cargo and baggage compartments of transport-category airplanes are described in 14 CFR 25.857, which provides the following:

(a) *Class A.* A Class A cargo or baggage compartment is one in which—

(1) The presence of a fire would be easily discovered by a crewmember while at his station; and

(2) Each part of the compartment is easily accessible in flight.

(b) *Class B.* A Class B cargo or baggage compartment is one in which—

(1) There is sufficient access in flight to enable a crewmember to effectively reach any part of the compartment with the contents of a hand fire extinguisher;

(2) When the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent, will enter any compartment occupied by the crew or passengers;

(3) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station.

(c) *Class C.* A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which—

(1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;

(2) There is an approved built-in fire extinguishing system controllable from the pilot or flight engineer stations;

(3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;

(4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.

(d) *Class D.* A Class D cargo or baggage compartment is one in which—

(1) A fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants;

(2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases, from any compartment occupied by the crew or passengers;

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits; and

(4) [Reserved]

(5) Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane. For compartments of 500 cubic feet or less, an airflow of 1,500 cubic feet per hour is acceptable.

(6) The compartment volume does not exceed 1,000 cubic feet.

(e) *Class E.* A Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which—

(1) [Reserved]

(2) There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;

(3) There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;

(4) There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and

(5) The required crew emergency exits are accessible under any cargo loading condition.

Title 14 CFR 25.855 states the following:

(b) Class B through Class E cargo or baggage compartments, as defined in 25.857, must have a liner, and the liner must be separate from (but may be attached to) the airplane structure.

(c) Ceiling and sidewall liner panels of Class C and D compartments must meet the test requirements of part III of appendix F of this part or other approved equivalent methods.[42]

(d) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in part I of appendix F of this part or other approved equivalent methods.

1.6.3.2 Safety Board Recommendations

On August 19, 1980, a Lockheed L-1011 operated by Saudi Arabian Airlines was forced to return shortly after departure from Riyadh, Saudia Arabia, because of an in-flight fire in the aft section of the airplane. Even though the airplane landed successfully, the fire continued and spread throughout the cabin, killing all 301 occupants. The Safety Board participated in that investigation in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation. As the result of findings from that accident, which concluded that a fire probably originated in the aft cargo compartment from an undetermined source, on February 10, 1981, the Safety Board issued two safety recommendations asking the FAA to do the following:

> Reevaluate the "Class D" certification of the L-1011 C-3 cargo compartment with a view toward either changing the classification to "C," requiring detection and extinguishing equipment, or changing the compartment liner material to insure containment of a fire of the types likely in the compartment while in flight. (A-81-012)
>
> [and]

[42] Part III of appendix F of 14 CFR 25 is contained in appendix F of this report.

> Review the certification of all baggage/cargo compartments (over 500 cu. ft.) in the "D" classification to insure that the intent of 14 CFR 25.857 (d) is met. (A-81-013)

On May 11, 1982, the FAA responded to the Board, stating that fire safety would be improved with the installation of a fiberglass ceiling liner, in lieu of the then-standard Nomex fabric ceiling liner. Based on this response and actions by airlines to comply with the intent of the recommendation, on November 2, 1982, the Safety Board classified Safety Recommendation A-81-012 "Closed—Acceptable Action."

With regard to Safety Recommendation A-81-013, in June 1983, the FAA Technical Center completed a study of the effectiveness of transport-category aircraft class D cargo compartments in containing fires by oxygen starvation. The FAA study concluded that the Federal regulations did not ensure adequate burn-through resistance of class D cargo liners subjected to realistic fires. The study also noted that the cargo compartment liner was the initial fire barrier for the protection of aircraft components, structure, passengers, and crewmembers from a fire inside the cargo compartment. The FAA report warned that some cargo compartments, although primarily lined with fiberglass, have aluminum components and that the use of aluminum might nullify the fire containment capability of burn-through resistant cargo compartment liners. (The burn-through temperature of aluminum is about 1,000 °F, depending on the composition of the alloy.)

Subsequently, on August 8, 1984, the FAA issued Notice of Proposed Rulemaking (NPRM), Notice 84-11, which addressed the problem of fire containment in cargo compartments by proposing a new test method for determining the flame penetration resistance of compartment liners. The Safety Board provided comments on the rulemaking on October 9, 1984, and advised the FAA that although the proposed flame penetration tests were more stringent than the previous ones, a fire should not be allowed to persist in any state of intensity in an airplane without the knowledge of the flightcrew, and that a fire detection system should be required in "class D" baggage/cargo compartments.

On May 9, 1986, the FAA issued a final rule to amend fire safety standards for cargo or baggage compartments. The final rule adopted more stringent cargo liner burn-through tests and limits on the size of "class D" cargo/baggage compartments, but the rule did not require fire detection systems in "class D" compartments. On June 25, 1986, the Board classified Safety Recommendation A-81-013 "Closed—Acceptable Action."

On February 3, 1988, American Airlines flight 132, a McDonnell Douglas DC-9-83, experienced an in-flight fire while en route to Nashville Metropolitan Airport, Tennessee, from DFW, Texas.[43] As the airplane was on a final approach, a flight attendant and a

[43]National Transportation Safety Board. 1988. *In-flight Fire, McDonnell Douglas DC-9-83, N569AA, Nashville Metropolitan Airport, Nashville, Tennessee, February 3, 1988*, Hazardous Materials Incident Report NTSB/HZM-88/02. Washington, D.C.

deadheading first officer notified the cockpit crew of smoke in the passenger cabin. The fire eventually breached the cargo compartment, and the passenger cabin floor over the mid cargo compartment became hot and soft. The fire did not extinguish in-flight. After landing, the 120 passengers and six crewmembers safely evacuated the airplane. The Safety Board found that hydrogen peroxide solution (an oxidizer) and a sodium orthosilicate-based mixture had been shipped and loaded into the mid (class D) cargo compartment of the airplane. The investigation determined that the chemicals were improperly packaged and were not identified as hazardous materials. After the hydrogen peroxide leaked from its container, a fire started in the cargo compartment.

As a result of that accident, on October 24, 1988, the Safety Board urged the FAA to do the following:

> Require fire/smoke detection systems for all class D cargo compartments. (A-88-122)
>
> Require a fire extinguishment system for all class D cargo compartments. (A-88-123)
>
> Evaluate prohibiting the transportation of oxidizers in cargo compartments that do not have fire/smoke detection and fire extinguishment systems, and determine if other classes of hazardous materials also should be excluded from cargo compartments without these safety systems. (A-88-124)
>
> Review the certification of all types of cargo compartments to identify any aluminum or other components that fail to meet thermal protection requirements at least equal to cargo compartment liner thermal protection requirements. Require that all safety deficiencies be corrected. (A-88-125)
>
> Consider the effects of authorized hazardous materials cargo in fires for all types of cargo compartments, and require appropriate safety systems to protect the aircraft and occupants. (A-88-127)[44]

Concerning Safety Recommendations A-88-122 and -123, the FAA on January 5, 1989, responded that it was considering the issuance of an NPRM proposing to require fire and smoke detection systems and a fire extinguishing system for all class D cargo compartments that were more than 200 cubic feet in volume. The FAA stated it believed that the current requirements in 14 CFR Part 25, combined with the recently amended cargo compartment liner and cargo container requirements, provided an acceptable level of safety for cargo compartments

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[44] Safety Recommendations A-88-126 and -128 were also issued to the FAA as a result of that incident. A-88-126 addressed joint cockpit and cabin crew training on emergency procedures and periodic emergency drills. (The recommendation was ultimately classified "Closed—Reconsidered." A-88-128 asked that principal operations inspectors determine if flight attendant instructions for emergency evacuations were consistent with the carrier's procedures. (The recommendation was ultimately classified "Closed—Acceptable Action.)

of 200 cubic feet or less. After several exchanges of correspondence between the Safety Board and the FAA, on August 10, 1993, the FAA responded to these two safety recommendations stating that the preliminary economic analysis conducted as part of the rulemaking indicated that the cost of compliance would exceed $350 million, and the costs did not meet cost/benefit criteria established in Executive Order 12291. The FAA also noted that the proposed rule would not provide a significant degree of protection to the occupants from the extremely severe fire that resulted from the illegal shipment of powerful oxidizers. It stated that the rulemaking would be terminated and no further action would be taken on these safety recommendations. On October 14, 1993, the Safety Board classified Safety Recommendations A-88-122 and -123 "Closed—Unacceptable Action" stating, "The Safety Board continues to believe that a fire should not be allowed to persist in any state of intensity in an airplane without the knowledge of the flightcrew. Further, the Safety Board is concerned that the FAA failed to consider the effects of hazardous materials (declared or undeclared) in cargo compartment fires when it approved burn-through test requirements for cargo compartment liners in 1986 in lieu of fire detection and extinguishment systems."

On August 23, 1993, Safety Recommendation A-88-124 was classified "Closed—Acceptable Action" based on a June 30, 1993, letter from the FAA that stated that both the FAA and the Research and Special Programs Administration (RSPA) had completed an evaluation of the transportation of oxidizers and other hazardous materials by air and both had concluded that oxidizers and other classes of hazardous materials that are authorized to be transported by air are safe when properly packaged, declared, and segregated. The Board noted in its evaluation of FAA's and RSPA's actions in response to A-88-124, "the FAA and RSPA also recognize that undeclared or hidden shipments of hazardous materials are a threat to safety and have taken actions to improve public awareness of this threat and enforcement of regulations."

On July 20, 1990, Safety Recommendation A-88-125 was classified "Closed—Unacceptable Action" based on the FAA's January 29, 1990, response that aluminum materials in portions of cargo compartment liners were not a hazard and were not a factor in the February 3, 1988, American Airlines incident. The Safety Board stated, "we strongly believe that these liners should be removed from service because they do not provide the required protection."

On April 19, 1993, the Safety Board wrote to the FAA concerning Safety Recommendation A-88-127, which had been classified "Open—Unacceptable Response" on July 20, 1990. The Safety Board stated that it had received no FAA correspondence since the Safety Board's July 20, 1990, letter. On March 17, 1994, the Safety Board classified A-88-127 "Closed—Unacceptable Action," because no response had been received from the FAA and there had been no apparent actions to meet the intent of this recommendation.

On May 24, 1996, 13 days after the ValuJet accident, RSPA issued an interim final rule[45] that prohibited the transportation of chemical oxygen generators on passenger aircraft

[45] *Temporary Prohibition of Oxygen Generators as Cargo in Passenger Aircraft*, Docket HM-224, in 61 FR 26418 on May 24, 1996.

until January 1, 1997, and the FAA issued an emergency notice[46] that any person who offers for transportation or transports oxygen generators as cargo aboard passenger aircraft would be subject to swift enforcement action. The interim final rule requested public comments within 60 days. Because the Safety Board believed that further action should be taken, on May 31, 1996, the Board issued safety recommendations to the FAA and RSPA that called for urgent actions to prevent similar accidents in the future.

The May 31, 1996, recommendations to the FAA were the following:

> Immediately evaluate the practices of and training provided by all air carriers for accepting passenger baggage and freight shipments (including company materials) and for identifying undeclared or unauthorized hazardous materials that are offered for transport. This evaluation should apply to any person, including ramp personnel, who accepts baggage or cargo for transport on passenger and cargo aircraft. (A-96-25)
>
> Require air carriers, based on the evaluation performed under Safety Recommendation A-96-25, to revise as necessary their practices and training for accepting passenger baggage and freight shipments and for identifying undeclared or unauthorized hazardous materials that are offered for transport. (A-96-26)
>
> Permanently prohibit the transportation of chemical oxygen generators as cargo on board any passenger or cargo aircraft when the generators have passed expiration dates, and the chemical core has not been depleted. (A-96-27)
>
> Prohibit the transportation of oxidizers and oxidizing materials (e.g., nitric acid) in cargo compartments that do not have fire or smoke detection systems. (A-96-28)

The following recommendations were issued to RSPA:

> In cooperation with the Federal Aviation Administration, permanently prohibit the transportation of chemical oxygen generators as cargo on board any passenger or cargo aircraft when the generators have passed expiration dates, and the chemical core has not been depleted. (A-96-29)
>
> In cooperation with the Federal Aviation Administration, prohibit the transportation of oxidizers and oxidizing materials (e.g., nitric acid) in cargo compartments that do not have fire or smoke detection systems. (A-96-30)

On July 16, 1996, the FAA and RSPA responded in a joint letter addressing Safety Recommendations A-96-25 through -30. With regard to A-96-25 and -26, the FAA stated

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[46] *Emergency Notice of Enforcement Policy* in 61 FR 26422 on May 24, 1996.

that it agreed with the recommendations and that it had initiated an immediate evaluation of air carrier hazardous materials manuals and training programs to determine if methods were included to identify undeclared or unauthorized hazardous materials.

With regard to Safety Recommendations A-96-27 and A-96-29, the FAA/RSPA response cited the May 24, 1996, interim final rule that prohibited until January 1, 1997, the offering for transportation and the transportation of all chemical oxygen generators as cargo on passenger-carrying aircraft. On December 30, 1996, RSPA issued its final rule (effective December 31, 1996) to prohibit the offering for transportation and the transportation of all oxygen generators as cargo on passenger-carrying aircraft.[47] On June 5, 1997, RSPA also issued a final rule[48] requiring a special approval to ship chemical oxygen generators by any mode other than passenger-carrying aircraft. According to the NRPM, this approval requires the Associate Administrator for Hazardous Materials to determine the hazard classification of chemical oxygen generators submitted for approval. The approval for the generators also requires at least two safety features that will prevent unintentional activation of the generators, and the generators are required to be contained in a packing prepared and originally offered for transportation by the approval holder when transported.

With regard to Safety Recommendations A-96-28 and -30, the FAA/RSPA response stated that the existing regulations forbade the air transportation of the highest risk oxidizing materials on board passenger-carrying aircraft. The letter stated that extensive RSPA regulations limit the amount of permissible oxidizing materials that might be carried in air transportation and set forth requirements for labeling, packaging, and handling of these materials. Nevertheless, RSPA initiated a rulemaking project to propose the prohibition of oxidizers on all passenger-carrying aircraft and on cargo compartments in cargo aircraft that are inaccessible to the flightcrew during flight. The FAA added that it would initiate rulemaking by October 1996 to require the clear identification (labeling) of class C and D cargo compartments for easy identification by ground personnel. No proposed rule has been issued to date.

On August 19, 1996, the Safety Board responded to the FAA and RSPA and classified Safety Recommendations A-96-25 through -30 "Open—Acceptable Response," pending completion of the rulemaking and other actions enumerated by the two agencies.

On March 24, 1997, and May 13, 1997, the FAA provided updates on its responses to Safety Recommendations A-96-25 through -28. With regard to A-96-25 and -26, the FAA noted that it had completed the first phase of its evaluation and had reviewed 215 air carriers certified under Parts 121, 125, and 135. During the evaluations, the FAA said that it had

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[47] On June 28, 1996, Part 1, Chapter 2, section 2.7 of the ICAO *Technical Instructions for the Safe Transportation of Dangerous Goods by Air* was amended forbidding the transportation of chemical oxygen generators (similar to those carried on ValuJet flight 592) as cargo on passenger aircraft.

[48] *Hazardous Materials: Shipping Description and Packaging of Oxygen Generators,* HM-224A. This rulemaking was to be in effect by July 7, 1997; however, the effective date was subsequently postponed until August 7, 1997.

reviewed FAA-approved air carrier manuals to ascertain what information was currently provided to prompt air carrier employees to recognize suspicious cargo or baggage and to ask additional questions before rejecting or accepting such cargo or baggage. The FAA said that it had initiated the second phase of the evaluation, which consisted of a follow-up inspection of those carriers to verify that they were complying with the established procedures in their manuals. Based on the outcome of the second phase, the FAA stated that it would have the necessary information to recommend appropriate actions to correct any noted deficiencies and to address the issues raised in Safety Recommendations A-96-25 and -26.

With regard to Safety Recommendation A-96-27, the FAA cited the December 30, 1996, final rule to prohibit the offering for transportation and the transportation of all oxygen generators as cargo on passenger-carrying aircraft. With regard to A-96-28, the FAA cited the December 30, 1996, NPRM [HM-224A] that proposes to prohibit transportation of oxidizers in class D cargo compartments of passenger and cargo aircraft. The proposed rule would permit oxidizers in accessible locations on cargo aircraft.[49]

In its February 28, 1997, comments to the docket for NPRM HM-224A, the Safety Board supported the adoption of the proposed rules with a few exceptions. Specifically, the Safety Board expressed concerns that the proposed rules did not prohibit limited quantities of oxidizers shipped as consumer commodities.[50] Further, the consumer commodity exception allows shipment of these materials without labeling to warn air carrier personnel that the package contains oxidizing materials. Consequently, they could be carried in class D cargo compartments that do not have smoke/fire detection.

The Safety Board comments to the docket on NPRM HM-224A also urged RSPA to complete its study of the effects of authorized hazardous materials in cargo compartment fires and to require appropriate safety systems to protect aircraft and their occupants.

The crash of ValuJet flight 592 prompted the FAA to state in November 1996 that it would issue an NPRM by the end of the summer of 1997 that would require the retrofit of all class D cargo compartments to class C compartments in about 2,800 older aircraft. The crash also prompted the Airline Transport Association (ATA) to announce in December 1996 that its members would voluntarily retrofit existing class D cargo compartments with smoke detectors. In January 1997, Delta Air Lines initiated a test program for a cargo compartment smoke detection system. Shortly thereafter, ValuJet initiated a program to study smoke in the forward cargo compartment and test a smoke detection system. ValuJet applied for and received permission from the FAA to temporarily modify a portion of the forward cabin floor (above the cargo compartment) in a DC-9 with Plexiglas. The modification enabled engineers to observe

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[49] On August 1, 1997, the Safety Board classified Safety Recommendations A-96-25 through -28 "Open—Acceptable Response," based on the March 24, 1997, and May 13, 1997, letters from the FAA.

[50] A consumer commodity is defined in Title 49 CFR as "a material that is packaged and distributed in a form intended or suitable for sale through retail sales agencies or instrumentalities for consumption by individuals for purposes of personal care or household use. This term includes drugs and medicines."

and study the smoke patterns resulting from air circulation inside the compartment and document the propagation of smoke out of the compartment in various conditions. Currently, both airlines are completing their certification testing and awaiting FAA approval for installation of their respective systems.

On June 10, 1997,[51] the FAA issued an NPRM that would require the installation of smoke detection and fire suppression systems in all class D cargo compartments. According to the NPRM, the airline industry would have 3 years from the time the rule becomes final to meet the new standards. The FAA indicated in the NPRM that it anticipated having a final rule issued by the end of the year.

1.6.4 DC-9 Ventilation System

Douglas documents for the DC-9 airplane show that the ventilation for the passenger cabin is introduced from above the passengers; the air then flows toward the center aisle, then aft and outboard. (See figure 4.) The design of the DC-9-30 series airplane allows for a complete change of cabin air 28 times per hour. Air exhausted from the cabin is directed downward from the lower outboard edges of the cabin to flow beside the lower cargo compartment, then aft toward the outflow valve.

The forward cargo compartment is pressurized and heated. The compartment ceiling has a pressure equalization valve, located between floorbeams that support the cabin floor. At more than ½ psi differential pressure, the valve is designed to open and vent pressure into the sub-floor area under the cabin floor boards. The air then flows outboard to the open spaces on either side of the cargo compartment, then aft to the outflow valve (pressure relief valves located to the left of the cargo compartment are shown in the Douglas illustration of airflow).

The primary source of fresh air for the DC-9 cockpit is the left air conditioning system, which provides a volume of air that is relatively independent of that of the cabin if the cockpit door and the door louvers are closed. Airflow in the DC-9 cockpit is designed to move the air from forward to aft. Cockpit air is replaced 68.4 times per hour, and the exhaust air is directed downward to the electrical compartment that is located below the aft portion of the cockpit and under the passenger door/galley area.

1.6.5 DC-9 Electrical Wiring System

According to the DC-9 electrical and wiring diagram manual, the DC-9 electrical wiring bundles are routed along the left, right, and top of the forward lower cargo compartment (between the fuselage and the cargo liner such that the bundles remain within the pressurized

[51] In May 1997, the Safety Board added the issue of smoke detection and fire extinguishment systems in class D cargo compartments to its "Most Wanted" list. The purpose of the Board's "Most Wanted" list is to bring special emphasis to the safety issues the Board deems most critical.

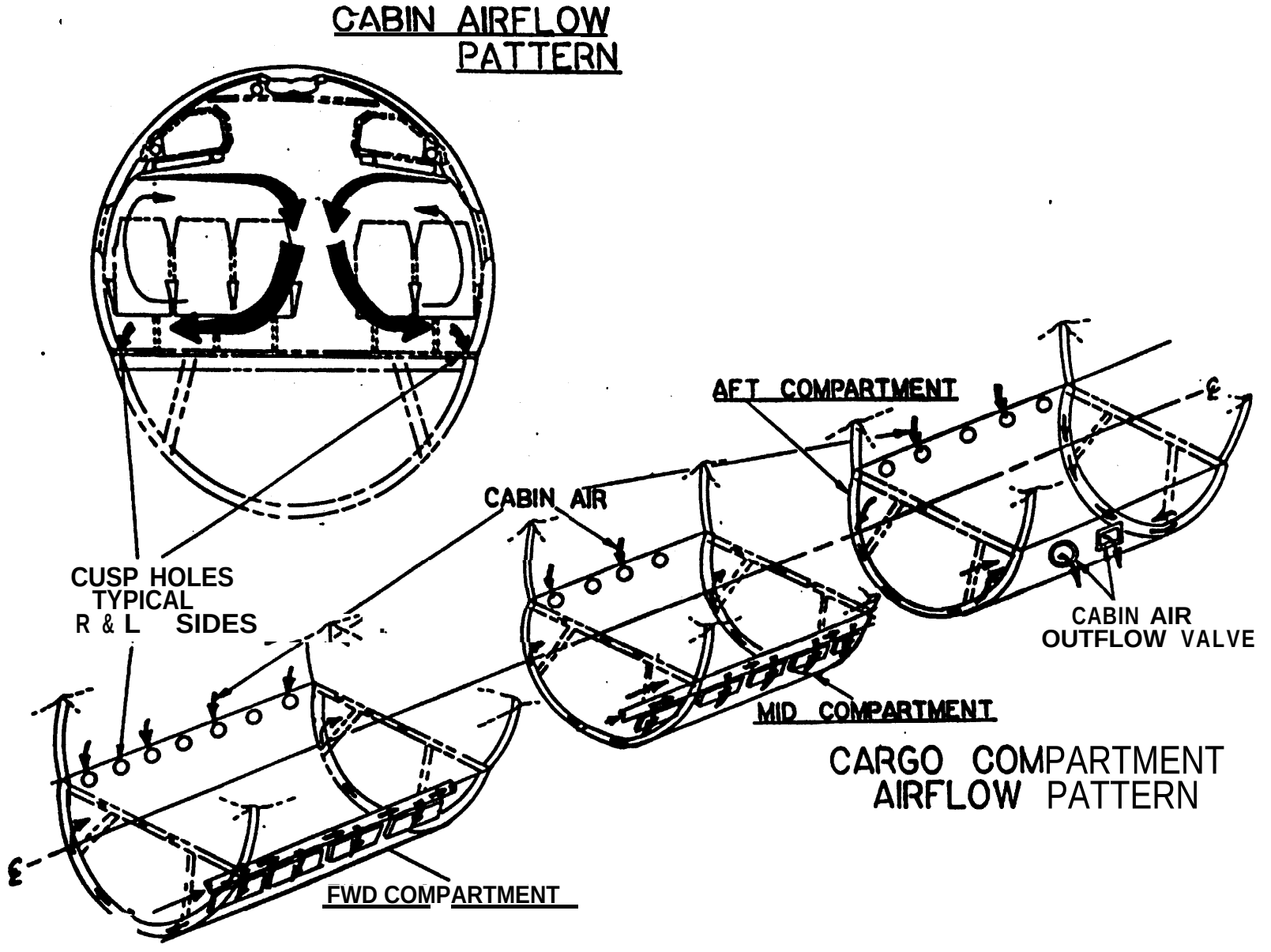

Figure 4—Cabin/cargo airflow pattern

vessel) from the electrical/electronics bay to the main gear wheel well. The bundles pass on the left, right, and top of the mid cargo compartment. The airplane's main power distribution system from the left and right engine-driven generators, the aft accessory compartment wiring, and the outflow valve control wiring are included in these bundles.

1.6.6 Maintenance

On May 9 and 10, 1996, the autopilot on the accident airplane was written up by flightcrews three times for "porpoising."[52] In the May 9 write-up, the corrective action statement indicated that a complete checkout of the autopilot system was performed in accordance with the maintenance manual, and that the system was determined to be "normal" during an operational check. The first of two write-ups on May 10 indicated that the autopilot was porpoising in cruise flight at flight level 330. The corrective action recorded for this discrepancy was to remove and replace the autopilot pitch computer. Later that day, the autopilot was described as "porpoising at all altitudes." At that point, the autopilot system was assigned to the minimum equipment list (MEL),[53] and placarded as inoperative.

During the flight from DFW to Atlanta on the morning of the accident, the crew wrote up the cockpit interphone (the service interphone allowing voice communication between flight attendants and the pilots) as being inoperative. Before departing from Atlanta, a mechanic removed and replaced the center pedestal handset. After connecting the new handset, the system was checked, and it still failed to operate. The inoperative interphone was then assigned to the MEL. According to ValuJet's FAA-approved MEL for the DC-9, the following operational procedure was required for the interphone system: "May be inoperative provided: a) alternate normal and emergency operations procedures are established and used; and b) the passenger address system is operative."

On the day of the accident, the airplane was delayed in departing the gate at Atlanta for the flight immediately before the accident flight because the right auxiliary hydraulic pump circuit breaker popped. After examining the pump, cleaning the cannon plug pins, and reconnecting the cannon plug, a mechanic was able to reset the circuit breaker without any further difficulty.

During the flight from Atlanta to Miami, the public address (PA) system stopped functioning. According to passengers on that flight, the flight attendants used a megaphone to communicate with the passengers while the airplane remained airborne, but discovered during the taxi to the gate that the PA system was once again operable. A SabreTech mechanic

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[52] Dynamic pitch changes, either induced by pilot input or the autopilot, resulting in an up and down movement of the airplane's nose.

[53] The MEL lists items of aircraft equipment that may be deferred when inoperable. The MEL is developed by each operator of an aircraft and must be equivalent to or more conservative that the master MEL, which is developed by the manufacturer.

responded to the captain's request to meet the plane when it landed and entered the electrical equipment bay just aft of the nose wheel well and checked the PA amplifier to see if it was hot. He reported that it was not hot, and that it was loose in its mount. He therefore secured the amplifier, and the PA system was once again operable. He said that he did not notice any unusual smells, noises, or vibrations while working in the equipment bay, and that the captain had said that no circuit breakers had popped en route to Miami. According to the mechanic, the pilot entered the corrective action the mechanic had taken into the airplane's log book, and the mechanic then signed the entry. The log book was retained on the airplane.

At the time of the accident, there were three open MEL items and one open configuration deviations list (CDL)[54] item being carried for N904VJ. Those items were as follows:

- Left fuel flow gauge inoperative.
- Cockpit interphone inoperative.
- Autopilot porpoising.
- Flap hinge fairing removed.

Maintenance records indicated that the airplane complied with all applicable airworthiness directives (ADs). AD 96-07-15, issued on May 15, 1996, called for the inspection of a wire bundle in the overhead switching panel of the cockpit to detect possible chafing or damage to the wire bundle that might lead to a fire. Maintenance records indicated that the inspection had been performed on this airplane on May 20, 1995, after issuance of a McDonnell Douglas Alert Service Bulletin on April 11, 1995. Maintenance records further indicated that no damage or chafing was found at that time, and that the protective spiral wrap called for in the service bulletin and the AD was applied to the bundle.

1.7 Meteorological Information

Pertinent surface weather observations at MIA were as follows:

> 1350—Record—clouds at 4,000 feet scattered; 14,000 feet scattered; visibility 12 miles; temperature 84° F; dew point 60° F; winds 100° at 8 knots; altimeter setting 30.08 inches of Hg.
>
> 1434—Special—clouds at 4,000 feet scattered; measured ceiling 8,000 feet broken; visibility 10 miles; temperature 85° F; dew point 60° F; winds 130° at 10 knots; altimeter setting 30.07 inches of Hg. (aircraft mishap)

[54] The CDL lists changes to the aircraft configuration that may be deferred.

No AIRMETs,[55] SIGMETs,[56] Convective SIGMETs, or center weather advisories were in effect for the time and area of the accident.

1.8 Navigational Aids

Not applicable.

1.9 Communications

ValuJet's revised flight attendant manual, issued on September 19, 1995, described the DC-9 onboard communications systems, including the PA system, the interphone, and the "call system." According to the manual, the PA system provides the means for the pilots and flight attendants to make announcements to the passengers through speakers in the passenger compartment and lavatories. The interphone system allows crewmembers to communicate verbally both between the cockpit and cabin and within the cabin. The call system provides non-verbal communication among crew and passengers. The call system includes call lights, call buttons, and chimes that are located throughout the cabin. The number of chimes, accompanied by a call light, conveys specific information. For example, two chimes, accompanied by a pink call light, indicate crew-to-crew communication. Six chimes, accompanied by a pink call light, indicate emergency crew-to-crew communication.

According to the FAA's principal operations inspector (POI) for ValuJet, the alternate means of communication referred to in the DC-9 MEL for an inoperative cockpit interphone might be a coded series of knocks on the cockpit door signifying either a normal entry or an emergency situation. It could not be determined if an alternate means of communication had been established by the flight and cabin crews on flight 592 to compensate for the inoperative cockpit interphone on the accident flight.

1.10 Airport Information

Not applicable.

1.11 Flight Recorders

1.11.1 Flight Data Recorder

The airplane was equipped with a Loral Fairchild Model F800 FDR, Part No. 17M903-274, (Serial No. 6132). The FDR records the following 11 parameters digitally on a loop of ¼-inch-wide magnetic tape that can record 25 hours of data before recording over the

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[55] Airmen's meteorological information advisory.

[56] Significant meteorological information advisory.

oldest data: pressure altitude, indicated airspeed, magnetic heading, lateral acceleration, vertical acceleration, pitch attitude, roll attitude, both engines' EPR, control column position, and VHF microphone keying.

Even though the recorder was substantially damaged, data were retrieved[57] and analyzed (see section 1.16.2). The underwater locator beacon (ULB) and attachment fittings remained attached to the crash survival memory unit, but its operative capabilities could not be determined. (Searchers were not able to locate the recorder using the ULB after the accident.) The interior of the crash enclosure was not damaged, nor was the magnetic tape recording medium.

1.11.2 Cockpit Voice Recorder

The airplane was equipped with a Fairchild Model A-100 CVR. The exterior of the CVR showed evidence of structural damage. The outer case was compressed and wrinkled along the longitudinal axis. A hole was punctured through the outer casing and through the structural portion of the memory module. A heavy coating of soot covered the front portion of the outer casing.[58] The interior of the recorder and the tape sustained only minor impact and no heat damage. The ULB was not attached.

The recording consisted of four channels of fair quality audio information. One channel recorded the cockpit area microphone, two other channels recorded the captain's and first officer's audio panel. The timing on the tape was established using the known time of several ATC transmissions. The recording started at 1340:29 and continued until the airplane crashed at 1413:40.[59] (See appendix B.)

1.12 Wreckage and Impact Information

1.12.1 General

The primary impact area was identified by a crater in the mud and sawgrass. The centerline of the crater was oriented along a north/south axis (10°/190° magnetic) with the narrow end of the crater located to the north. The crater was about 130 feet long and 40 feet wide. Most of the wreckage debris was located south of the crater in a fan-shaped pattern, with some pieces of wreckage found more than 750 feet south of the crater.

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[57] Because the FDR stopped recording almost a minute before the crash, data from the last minute of flight were not retrieved.

[58] The recording unit for the CVR on the DC-9 aircraft is located outside the pressure bulkhead in the tail of the aircraft.

[59] There was a 1 minute 12 second interruption in the CVR recording beginning at 1411:45. (This duration was known because synchronization was re-established with a subsequent ATC transmission.) There was a second interruption of unknown duration in the CVR recording beginning at 1413:11.

A ground penetrating radar indicated a layer of limestone rock located approximately 7 feet beneath the water surface. Divers assisting the investigation described a depression in the limestone rock at the impact crater, generally filled with broken rocks; surrounding areas were smoother and more intact. The bottom of the undisturbed Everglades floor consisted of a thick layer of sawgrass root structure and thatch. This natural sub-surface growth and decaying material prevented viewing beyond several inches below the surface of the water, and when the water was stirred up by the walking searches and the airboats, there was no visibility.

The majority of the wreckage was recovered by hand and placed on airboats that transported the pieces to a nearby levee for decontamination. The pieces were then transported by enclosed truck to a hangar for examination.

The airplane structure was severely fragmented. In general, fewer pieces of right side forward fuselage skins were identified, and pieces from the right side were generally more fragmented. The majority of identified pieces were from the wing and fuselage aft of the wing box.

Examination of the engines revealed no signs of in-flight or preimpact failure. Two engine fire suppression system extinguishing bottles were found; each with all its squibs and diaphragms intact.[60] Both engines showed evidence of rotation and the ingestion of interior cabin material, swamp grass, mud, and other debris when they impacted the ground.

The tires and wheel assemblies from the landing gear system of the accident airplane were recovered. The tires exhibited numerous rips and tears. Main landing gear actuators were found in positions corresponding to retracted landing gear.

Investigators attempted to identify flight control cables with respect to function, fuselage station, turnbuckles or other identifying hardware, unraveling of the ends, and distance to each prominent kink or cut, but were unable to conclusively identify the function of all cables. Although numerous floor beam fragments, including some fragments from the burned area of the cabin floor, had imprints of control cables at the edges of cable cut-outs (consistent with the cable being under tension at the time of impact), control cable continuity could not be established for all cables. Although the investigation recovered pieces from each of the flight controls, it was not possible to fully reconstruct and document all of the pieces because of the degree of their fragmentation.

The majority of both the left and right wings were recovered. About 75 percent of the right aileron and approximately 50 percent of the left aileron were identified. Actuators for the landing gear, slats, and flaps were found in their retracted positions. Three of the wing spoilers were found in the retracted positions, and one was found at 40^{o} deflection, with impact damage to the forward end of the actuator attachment.

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[60] A squib is a small explosive charge that, when triggered, ruptures the diaphragm (a frangible seal), allowing the pressurized extinguishing agent to flow to the appropriate engine or location.

Most of the right and left horizontal stabilizers were recovered in fragments, including center sections, spars, skin panels, and both hinge fittings. No marks were found to identify pitch trim or elevator orientation at the time of impact with the swamp.

Several pieces of the rudder were recovered. The largest piece measured 57 inches by 43 inches. The preimpact position of the rudder was not determined.

Examination of pressurization system components found evidence that one of the two air conditioning/pressurization systems was operating at the time of impact. Evidence included one flow control valve in the open position (the other valve was found closed) and rotational scoring in the housing around the impeller of the air cycle machine turbines (no rotational scoring was observed in the housing of the other air cycle machine).

The DC-9 has a set of valves that control the outflow of air from the pressurized fuselage. Two sets of soot and damage marks were found on the outflow valve nozzle; one toward the closed position and one near the fully open position. According to the manufacturer, the nozzle would be open whenever the larger circular butterfly valve was open and the nozzle would only begin to close after the butterfly valve was fully closed. A clear sooted silhouette of the circular outflow butterfly valve was found in an open position on the valve frame.

The wreckage of the environmental control system (ECS) ducting near the scoop at the base of the vertical tail was found with a gray to black residue. Two ECS valves had a heavier black residue.[61]

Passenger service units from the cabin were found with the oxygen masks in the stowed positions. The mask from the cockpit walk-around oxygen bottle was found with the adjustment straps at their loosest positions.

Three hand-operated fire extinguishers were found, all with severe impact damage. Because of the impact damage, laboratory analysis could not positively determine if the extinguishers had been used.

The door handle mechanisms for the forward passenger door and the forward service door were recovered and found in the stowed position.

1.12.2 Forward Cargo Compartment

All recovered wreckage identified as being from the area of the forward cargo compartment was assembled into a full-scale, three-dimensional mockup. (See figure 5.) The forward cargo compartment extended from fuselage station (FS) 218 to 581. The forward edge of the forward cargo door was located at FS 373 and the aft edge was located at FS 425. Most of

[61] Detailed information regarding fire and heat damage is contained in section 1.14.

Figure 5—Cargo compartment mockup

these pieces, which included the cargo floor, cargo liners, and fuselage structure, exhibited soot and heat damage.

About 50 percent of the forward bulkhead and about 25 percent of the aft bulkhead of the forward cargo compartment were recovered. A section of the forward cargo compartment left sidewall liner from FS 218 to 313 had all of the sidewall struts still attached. A left sidewall strut from FS 332 was recovered with sidewall liner from FS 313 to 351 still attached. A piece of center ceiling liner from FS 484 to 503 was located, with a portion of the floor beam at FS 503 attached.

A 25-inch section of the right side floorbeam at FS 294 containing the cargo compartment pressure equalization valve and a portion of fiberglass ceiling liner still attached was recovered. Although pieces of outboard left and right floor beams were identified, very few floor beams from the center of the cabin floor area above the forward cargo compartment were identified.

Portions of the left side floorbeams were identified for locations between FS 218 (the forward end of the compartment) to FS 446, except FS 237 and 332. Portions of right side floorbeam pieces were identified for locations from FS 294 to 408, except FS 389.

The forward cargo compartment door handle mechanism and about 3 feet of door structure were recovered; the handle was found in the stowed position. A portion of the lower door jamb and sill was also recovered.

Recovered airplane wiring was examined for heat and fire damage and evidence of arcing. Heat and fire damage was observed on many of the wire bundles and cables that ran adjacent to the forward cargo compartment. (All of the wire bundles running along the left side of the cargo compartment, and some of the bundles running along the right side showed heat and fire damage.) The most severe damage to the wiring began at FS 351 and extended forward to FS 300. The fire damage on the power feeder cable conduit extended 10 inches farther forward, ending at FS 290. The heat-damaged wires and cables showed no evidence of electrical arcing, and the burn patterns on those wires and cables were consistent with those resulting from an external heat source.

1.13 Medical and Pathological Information

Human remains were recovered from the accident site over approximately 7 weeks. Although the remains that were recovered were fragmented and had been exposed to extreme environmental conditions, the Dade County Medical Examiner, with the assistance of the Federal Bureau of Investigation, was able to identify 68 of the 110 persons on board flight 592.

A small amount of human tissue was identified as that of the first officer. However, because of the insufficient amount and the condition of the tissue, toxicology testing was not possible. None of the remains recovered were identified as those of the captain.

The Safety Board requested toxicology sampling of the passenger remains in an effort to determine the carbon dioxide and hydrogen cyanide levels that might have been present in the airplane. According to the Dade County Medical Examiner, all of the human tissue and bodily fluids recovered were unsuitable for testing.

1.14 Fire Damage

1.14.1 Cargo Carried in Forward Cargo Compartment

Of the 28 pieces of chemical oxygen generators recovered at the accident site (18 nearly whole units and 10 smaller pieces), 9 generators had indentations in their percussion caps consistent with indentations caused by the actuation mechanism. Of those 9 generators, 3 had sooting or evidence of fire damage. Seven other generator pieces had sooting or evidence of fire damage. Only 3 generators had serial numbers that were completely identifiable.

The DC-9 nosegear tire that was being transported as COMAT in the accident airplane's forward cargo compartment was found just south of the impact crater. The tire, found without a wheel rim, exhibited substantial fire damage. One of the DC-9 main gear tires that were being transported in the forward cargo compartment was found with evidence of fire damage on one sidewall, extending halfway down the tread area. The fire damage covered an arc on the sidewall of approximately 60^{o}. The tire was also found without a wheel rim. The bead area[62] of the tire was intact and exhibited minor abrasive damage. An unburned piece of lower fuselage longeron (about 1 foot long) was found imbedded in the tire. Debris found inside the tire included a heat-damaged stainless steel oxygen generator end cap with striker bracket attached, an ignitor guide, a metal part similar to an oxygen generator end cap or a heat shield normally located under the end cap,[63] a small piece of resolidified molten metal (not aluminum), an unburned piece of longeron, a small spring, two rivet heads, an aircraft bolt, and several more unidentified pieces of metal.

The other DC-9 main gear tire carried as COMAT in the forward cargo compartment was found mounted on a wheel rim and exhibited extensive burn damage on both sidewalls. The tire had a tear along one sidewall with an X-shaped tear across the tread area. The sidewall tear extended across the area of the sidewall that exhibited the most fire damage. Nine of the original 12 sidewall plies exhibited fire damage from the outside of the tire inward along the edge of the tear in the sidewall. The edges of the tire along this tear were deflected outward, consistent with the tire having ruptured along this tear in the sidewall. There was no fire damage on the inside of the tire or along the inside of the torn edges of the sidewall. Part of the outer rim of the wheel was bent in toward the axle area and partially fractured. The wheel was also lightly sooted.

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[62] The bead area is the area in contact with the wheel rim.

[63] These small chemical oxygen generator parts were in addition to the 28 larger pieces discussed earlier.

1.14.2 Forward Cargo Compartment

Recovered pieces of the fiberglass liner from the forward bulkhead of the forward cargo compartment were sooted on the inward face of the liner, but the forward face of the liner had no soot or fire damage. The concentration of soot on the inside of the aft bulkhead liner was similar to that on the inside of the forward bulkhead liner. The left sidewall liner from FS 294 to 313 was charred on both sides; the remaining portion of the liner was sooted on the cargo side and had no soot or fire damage on its exterior side. The right sidewall compartment liner from FS 427 to 497 was heavily sooted on the compartment side and had no soot or fire damage on its exterior side. A section of ceiling liner near the center of the ceiling from FS 427 to 484 was sooted and burned on its forward left corner. The bottom of the center ceiling liner from FS 484 to 503 was sooted and the cabin floor beam in that location was sooted both forward and aft, but more so on the forward side. The resin was burned out of the portion of fiberglass ceiling liner that was still attached to the right side floorbeam at FS 294.

A 19-inch by 39-inch piece of cargo compartment liner, the exact position of which could not be determined, was found with molten plastic adhered to its interior surface in several locations. In some places, the melted plastic was burned and its original color could not be discerned. However, in other places, the melted plastic was blue or purple in color, consistent with the color of the plastic wheel covers used for the main and nosegear tires being carried in the forward cargo compartment. Additional pieces of purple and blue plastic were found sooted and partially burned and melted. One of the purple pieces had the word "INNER" stamped into the plastic. On two purple pieces, holes in the plastic were spaced consistent with the spacing of bolts on the DC-9 nose wheel assembly.

A section of the left side frame at FS 313 from longeron 20 to 29 was sooted. A 17-inch section of left side floor beam from FS 313, including the sidewall strut attach point was heavily sooted with extensive broomstrawing[64] on the inboard fracture surfaces. The fracture surface was 6 inches inboard of the sidewall strut.

Two sections of left upper side floor panel from FS 218 to 332 were sooted on the cargo compartment side, with the heaviest sooting in the aft outboard corner. A section of aluminum flooring between FS 418 and 512 was sooted, and the forward portion of this piece was crushed in a rearward direction. The aft right upper floor panel from FS 465 to 512 was relatively free of soot. A section of cargo floor from FS 370 to 408 was sooted. Attached to this piece of floor was a portion of cargo compartment sidewall strut and a portion of fuselage frame from FS 370. The paint on the sidewall strut was discolored from heat.

The floorbeam at FS 218 was sooted on its aft surface, with traces of soot also on its forward surface. Fire damage to recovered floorbeams between FS 256 and 446 included soot and heat damage. Evidence of broomstrawing was observed on the inboard end of the floorbeam

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[64] A phenomenon that describes the appearance of metal that is partially melted and then subjected to shock loading and fracture.

piece at FS 313; a section of seat track attached to this floorbeam piece also had evidence of broomstrawing on its fracture surface near FS 322.

The upper part of the recovered portion of the forward cargo door barrier was sooted. A portion of the outer skin of the cargo door had a small area of soot along the lower edge. Primer paint on a recovered portion of the cargo door inner skin exhibited heat discoloration. Evidence of light sooting was found on a small section of the aft frame of the cargo door opening, but no soot was found on the cargo door and sill.

Evidence of soot and heat damage was found on the sidewall struts for the forward cargo compartment. The greatest heat damage was found on the struts between FS 351 to 408, which had evidence of broomstrawing on the fracture end (near the floor beam) on the strut piece at FS 351.

The cargo compartment pressure equalization valve was heavily sooted and damaged by heat.

No fire or soot damage was observed on the recovered pieces of the bladder tank and attached structure of the auxiliary fuel tank in the aft end of the forward cargo compartment.

1.14.3 Aft Cargo Compartment

Recovered sections of the aft cargo compartment were also free of soot, heat, or fire damage.

1.14.4 Fuselage

Soot was found on the interior of pieces of the left fuselage skin between FS 237 to 408 and below longeron 18 (cabin floor level). The heaviest sooting was found on the left side of FS 256 to 332, on longeron 24 to 26, and from FS 370 to 408, on longeron 25 to 28. Some of these areas also contained black, greasy deposits.

The alternate static ports, located on the exterior of the fuselage near left and right FS 341, had soot trails extending aft on their exterior skin surfaces. No soot or heat damage was observed on the exterior of the left and right primary static ports, located at FS 456. However, the primary static port at left FS 456 contained blackened deposits on the inside skin area.

The fuselage area near the cabin outflow butterfly and nozzle valves had a heavy soot trail extending aft on the left fuselage exterior surface near FS 980. Soot was found on both valve assemblies.

No evidence of soot or fire damage was found on the recovered electric and electronics compartment components and structure located just under the cockpit and forward of

the cargo compartment. No evidence of soot or fire damage was found on the wing pieces or flight control pieces from both wings.

There was no evidence of fire damage on the pieces of the forward cockpit instrument panels or overhead switch panels. Light sooting was evident on the passenger oxygen bottle from behind the first officer's seat, and the top of the bottle was darkened. Only trace amounts of soot were found on circuit breaker panels from behind the captain's seat. None of the recovered pieces of circuit breaker panels from behind the captain's seat exhibited any damage by heat, arcing, or soot. No evidence of heat damage was found on the mask from the cockpit walk-around oxygen bottle that was recovered.

There was no evidence of fire damage to the tires or wheel assemblies from the landing gear system of the accident airplane.

1.15 Survival Aspects

The accident was not survivable.

1.15.1 ValuJet's Procedures for Lap Children

ValuJet's passenger manifest for the accident flight listed the names of 104 passengers. Immediately after the accident, ValuJet personnel informed the Safety Board that flight 592 was carrying 104 passengers and 5 crewmembers. However, on May 13, 1996, ValuJet revised the total passenger count to 105 because it was discovered that one of the passengers had been traveling with a lap child (a child under the age of 2 not assigned to a seat position).[65] According to ValuJet, inquiries made by the child's relatives were the basis for the revised passenger count. The "lap child" (who in fact was 4 years old) was not listed on the passenger manifest, nor was there any other written record maintained by ValuJet to reflect the presence of this child aboard the flight.

Title 14 CFR Part 121.693(e) states that the load manifest that is maintained by an air carrier for each flight must contain, in part, "names of passengers, unless such information is maintained by other means by the air carrier…."

According to FAA Air Carrier Operations Bulletin (ACOB) 8-91-2, "Accident Notification and Manifest Accounting Procedures," air carriers are required to include the names of passengers on the load manifest. This ACOB references FAA Action Notice 8430.29, which states, "The word 'passenger' as used throughout the Federal Aviation Regulations, means any passenger regardless of age…."

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[65] Title 14 CFR Part 121.311(b)(1) states that a child aboard a U.S. civil aircraft may "be held by an adult who is occupying an approved seat or berth if that person has not reached his or her second birthday."

At the time of the accident, ValuJet used an open seating policy and controlled passenger boarding with numbered, plastic cards. The Safety Board learned that some time after the carrier began operations, but before the accident, ValuJet management had expressed concern about boarding control of lap children, and that in response to this concern, the air carrier implemented a procedure in which the adult associated with each infant passenger was issued an unnumbered plastic boarding card at the time of check-in. This card would be collected at the time of boarding, thus providing the air carrier with a post-departure record of the number of passengers (including lap children) aboard the flight. However, the procedure did not provide ValuJet with the names of lap children boarded on its flights.

The Safety Board has identified inaccuracies with passenger manifests to include lap children in previous accident investigations and has issued Safety Recommendations A-79-65 and A-90-105 to the FAA to require standardized reporting by air carriers of passengers on manifests.[66] The Safety Board also issued Safety Recommendation A-95-56 to an air carrier to review its procedures regarding passenger manifests to ensure their accuracy and accountability of all occupants on the airplane.[67]

1.15.2 Onboard Firefighting and Smoke Removal Procedures

1.15.2.1 ValuJet's Flight Attendant Manual

ValuJet's flight attendant manual, in effect at the time of the accident, outlined procedures for extinguishing an in-flight fire or a small fire on the ground. The manual set forth procedures, which included the following proviso:

- "Do not open cockpit door if smoke or harmful gases are present in the forward cabin; use the interphone."

1.15.2.2 ValuJet's Aircraft Operating Manual

ValuJet's aircraft operating manual for the DC-9 outlines emergency procedures for use in the event of electrical smoke or fire and for air conditioning smoke, including cabin and cockpit smoke removal procedures (for both a pressurized and nonpressurized airplane). Both procedures call for the immediate donning of the oxygen masks and smoke goggles[68] by the cockpit crew followed by a series of steps, including depressurizing the airplane by opening the outflow valve. (See appendix G.)

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[66] Safety Recommendations A-79-65 and A-90-105 were classified "Closed—Acceptable Action" on April 6, 1981, and April 1, 1992, respectively. ACOB-8-91-2 was developed in response to the Safety Board's Safety Recommendation A-90-105.

[67] The air carrier responded to Safety Recommendation A-95-56 in a letter dated June 24, 1997. As of July 15, 1997, the response is being evaluated; thus, the recommendation is classified "Open—Initial Response Received."

[68] Oxygen masks and smoke goggles are discussed further in section 1.15.3.

ValuJet's emergency procedures and flightcrew training manuals did not explicitly instruct flightcrews to immediately land at the nearest airport in the event of an uncontrollable fire in flight.

At the time of the accident, there were no FAA requirements for aircraft manufacturers or air carriers to establish emergency procedures for dealing with a rapidly propagating fire. Further, appendix E of Part 121 (Flight Training Requirements) did not explicitly require air carriers to train flightcrews in coping with these fires or responding to fires with emergency approaches and landings. An informal survey by the Safety Board of air carrier training programs and manuals found that many air carriers did not provide flightcrews with comprehensive instruction or practice in dealing with a rapidly propagating fire, during initial or recurrent ground school and simulator training. Emergencies involving smoke procedures were established and training was provided, in accordance with current FAA requirements.

1.15.2.3 Douglas Aircraft DC-9 Flightcrew Operating Manual

The Douglas flightcrew operating manual (FCOM) in a section titled, "Airplane General-Abnormal Procedure-Pass. Cabin Smoke or Fume Evac. Procedure," specifies opening the (right) forward service and the passenger aft (tailcone) entrance doors as a procedure to remove cabin smoke. The procedure calls for the following steps, when the airplane is below 10,000 feet:

1. Manually depressurize
2. Airspeed (Flaps and slats as required)……..160 to 250 KIAS
3. Right Forward Service Door Slide Girt Bar ……DISENGAGE/STOW
4. Remove all loose items within 3 feet of door and ascertain that all passengers are seated with seat belts fastened.
5. Right Forward Service Door……UNLATCH
   NOTE: High handle loads are required to unlatch door. When unlatched, allow door to seek its own position against airstream. The door will remain centered over the opening.
6. Passenger Aft Entrance Door……..UNLOCK AND OPEN
   NOTE: Moderate high handle loads required to unlock door. Door will open inward and airflow will sweep smoke forward.

This procedure is not mentioned in the Emergency Procedures section of Douglas's FCOM or in any ValuJet manual. Procedures for smoke removal from passenger compartments are not required by the FAA to be part of an airplane type's aircraft flight manual (AFM), which contains all of the emergency procedures required to be furnished to the pilot. As part of this investigation, a Safety Board review of U.S. air carriers found that some U.S. operators include the Douglas smoke removal procedure in their manual and others do not. For example, the Northwest Airlines and USAirways DC-9 (Series 80) pilot's handbook and the Midwest Express Airlines DC-9 and MD-80 quick reference handbooks include the procedure. Delta Air Lines and ValuJet handbooks do not include the procedure. SwissAir has also

incorporated this procedure in its company AFM, and handbooks for the military version of the DC-9, known as the C-9, incorporate this procedure.

The Douglas smoke removal procedures were developed as a result of DC-9 flight tests conducted in 1975 by the Douglas Aircraft Company.[69] Douglas engineers noted that the normal outflow of cockpit air through the electrical compartment would clear smoke from a continuous source of smoke from the cockpit in 13-25 seconds. The flight tests also revealed that opening a cockpit window would effectively remove cockpit smoke if the smoke originated in the area of the cockpit.

Douglas engineers reported that various tests were conducted involving the in-flight opening of cabin compartment doors to clear smoke from the cabin. The tests found that opening the overwing escape hatches was possible in a depressurized airplane, but was not safe. However, they found that slightly opening the forward right galley (service) door was an effective means of quickly removing cabin smoke, especially when the aft bulkhead (tailcone) door was also opened. Opening this door created a forward flow from the tailcone door and cleared smoke from the cabin, but did not remove smoke from the cockpit. The tests found that opening the service door wide enough for a person to pass through was not possible, and even at lower airspeeds of about 130-160 knots, the door could not be pushed open more than several inches. Douglas engineers reported that before opening the doors, the smoke generated during the tests was thick enough that they could not see their feet when seated.

In a separate test conducted by SwissAir, after depressurization that required 25 seconds, smoke that originated in the cockpit cleared within 2 seconds of opening the window. However, in tests with smoke created in the cabin or with the cockpit door louvers open, smoke was drawn into the cockpit as soon as the cockpit window was opened.

1.15.2.4 Guidance for Smoke Removal on Other Airplanes

Emergency procedures contained in the Air Canada Boeing 747 Flight Attendant Manual include a section titled, “Smoke Evacuation Procedures.” The procedures contain the following:

> If cabins cannot be cleared of smoke or fumes to a tolerable level, the Captain may decide to descend to a lower altitude and de-pressurize the cabins. At this time, a cabin door can be opened to allow for removal of smoke or fumes in cabins. If Captain has elected to lower aircraft altitude and de-pressurize the cabins, s/he (or delegate) will:
> Make an announcement to advise passengers
> Advise Cabin Crew on which door(s) to open

[69] Douglas Flight Development Data Transmittal, Test Report No. 171A (Revision), dated 7-17-75, for flight test No. 5.2.1, flight 58.

The above text is followed by the specific steps on how the cabin doors are to be opened.

The Tower Air, Inc., Boeing 747 flight manual, emergency/abnormal procedures section, includes the procedure for upper and main deck smoke evacuation. This procedure involves opening main cabin doors to evacuate the smoke. This procedure is not included in the FAA-approved Boeing 747 AFM.

1.15.2.5 Safety Board Recommendations on Smoke Removal Procedures

The Safety Board addressed the adequacy of smoke removal procedures in AFMs following an in-flight fire that originated in the left rear lavatory of an Air Canada DC-9 that forced the flightcrew to make an emergency landing on June 2, 1983, at the Greater Cincinnati Airport. The interior materials of the airplane's cabin continued to burn after the landing. Five crewmembers and 18 passengers were able to evacuate the burning cabin; the remaining 23 passengers died in the fire. As a result of its investigation of that accident, the Safety Board issued Safety Recommendation A-83-77 on October 31, 1983. The safety recommendation asked the FAA to do the following:

> Evaluate and change as necessary the procedures contained in the FAA-Approved Airplane Flight Manuals (AFM) of transport category airplanes relating to the control and removal of smoke to assure that these procedures address a continuing smoke source and are explicit with regard to the presence of fire and the optimum use of cabin pressurization and air conditioning systems.

In its letter of March 12, 1987, the Board responded to the FAA:

> The Safety Board is pleased to learn that the U.S. manufacturers of transport category airplanes have all either completed the revision of their [AFMs] to include smoke removal procedures or have committed to do so at the next AFM revision. The Board is additionally pleased that the necessary AFM revisions for the remaining transport category airplanes will be completed by May 1987 and that the Federal Aviation Administration plans to work with the foreign airworthiness authorities in developing similar requirements. Based upon this action, Safety Recommendation A-83-77 has been classified as "Closed—Acceptable Action."

1.15.3 Smoke Goggle Equipment and Training for Air Carrier Pilots

ValuJet DC-9 airplanes were equipped with quick-donning type oxygen masks at each pilot station. Smoke goggles were stored in a compartment on the cockpit sidewall outboard of each pilot's seat. The smoke goggles were designed similar to those used at many air carriers and in many aircraft types. They had clear plastic lenses, an adjustable elastic head strap, and a vent at the bottom of the unit to accept oxygen from the purge valve of the oxygen mask. Smoke goggles were to be donned after donning the oxygen mask, by placing the head strap behind both the pilot's head and the bracket assembly of the oxygen mask.

According to ValuJet pilots, at the time of the accident, the smoke goggles provided to them were enclosed in a plastic bag for protection from scratching and dust. Some of the plastic bags were sealed and, according to the pilots, extremely difficult to open. Pilots told investigators that they had to use their teeth to open the bags, a task that was impossible to perform while wearing an oxygen mask. According to the pilots, other smoke goggles in service at ValuJet were stored in a zipper bag that was easier to open. The Safety Board was unable to determine which storage method was used for the smoke goggles installed on the accident airplane because neither the smoke goggles nor their storage materials were recovered at the accident site. [70]

An informal, postaccident review by Safety Board staff of smoke goggle storage methods in the air carrier industry indicated that a sealed plastic bag was used to store smoke goggles not only at ValuJet, but also at other air carriers. Before the accident, to reduce scratching of the goggle lenses, some air carriers had discouraged pilots from opening the plastic bags. After the accident, one air carrier contacted by the Board staff had authorized the smoke goggles to be stored in an open plastic bag that was contained in a fabric pouch with a Velcro closure. Another had changed the storage bag to a type that was easier to open.

The Safety Board staff also reviewed an alternative to the two-piece oxygen mask and smoke goggles: a single-piece oxygen delivery system with an integral full-face mask. This design has been certificated by the FAA for use in several transport-category aircraft, and it has been ordered as standard equipment by some U.S. air carriers contacted by the Safety Board staff.

According to the ValuJet operations training manual, pilots received ground instruction in the use of smoke masks and goggles during the "Initial New-Hire General Emergency Training" module. Also, according to the training manual, pilots received a simulator training session involving smoke in the cockpit during their DC-9 initial training. This session required the pilots to don the oxygen masks and smoke goggles, then to fly the airplane in a descent and approach. According to ValuJet records, both of the pilots involved in the accident received this initial ground instruction and simulator training.

The Safety Board's review of the ValuJet training manual indicated that the air carrier did not require recurrent ground training in the use of smoke goggles. Similarly, ValuJet did not require recurrent practice in donning this equipment during a simulated emergency.

An informal Safety Board survey of the air carrier industry revealed that before this accident, air carriers generally had not provided recurrent simulator training that involved donning the smoke goggles. Some had provided the opportunity for pilots to practice donning the smoke goggles at a fixed workstation. Following the accident, some air carriers had added to their recurrent training programs a line-oriented simulation exercise involving smoke in the cockpit or cabin and the donning of smoke goggles.

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[70] Since the accident, ValuJet has replaced the sealed plastic bags with a canvas bag that is sealed by Velcro.

The Safety Board evaluated the procedures involved in donning the oxygen mask and smoke goggles using the DC-9-32 simulator employed by ValuJet for pilot training in Atlanta, Georgia. The Board's evaluation pilot performed the ValuJet electrical smoke/fire procedure while in simulated flight, accompanied by a ValuJet flight instructor. The evaluation pilot found that while the oxygen mask was easy to don, the smoke goggles required considerable manipulation to fix in place and adjust to the proper size. Further, the lateral pressure that was produced by the goggles' strap worn over the oxygen mask caused the goggles to press on the pilot's eyeglasses, distorting his vision and making it difficult to fly by reference to the flight instruments.[71] The initial attempt to don the oxygen mask and smoke goggles (which were not sealed in a plastic bag) required more than 30 seconds of effort; during this period, all other flight deck tasks had to be performed by the other pilot. Meanwhile, the other pilot was not able to begin donning the oxygen mask or goggles during this period. Finally, the evaluation pilot noted that once the process of donning the masks and goggles had begun, communication between the crewmembers was impaired until the process was complete and additional steps were taken to establish communications using the oxygen mask microphones. The evaluation pilot noted that the speed and ease of donning the smoke goggles improved with practice.

Air carrier pilots interviewed by the Safety Board concurred that smoke goggles were awkward to don over oxygen masks, particularly for pilots wearing glasses. Another concern was the difficulty of aligning the purge valve of the oxygen mask with the smoke goggle's vent; this action was essential on two-piece mask/goggle units to clear smoke from the goggles. One air carrier training manager noted that the time required to don the smoke goggles was directly related to the amount of elapsed time since the pilot had last practiced with this equipment. Generally, pilots believed that the current oxygen masks and smoke goggles were adequate, given recent instruction and practice in using the equipment (especially the purge valve), but those who had used the single-piece full-face mask believed that this equipment was simpler to use, provided faster protection for the eyes, and avoided the complications of the purge valve.

1.16 Tests and Research

1.16.1 Oxygen Generator Fire Tests

A series of five tests involving oxygen generators was conducted at the FAA's fire test facility near Atlantic City, New Jersey, on November 6 and 7, 1996, under the direction of the Safety Board. The tests were carried out in an instrumented[72] and fire-protected DC-10 test

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[71] According to both his training partner at ValuJet and his family, the first officer involved in this accident wore reading glasses. It is not known if he was wearing them on the accident flight.

[72] The cargo compartment was instrumented with the following: (1) multiple thermocouples for temperature measurements, (2) a water-cooled calorimeter located about 40 inches above the floor (the distance between the floor of the DC-9 cargo compartment and the ceiling) and above the packaged oxygen generators, (3) continuous oxygen measurements, (4) continuous carbon monoxide and carbon dioxide measurements, and (5) smoke measurement.

chamber cargo compartment with a volume of about 2,357 cubic feet. (As noted earlier, the volume of the cargo compartment in the DC-9 airplane is about 560 cubic feet.) The door to the cargo compartment was left open for video recording purposes.

The first two tests each involved 1 box with 28 generators.[73] The next three tests each involved 5 boxes with 24 generators in each box. About 2 inches of plastic "bubble wrap" packing was placed above the top row of generators in each box, and the boxes were sealed. All tests were initiated by pulling the retaining pin on one of the generators located at the top of a box.

1.16.1.1 Test Conditions and Results

In the first test, the box of oxygen generators was placed on top of a small steel framed table below the calorimeter and thermocouple. In this test, the top of the box of oxygen generators was about 1 foot below the calorimeter/thermocouple. A thermocouple was also placed in the top of the "ignition" box. The test was initiated by pulling the firing pin on a generator located in the top of the box.[74] The first test did not result in a fire propagating beyond minor smoke generation. This test was terminated and the expended generator and heat-damaged bubble wrap were replaced. The test was repeated and this second test resulted in a fire.[75] The temperature in the top of the box increased to about 2,000 °F, 10 minutes after ignition. The temperature about 1 foot above the box (approximately the distance to the ceiling of the DC-9 compartment) exceeded 2,000 °F within 15 minutes after ignition.

In the third test, the five boxes of oxygen generators were stacked on the floor of the test chamber directly below the calorimetric/temperature measurement equipment. Insulation boards were put around the boxes to prevent the oxygen generators from rolling away when the cardboard boxes were burned through. Again, thermocouples were placed in the box containing the "ignition" generator, about 1 foot above the boxes. The third test resulted in some minor smoke generation. After 13 minutes, the test was terminated, and the expended generators and bubble wrap were replaced. The test was repeated (fourth test) and a fire occurred. The temperature above the box reached about 2,000 °F about 13 minutes after the pin was pulled with a peak temperature of about 3,000 °F after 16 minutes.

Two types of thermocouples were used: type K (chromel/alumel) and type B (platinum—6 percent, rhodium/platinum—30 percent rhodium) for higher temperatures.

[73] Some of the oxygen generators used in the tests were taken from Boeing aircraft and were designed slightly differently from the Douglas oxygen generators being transported aboard the accident airplane, and a Douglas generator was always used as the ignition generator. However, both types of oxygen generators were made by Scott Aviation.

[74] A wire was attached to the pin and easily pulled to initiate the test.

[75] Auto-ignition of the bubble wrap in contact with the hot surface of the generators in the presence of elevated concentrations of oxygen was the source of the ignition.

In the final test, two boxes of oxygen generators were placed on top of a main gear tire pressurized to 50 psi.[76] The other three boxes of generators were placed around the tire. Luggage was stacked around the tire and boxes of oxygen generators. The box containing the "ignition" generator contained only generators manufactured for Douglas airplanes. The other four boxes contained generators from Boeing airplanes. About 10 minutes after ignition, the ceiling in the DC-9 type cargo compartment reached about 2,000 °F; after 11 minutes, the temperature was about 2,800 °F. About 11.5 minutes after ignition, the temperature at this location exceeded the temperature measurement capabilities of the system (greater than 3,200 °F). Sixteen minutes after the ignition generator was activated, the tire ruptured.

1.16.2 Airplane Flight Performance

Recorded radar data, CVR comments and sounds, and FDR data were used to develop a time history of flight 592's performance. (See figures 6a and 6b.) The performance of the flight was normal until 1410:03, when an unidentified sound was recorded on the CVR. According to the FDR, just before the sound, the airplane was climbing through 10,634 feet msl, 260 KIAS, and both EPRs were 1.84. Simultaneous with the noise on the CVR, the FDR recorded a 33-knot decrease in indicated airspeed and a pressure altitude drop of 817 feet. The FDR airspeed and altitude data returned to normal values within 4 seconds. An increase of 69 pounds per square foot (psf) in the static pressure sensed by a static pressure sensor on the airplane would result in an 817-foot decrease in altitude (as recorded by the FDR). Further, an increase of 69 psf in static pressure would result in a decrease in airspeed of about 40 knots and this is consistent with a curve fit of the airspeed decrease recorded on the FDR. Therefore, the recorded perturbations in altitude and airspeed at 1410:03 are consistent with a short duration increase in the static system pressure of 69 psf.

Almost immediately after the anomaly in FDR altitude, occasional data dropouts and "noise" became evident in several parameters, including control column position. Further, the FDR data indicate that at 1410:26, the EPR values on the right engine began to decrease, dropping to 0.97 over the next 4 seconds. The left engine EPR decreased slightly to 1.79. Coincident with the change in right engine EPR, the lateral acceleration increased from near zero to an approximate value of 0.05 G. (An asymmetry in right and left engine EPR levels, as well as a positive lateral acceleration, remained until the end of the recorded FDR data.) At 1410:31 the airplane stopped climbing after reaching a peak altitude of about 10,879 feet msl and then began to descend.

The FDR and radar data indicated that flight 592 began to change heading to a southerly direction about 1411:20. Shortly thereafter, the FDR recorded increases in vertical acceleration to a maximum of 1.43 Gs and an approximate 5° reduction in control column position from 1.54° to –3.8° (i.e., nose down); the vertical acceleration decreased to about 1.0 G.

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[76] Based on a Goodyear representative's statement that damage to one of the main gear tires that was carried as COMAT in the forward cargo compartment was consistent with a tire rupturing under a pressure of between 30 and 50 psi, 50 psi, which is above atmospheric but below operational pressure, was used in the test.

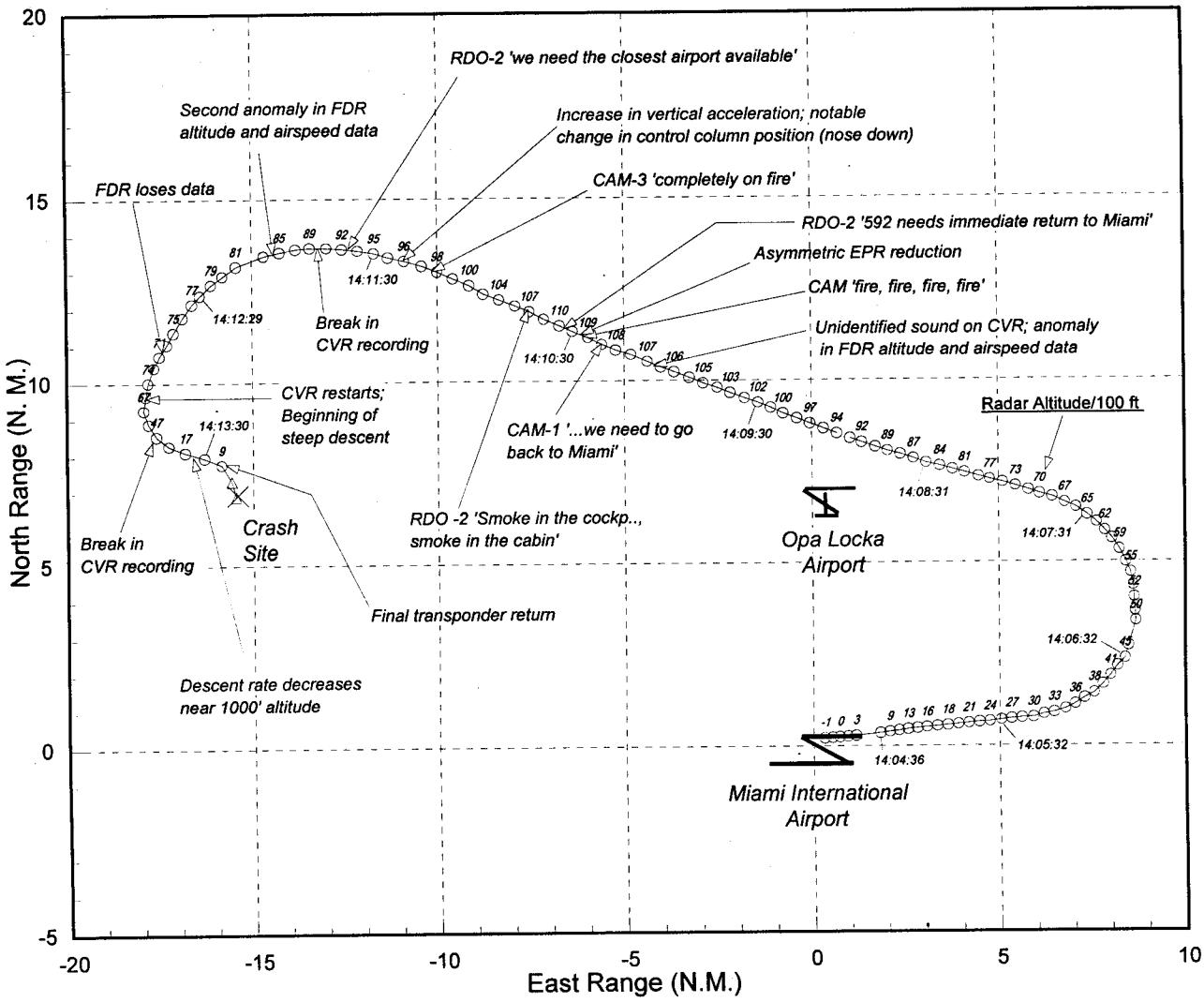

Figure 6a—Ground track of flight 592 (2-dimensional)

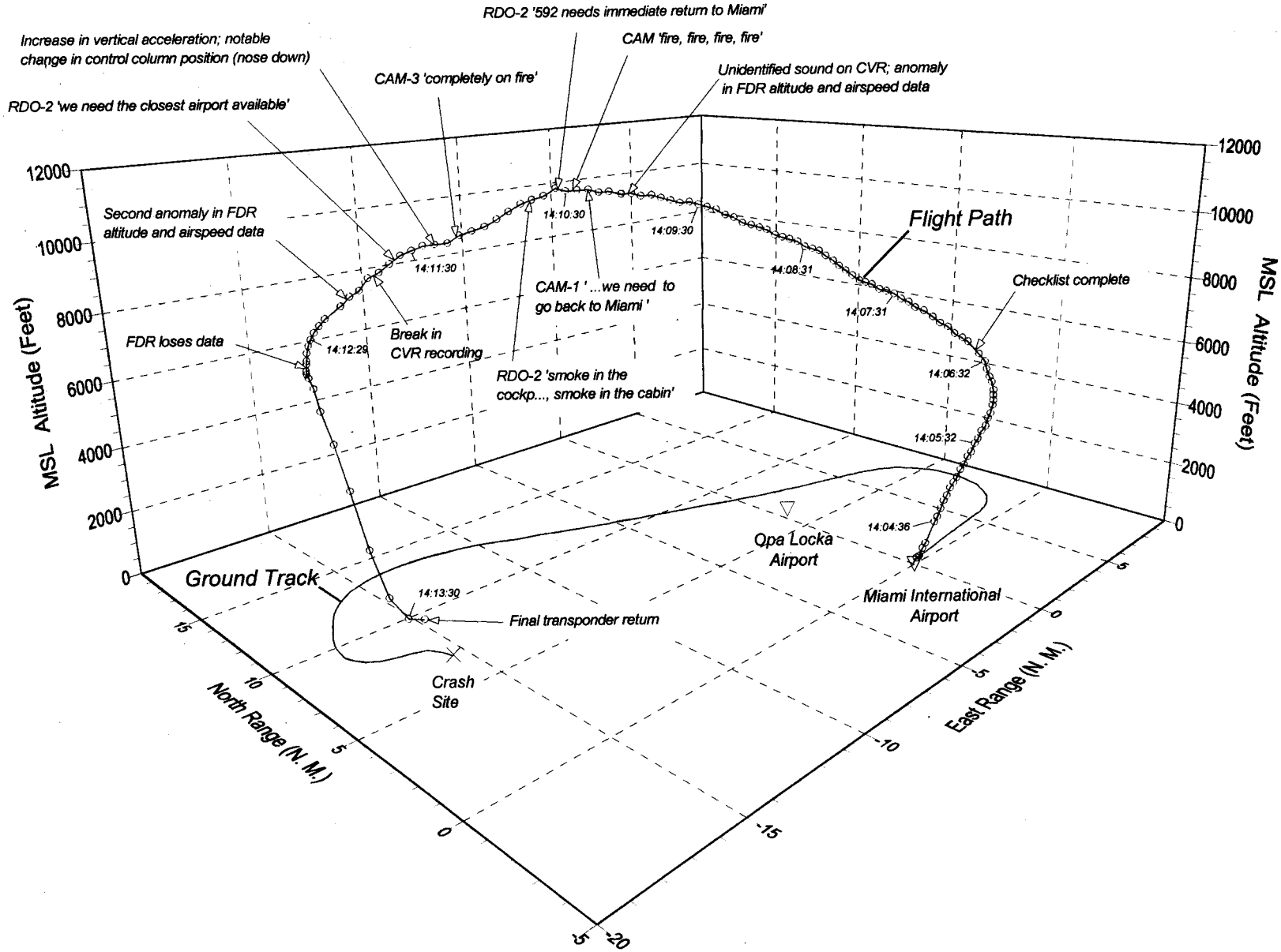

Figure 6b—Ground track of flight 592 (3-dimensional)

FDR and radar data indicate that the airplane remained at an altitude of about 9,500 feet msl over the next 15 seconds, while airspeed decreased from 302 KIAS to 283 KIAS.

At 1412:00, a second FDR altitude anomaly occurred, when the altitude dropped approximately 300 feet compared to the radar altitude, and this offset remained until the end of recorded data. At 1412:48, the FDR stopped recording data. The last recorded data showed the airplane at 7,200 feet msl altitude, at a speed of 260 KIAS, and on a heading of 218°.

The airplane's radar transponder continued to function and transmitted altitude data after the FDR stopped recording data. At 1412:58, after about 30 seconds at 7,400 feet msl altitude with a gradual heading change to 192°, the radar indicates an increasing turn rate from the southerly direction to the east and a large increase in the rate of descent. Flight 592 descended 6,400 feet (from 7,400 feet to 1,000 feet) in 32 seconds. The final three transponder radar returns recorded between 1413:25 and 1413:34 indicated that the turn stopped and the airplane briefly held a constant heading of about 110°, which was only slightly north of a direct heading toward the Miami airport from that point. The descent rate also reduced, with only a 100-foot change in altitude between the last two transponder returns at 1413:30 (1,000 feet) and 1413:34 (900 feet). At 1413:39, a primary radar return[77] indicates that the airplane turned abruptly to the right, toward a more southerly heading.

Computations of airspeed, based on radar data, indicate that the airspeed of flight 592 was more than 400 KIAS and increasing at the time of ground impact, which occurred about 1413:40. Ground scars and wreckage scatter indicate the airplane crashed into the Everglades in a right wing down, nose down attitude.

1.17 Organizational and Management Information

1.17.1 General

ValuJet Airlines, Inc., a "new entrant"[78] air carrier based in Atlanta, Georgia, was incorporated on July 10, 1992, under the name Charter Way, Inc. The company name was changed to ValuJet in May 1993, and the airline began flight operations under 14 CFR Part 121 on October 26, 1993, with two Douglas DC-9-32 airplanes, operating eight daily flights between Atlanta, Georgia, and Jacksonville, Orlando, and Tampa, Florida.[79] The airline management structure initially consisted of a board of directors, chief executive officer, president, and approximately 11 vice presidents with varied responsibilities.

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[77] A primary radar return is a return based on a radar reflection from the skin of the airplane, not from a transponder.

[78] The FAA defines a "new entrant" carrier as one with less than 5 years of operating experience.

[79] ValuJet provided basic airline service (i.e., no full meal services, frequent flyer programs, airline clubs, or advanced seat assignments).

By March 1994, the fleet size had grown to 10 airplanes and the daily scheduled flights had increased to 70, with new service to Washington's Dulles International Airport. About 1 year later, the airplane fleet consisted of 14 DC-9s and scheduled service had increased to 92 daily flights, with Chicago and Philadelphia being added to the schedule. By December 1994, ValuJet had increased its fleet size to 22 airplanes, served 17 cities, and operated 124 daily scheduled flights.

In June 1994, ValuJet hired a new senior vice president of operations, who was responsible for both flight operations and maintenance. He served in that position until February 1996, when he retired from the company. He told Safety Board investigators that when he joined ValuJet, the air carrier was operating 13 airplanes. He said that although he had expected the company to be running smoothly, when he began his new job he found a number of discrepancies, including maintenance records that were "not in great shape" and "lots of sloppiness due to rapid growth." He stated that the person who was serving as the director of quality assurance in the maintenance department was "way over his head."

The senior vice president stated that in 1994 the airline was adding airplanes "as fast as we could get them." He told Safety Board investigators that the airline had been growing too quickly in 1994 and early 1995. He said that in the beginning of 1995, he had discussed the airline's rate of expansion with the company president. He said he told the president that the system had been strained to get the new airplanes in service. He stated that he and the president decided to limit the rate of expansion to 18 to 21 new airplanes per year.

In 1995, ValuJet continued its growth with scheduled flights to New York and 31 cities in the east, the south, the midwest, and the southwest, and increased its DC-9 fleet to 48.

On October 19, 1995, ValuJet and McDonnell Douglas announced that the airline would become the first customer of the new 129-passenger MD-95 airplane, with an agreement to purchase 50 airplanes and options for 50 more.

At the time of the accident, ValuJet's fleet consisted of 52 airplanes: 4 DC-9-20s, 44 DC-9-30s, and 4 MD-80s. Of the total fleet, 44 were used for scheduled line operations and 8 were used for maintenance, training, and operational spares. The airline employed 191 captains and 209 first officers.

On July 10, 1997, ValuJet announced that it planned to merge with AirTrans Airways.

1.17.2 ValuJet's Aircraft Maintenance Program

1.17.2.1 General

ValuJet's in-house maintenance facilities were located at Hartsfield Airport in Atlanta and Dulles Airport in Virginia. These facilities were capable of performing N checks[80] (required every 2 days), A checks (required every 100 flight hours), and B checks (required every 500 flight hours); the facilities were not equipped or authorized to perform C checks[81] or other heavy maintenance.

According to ValuJet, at the time of the accident, it had contracts with 21 FAA certificated maintenance facilities and repair stations to service its airplanes when the airplanes were away from ValuJet's maintenance facilities or to perform C check or greater heavy maintenance. These contract facilities performed various maintenance functions, including, but not limited to, servicing, cleaning, scheduled checks, inspections, overhauls or modifications of aircraft, powerplants or appliances, and repairs of a non-routine nature. All 21 facilities were contracted to perform N checks; 8 were also contracted to perform A checks; 7 were contracted to perform N, A, and B checks.[82] Three of the 21 facilities—AeroCorp, in Lake City, Florida; Zantop, in Macon, Georgia; and SabreTech, in Miami, Florida—were contracted to perform all of the checks and heavy maintenance, including C checks.

ValuJet hired contractors to serve as technical representatives when heavy maintenance work was being performed at the contract facilities. According to ValuJet, the number of representatives assigned to a facility was dependent on the number of airplanes and tasks being worked on. ValuJet's vice president of heavy maintenance testified at the Safety Board's public hearing that technical representatives are responsible for ensuring that projects stay on schedule and are carried out in accordance with the contract specifications. He stated that technical representatives performed "spot checks" to see that work was being properly performed and the results of those "spot checks" would be reported to ValuJet's quality assurance department.

ValuJet's general maintenance manual (GMM) described the technical representatives' responsibilities as follows:

> The representative will have a general working knowledge of aircraft systems and manuals and appropriate Federal Aviation Regulations including drug and alcohol testing.

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[80] The N check is a general servicing and corrective action check of current write-ups.

[81] The A, B, and C checks are a series of inspections dictated by Douglas-generated routine work cards. Items required to be inspected are assigned to a specific check based on time and cycle intervals established by Douglas.

[82] Certified airlines that operated similar equipment as ValuJet were also approved to perform N, A, and B checks.

> The representative will be in contact with other appropriate ValuJet representatives to assist in determining proper task compliance relative to the ValuJet Reliability Program, Mechanical Reliability Reporting, and the Corrosion Preventions Control Program (CPCP).
>
> Equally important as above, the representative must be knowledgeable of the limits of the contractor's certificate. It is the responsibility of the Vice President of Maintenance, with concurrence of the Director of Technical Services, to assure that the representative meets and understands these requirements.
>
> It will be the responsibility of the ValuJet Quality Assurance/Maintenance representative, to see that the necessary maintenance has been completed satisfactorily and that all paperwork, including signing of the Aircraft Flight Log has been properly accomplished prior to scheduled flight.

The ValuJet GMM also stated that the technical representatives could be called upon to inspect the contract maintenance facilities at which they were representing ValuJet.

1.17.2.2 SabreTech

SabreTech, Incorporated of Miami, Florida, was an FAA-certificated 14 CFR Part 145 domestic repair station. Its original Air Agency Certificate, certificate No. RD3R811L, was issued December 3, 1969.[83] Before the accident, the last renewal of the certificate was December 1, 1993. That certificate authorized SabreTech to exercise the privileges of an airframe rating (class 4), an accessory rating (class 1), a limited powerplant rating (excluding overhaul or disassembly), a limited propeller rating, and limited specialized services ratings for transponder testing and non-destructive testing and inspection. Before being purchased by Sabreliner in June of 1995, Repair Station RD3R811L was operating as DynAir Tech of Florida, Inc. It began operating as SabreTech, Inc., on February 1, 1996, after Sabreliner Corporation, headquartered in St. Louis, Missouri, purchased DynCorp's DynAir Tech maintenance operations in Texas, Arizona, and Florida.

Although DynAir had performed maintenance on ValuJet airplanes as early as 1993, no heavy checks were done until May 1995, and there was no ongoing formal "Aircraft Maintenance Service Agreement" until September 15, 1995. Before this date, a separate maintenance agreement was executed for each individual aircraft.

Soon after the September 1995 agreement was executed, ValuJet provided SabreTech with the documentation necessary to perform repetitive heavy-check maintenance services. As part of this documentation package, ValuJet included the ValuJet GMM, a master copy of all ValuJet routine work cards, a master copy of the tally sheet listing all required work

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[83] On January 15, 1997, SabreTech voluntarily ceased operations at its Miami repair station.

cards necessary to complete all of ValuJet's routine checks, and a microfilm library containing the following: (a) ValuJet's Douglas DC-9 airframe manual, (b) ValuJet's P&W JT8D powerplant manual, (c) ValuJet's DC-9 illustrated parts catalog, and (d) ValuJet's DC-9 wiring diagram manual.

In addition to its own full-time employees, SabreTech typically maintained its work force at required levels through the use of contract employees from companies that provided individuals on an as-needed basis. The contractors hired and were responsible for paying the individuals whom they supplied to SabreTech. The contractors then submitted a weekly invoice to SabreTech. The contractors were responsible for ensuring that the individuals provided to SabreTech had the appropriate licenses and/or experience that SabreTech indicated was required. The president of SabreTech testified at the Safety Board's public hearing that after the accident SabreTech no longer relied on contractors to determine whether an individual possesses the required qualifications, but determined this itself.

According to SabreTech, around the time it was working on the three ValuJet MD-80s from which the oxygen generators were removed, the following six companies were the primary sources of its contracted workers: (a) PDS Aviation Services in Miami, Florida; (b) McDonnell Douglas Technical Services Co. in St. Louis, Missouri; (c) E&C Aircraft Services, Inc., in Miami, Florida; (d) STS Services, Inc., in Nashville, Tennessee; (e) SMART, Inc., in Edgewater, Florida; and (f) Strom Aviation in Bedford, Texas.

According to SabreTech records, the total number of individuals working at SabreTech's Miami facility and the ratio of SabreTech employees to temporary/contract personnel varied throughout the year. A review by Safety Board staff of 3 separate months in the year before the accident revealed the following personnel data:

Date	Permanent Employees (Percent of Total)	Contract (Percent of Total)
10/26/95	236 (41.9 percent)	326 (58.1 percent)
01/11/96	240 (48.3 percent)	257 (51.7 percent)
05/08/96	265 (43.0 percent)	351 (57.0 percent)

According to SabreTech, 587 individuals logged hours against the three ValuJet airplanes (N802VV, N803VV, and N830VV) at the SabreTech Miami facility beginning in February 1996 for various maintenance, including the replacement of the oxygen generators. Of these individuals, 145 (24.7 percent) were SabreTech employees and 442 (75.3 percent) were employed by the above-mentioned contractors. Of the 145 SabreTech employees, 95 (65.5 percent) held an aircraft and/or powerplant mechanic's license, and of the 442 contract personnel, 157 (35.5 percent) possessed one or both of the licenses. Of the 35 SabreTech employees who were assigned to the general maintenance crew, all but one held at least one of the two licenses.[84]

[84] According to 14 CFR Part 145, the only individuals at a repair station who are required to be certificated as a mechanic or repairman are those "...directly in charge of the maintenance functions of a repair station.…" The abilities of the uncertified workers are determined by the officials of the station on the basis of "...practical tests or employment records."

1.17.2.3 SabreTech's Procedures for Tagging and Identifying Aircraft Parts

Section V, page 44, of SabreTech's FAA-approved inspection procedures manual (IPM), "Tagging and Identification of Parts," lists four tags used for parts being removed from a customer's aircraft. The tags and their usage are defined as follows:

> White Tag—M040: Used to identify parts/components that are removed from customer's aircraft/engines to hold for reinstallation.
>
> Green Tag—M021: Used to identify parts requiring repairs or test. Includes information on work/test to be accomplished.
>
> Yellow Tag—M019: Attached to completed parts/components that have received final inspection and are approved for return to service. To be signed by designated person only.
>
> Red Tag—M020: Attached to condemned/rejected parts pending final disposition. Such parts are to be segregated. Tags are to be completed by an Inspector.

In section VI of the IPM, "Forms," the tags and their usage are further defined as follows:

> Repairable Parts Tag—Form M021: Form M021 is a green repairable parts tag used to identify components and parts removed from aircraft for repair. It is to be filled in by the mechanic who removes the part.
>
> Condemned Parts Tag—Form M020: Form M020 is a red condemned parts tag. This tag will be attached to rejected or scrapped parts, pending final disposition. This tag is to be completed or signed by an inspector. Parts so tagged are not to be mixed with serviceable parts and must be placed in a segregated area.
>
> Serviceable Tag—Form M019: Form M019 is a yellow two-sided tag. The face side is for pertinent data pertaining to the part. The back side is the Release Statement. It is to be completed by mechanics and cleared by inspectors.
>
> Removed Serviceable Tag—Form M022 [cream colored]: The Removed Serviceable Tag is to be used when an operator (customer) wishes to take a part from one aircraft for transfer or use on another aircraft. This procedure is covered in Section V of this manual under Receiving Inspection Procedures, Airworthiness of Removed Parts not Requiring Repair or Overhaul.
>
> White Removed/Installed Tag—Form M040: (Note: This tag is not further defined in section VI of the IPM, but instructions for its use are given.)

Section V, page 46, of the IPM, under the subsection, "Disposition of Unsalvageable Aircraft Parts and Materials," discusses how to handle "unsalvageable aircraft parts and materials that are being disposed/scrapped.…" Paragraph three of that subsection lists the types of parts/materials that would have to be disposed of or rendered unserviceable. Included in that list is, "Life-limited parts that have reached or exceeded their life limits, or have missing or incomplete records." Further instructions regarding the disposal of such items state, "Customer owned parts will be returned to the customer for disposal or disposed for the customer by indicated standards."

1.17.3 ValuJet's Maintenance Training Program

At the time of the accident, ValuJet employed six full-time ValuJet instructors to train ValuJet employees in maintenance procedures. In addition, employees received on-the-job training.

Newly hired ValuJet employees were required to take an initial technical training course specific to the aircraft/engine type on which they would be performing maintenance. A minimum of 32 hours of initial technical training was provided for each aircraft type, and a minimum of 8 hours was provided for each engine type. An orientation course was also given to new employees covering the company manual, aircraft deicing, and personal safety. The course lasted a minimum of 4 hours. Additional training was sometimes provided depending on the individual's previous experience. During a probationary period, which could last from 6 months to 3 years, a new employee was assigned to work with an experienced mechanic or lead mechanic. The entry-level mechanics (apprentice mechanics) were also assigned to an experienced mechanic for approximately 18 months before they were evaluated for promotion to mechanic. Documentation of their work progress was maintained in their training file.

Annual recurrent training was required for all ValuJet personnel (temporary and permanent) who were RII authorized.[85] These individuals were required to successfully complete an RII classroom training course and pass a written examination.

When new equipment or new types of airplanes were added to the ValuJet fleet, formal classroom training was required, as outlined in ValuJet's standard practice 8130, for all ValuJet maintenance personnel.[86] Recurrent training was provided on an "as needed" basis. Notice of training was posted on bulletin boards. Recurrent courses were unique in content and typically related to aircraft systems operations. Standard recurrent courses were courses such as "winter de-icing" and "right-to-know."

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[85] Title 14 CFR 121.371 states that no operator "may use any person to perform required inspections unless the person performing the inspection is appropriately certificated, properly trained, qualified, and authorized to do so."

[86] Title 14 CFR 121.375 states, "Each certificate holder or person performing maintenance or preventive maintenance functions for it shall have a training program to ensure that each person (including inspection personnel) who determines the adequacy of work done is fully informed about procedures and techniques and new equipment in use and is competent to perform his duties."

Training of temporary employees was conducted by a ValuJet employee, and included an overview of ValuJet's Standard Practice Program, documentation of ValuJet's CPCP, an overview of ValuJet's C check tally and signoff procedures, MEL signoff procedures, logbook signoff procedures, use of ValuJet's serviceable and non-serviceable tags, critical points of contract, and airworthiness release and RII requirements.

1.17.4 Training of SabreTech Employees

At the SabreTech facility, the manager of maintenance training was trained by a ValuJet employee on ValuJet policies and procedures. The SabreTech manager then trained SabreTech employees on ValuJet's airworthiness release procedures. Forty-five individuals completed this 2-hour course, which focused on ValuJet policies, procedures, paperwork, and the GMM. In addition, according to the SabreTech training department, SabreTech permanent employees participated in several other training courses that related directly to their ability to carry out the maintenance programs applicable to ValuJet airplanes. These training courses were the following:

(1) ValuJet RII training: Fifteen individuals completed the 2-hour course, which emphasized inspection procedures, qualification and authorization of inspectors, inspection paperwork, and the ValuJet RII list. At the end of the course, each participant had to pass a written test which was provided by ValuJet. Six individuals also received recurrent RII training.

(2) MD-80 general familiarization training: Fourteen individuals completed this 40-hour course, which was conducted by American Airlines. The course provided an overview of all of the MD-80 systems. Nine attended the course in 1993, three in 1994, and two in 1995.

(3) DC-9/MD-80 general familiarization and differences training: Nineteen individuals completed this 40-hour training course, which provided an overview of the primary differences between the systems in the two model airplanes. Nine employees attended the course in 1995, and 10 completed it in 1996.

(4) Hazardous substance in the workplace awareness training: This course focused on the ability to identify items in the work environment that are hazardous, how to handle those items, and how to protect against exposure to the hazardous materials. (The course did not deal with packaging and shipping of hazardous materials.) The course was conducted in 1994 and 1995. Records were not available to determine the duration of the course or the total number of individuals who attended.

According to the SabreTech manager of maintenance training, the SabreTech Miami facility did not provide a hazardous materials training program to its employees regarding the recognition or shipping of hazardous materials, nor was such a program provided by ValuJet. The manager of maintenance training stated that SabreTech had a program to handle the proper disposal of hazardous wastes, such as oil and other fluids removed from aircraft, and that he was in charge of that program. The stock clerk stated that in 1989 or 1990, he received training in

shipping the hazardous chemical wastes generated at their facility. He indicated that these wastes did not include aircraft parts. The stock clerk said that hazardous wastes were only transported by highway, not by air. He further stated that he did not have any training specific to the air shipment of hazardous materials. The SabreTech manager of maintenance training stated that he managed the hazardous waste program and that people in stores, including the stock clerk, would ship the wastes. According to the manager of maintenance training, wastes generated by SabreTech included materials such as gasoline, oils, thinners, and paints.

The director of logistics stated that SabreTech had a contract with Dangerous Goods Consultants of Miami to handle the packaging, marking, labeling, and preparation of shipping papers for all hazardous materials to be offered for transportation by SabreTech. The stock clerk was authorized to directly contact Dangerous Goods Consultants whenever hazardous materials needed to be shipped. The director also stated that transportation to and from Dangerous Goods Consultants was provided by SabreTech. According to the director, once a shipment was prepared, it was returned to SabreTech for shipping. The director further stated that SabreTech did not have a list of the hazardous materials it handled. Personnel relied on prior experience to recognize hazardous materials. The director indicated that SabreTech had no prior experience handling oxygen generators. At the Board's public hearing, the president of SabreTech testified that SabreTech did not know what was acceptable to ValuJet regarding carriage of hazardous materials aboard its airplanes. The president of SabreTech further testified that after the accident, SabreTech implemented a hazardous materials training program.

According to SabreTech, in addition to the above training courses, each individual holding the position of lead mechanic or higher was required to verify that they had read the SabreTech FAA-approved repair station inspection procedures manual. A statement that the person had done so was then entered into their personnel file.

1.17.5 ValuJet's Hazardous Materials Policy

At the time of the accident, Chapter 9 of ValuJet's company operations manual (COM) stated, "ValuJet will not engage in transportation of hazardous materials." Chapter 9 further cited 49 CFR section 175.10, which the manual stated "lists the allowable exceptions which are required for support of ValuJet's operations and certain items which are exempted partially or completely from the Hazardous Material Regulations." Section 175.10 lists certain hazardous materials that are not subject to the hazardous materials regulations.[87] Chemical

[87] Among the exempted items listed are the following: aviation fuel and oil in properly installed tanks; tire assemblies (when the tire pressure does not exceed "the maximum rated pressure for that tire"); properly packed small-arms ammunition in checked baggage; medical devices implanted in human beings; and certain personal smoking materials. Also exempted are "hazardous materials required aboard an aircraft in accordance with the applicable airworthiness requirements and operating regulations." However, "items of replacement for such hazardous materials must be transported in accordance with [the hazardous materials regulations] except that alternate protective packaging may be used in place of otherwise required packagings, and there is no quantity limit on aircraft batteries."

oxygen generators (unless furnished by the carrier for medical use by a passenger) are not included in the list.

At the time of the accident, ValuJet's FAA-approved station operations manual, Chapter 8, *General*, page 4-8-1, also stated, "ValuJet will not engage in transportation of hazardous materials. ... Prompt recognition and refusal of such materials is essential to the safety of our passengers and employees because these materials can cause harm to employees handling them or to the aircraft. When uncertain of a shipment, call Flight Control. DOT CFR 49 parts 100-177 (DOT Regulations), ICAO Dangerous Goods manual, and DOT P 5800.5 are available to all personnel in that office." This is known in the industry as a "recognition-only" hazardous materials program (also known as a "will-not-carry" hazardous materials program) and was approved by the FAA's POI in Atlanta, Georgia, in a transmittal letter dated August 5, 1993, after prior review by the FAA Civil Aviation Security Division in Atlanta.

Chapter 8, *Disposition*, page 4-8-2, stated, "no packages are accepted containing hazardous material. Should an item of hazardous material be discovered to be in our possession or on the premises it will be refused acceptance from the shipper."

Chapter 8, *Hazardous Material*, page 4-8-5, stated, "although ValuJet does not accept hazardous material it is important that all customer contact personnel, ramp personnel, flight crews, and dispatchers have awareness to identify Hazardous Materials."

Chapter 8, *Hazardous Material*, page 4-8-9, stated, "Cargo may be declared under a general description that may have hazards which are not apparent, and the shipper may not be aware of this. You must be conscious of the fact that these items have caused serious incidents, and in fact, endangered the safety of the aircraft and personnel involved. As stated on page 1, when in doubt refuse the shipment until approved by Systems Operations Control, who will verify the substance against the ICAO [International Civil Aviation Organization] Dangerous Goods Manual and DOT [Department of Transportation] 49 CFR 172."

Chapter 8, *Incidents*, page 4-8-12, identified two incidents involving the transportation of improperly prepared hazardous materials that resulted in injuries to baggage handlers.

Chapter 8, *Customer Service Agent's Responsibility*, page 4-8-12, stated, "Your responsibility in recognizing hazardous materials is dependent on your ability to: 1. Be Alert! 2. Take the time to ask questions! 3. Look for labels! ...Ramp agents should be alert whenever handling luggage or boxes. Any item that might be considered hazardous should be brought to the attention of your supervisor or pilot, and brought to the immediate attention of Flight Control and, if required, the FAA. REMEMBER: SAFETY OF CUSTOMERS AND FELLOW EMPLOYEES DEPENDS ON YOU!"

Chapter 8, *Training Program, General*, page 4-8-30, stated, "The training program for Hazardous Materials (HM) Awareness/Recognition shall apply to all personnel who are concerned with or have any duty or responsibility concerned with accepting, handling, or

loading of air cargo and passenger baggage." The two ValuJet ramp agents who were on duty at the time the oxygen generators were loaded on flight 592 testified at the Safety Board's public hearing that they had received the hazardous materials recognition training.

Chapter 8, *Training Program, Subject for Required Training,* page 4-8-31, stated, "All concerned must thoroughly understand Organizational Policy and Procedures as concerns Acceptance/Transportation of HM."

The ValuJet hazardous materials training manual that was current as of the accident date, stated, in part, "Company Policy-With the exception of dry ice, certain personal effects, assisting aids required by handicapped customers and a few other items as outlined on page 13,[88] ValuJet airlines prohibits the carriage of hazardous materials on any aircraft." The manual further stated, "…you may occasionally be exposed to customers attempting to ship materials as air freight or COMAT that are considered hazardous." The manual outlined procedures and information to assist ValuJet personnel in recognizing, disposing of, and reporting on incidents involving hazardous materials.

At the time of the accident, the ValuJet GMM contained standard practice 8228,[89] titled "Dangerous Goods Shipping Procedures," which stated "In order to keep ValuJet aircraft in an airworthy condition and in compliance with regulations, some aircraft equipment considered dangerous goods must routinely be shipped between stations." Standard practice 8228, which was added to the GMM in revision 71, dated April 19, 1996, provided instructions for packaging, labeling, and shipping various items of aircraft equipment considered "dangerous goods."[90] Chemical oxygen generators were not among those items.

In a joint letter to ValuJet, dated May 20, 1996, its POI and its principal maintenance inspector (PMI) instructed the airline to remove standard practice 8228 from the GMM because it had not been properly submitted to the POI, reviewed by the FAA Security Division, or approved. The POI stated that the ValuJet maintenance manual revision containing standard practice 8228 should have been sent to him for review because it involved hazardous materials. He said that ValuJet had sent the revision to the PMI, who brought it to the POI to discuss.

On May 21, 1996, ValuJet responded to the FAA request to remove standard practice 8228 citing 49 CFR 175.10(a)(2) as support for its position that it was authorized to

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[88] Page 13 listed items exempt from the hazardous materials regulations.

[89] According to ValuJet's company operations manual (COM) in effect at the time of the accident, the standard practice system is a "method of writing, publishing and controlling manuals. Since many ValuJet manuals are being converted to this system, this standard practice is issued to explain the system to all personnel." The COM further stated, "A collection of standard practices concerning the tasks or policies of a department become a manual for that department. Standard practices which involve more than one department become a part of the manual for each department involved."

[90] Those items were oxygen bottles, radar transmitters, fire extinguishers, aircraft batteries, protective breathing equipment, evacuation slides, and power device cartridges (squibs).

carry certain items of hazardous aircraft equipment. ValuJet's letter further states "…it is clear that ValuJet is authorized by its approved hazardous materials program to ship certain items of replacement equipment (even if otherwise considered hazardous) provided it is accomplished in accordance with the above standards. SP 8228 is merely the document ValuJet uses to ensure that it complies with its duty to ensure that authorized items of company material are labeled, marked, and packaged in the appropriate manner." A ValuJet transmittal sheet dated May 31, 1996, for revision 72 to the GMM deleted standard practice 8228 from the manual.

At the Safety Board's public hearing on November 9, 1996, ValuJet's president and chief operating officer from the time the company was founded until the time of the accident testified regarding the air carrier's procedures for the packaging, labeling, and acceptance of company-owned aircraft equipment and parts for transportation as COMAT. He testified, "I think what we're talking about is a paperwork discrepancy, where we were moving items…that are perfectly acceptable to be moved and are moved every day by equivalent of DC-9 airplanes with the pilot force and with the maintenance force and with the customer service and terminal operations force, working together on that." ValuJet's manager of customer relations at the time of the accident (who was responsible for developing the training program for ramp personnel) testified at the Safety Board's public hearing and stated with respect to the president's testimony "[he] mentioned in the first part of his testimony when ValuJet was first established, that the decision was made not to carry hazardous materials. And the only thing I can say in that respect, sir, is that I think possibly he might have misunderstood the question, but we do not carry hazardous materials." The former senior vice president of operations told Safety Board investigators he had been "led to believe" that ValuJet was authorized to carry hazardous materials aircraft equipment as COMAT.

The ValuJet station operations manual referred station personnel to the air carrier's flight control (dispatch) department to resolve questions about the acceptance or rejection of hazardous materials shipments. Several station agents and pilots interviewed by the Safety Board indicated that they would look to the dispatch department for the information necessary to decide on the acceptance of cargo. ValuJet's aircraft dispatcher who was on duty at the time of the accident stated that carrying company related hazardous materials on airplanes was approved. He provided the relevant sections from the company maintenance manual [standard practice 8228] as justification. He also stated that he was unaware that tires and oxygen generators were aboard flight 592.

The Safety Board's review of the operations manuals of several air carriers not authorized to accept hazardous materials indicated that a variety of provisions for handling hazardous COMAT had been approved by the FAA. With respect to aircraft parts, the company operations manual of an air carrier that was not authorized to accept hazardous materials provided a non-exclusive list of parts that could be considered hazardous and stated, "items of replacement such as batteries, aerosol dispensers, and signaling devices must be packed in strong outside [sic] containers, and tires must be serviceable and may not be inflated to pressures greater than their rated inflation pressures." This manual did not contain any other information about the identification, rejection, labeling, packaging, or loading of hazardous COMAT. The manual provisions were current at that air carrier as of March 1997.

1.17.5.1 Prior Hazardous Materials Incident

According to an FAA "enforcement investigative report," on February 15, 1995, a passenger on a ValuJet flight from Dulles International Airport asked a ValuJet ticket counter representative if she could take her oxygen cylinder on the airplane. At first, the ticket counter representative asked the passenger to speak with another ValuJet representative because she was unfamiliar with the procedures for handling oxygen. However, after airport security personnel refused to let the passenger pass through the security checkpoint with the cylinder, the ticket agent examined the cylinder, determined it to be empty, and accepted it as checked baggage. Airport security had notified the FAA Civil Aviation Security, who responded to the ValuJet ticket counter and examined the cylinder. Pressure tests revealed that the cylinder had 1,600 psig of gas. The cylinder was not loaded on the airplane. According to the FAA report, it was believed that ValuJet violated sections 175.3, 175.20(a) and (b), 175.30(a)(2), 172.702(b), and 172.724(a)(1) of the hazardous materials regulations. As a result of this incident, the FAA issued ValuJet a letter of warning.

1.17.6 ValuJet's Oversight of SabreTech

ValuJet initially inspected SabreTech's Miami facility in February 1994, using a general ValuJet-developed checklist that primarily addressed the facility's physical layout and technical capacity. (At that time, it was known as DynAir Tech of Florida.) ValuJet conducted an in-depth audit inspection on February 9, 1996, and a follow-up to this audit on March 20, 1996. Present during the February 9, 1996, audit inspection were the ValuJet Manager of Maintenance Programs, a ValuJet auditor, and the ValuJet PMI[91] from the Atlanta FAA flight standards district office (FSDO).

For the February 9, 1996, inspection, ValuJet used an audit checklist developed by Coordinating Agency For Supplier Evaluation (CASE).[92] The areas listed on the checklist were the following: Certification, Anti-Drug Testing Plan, General, Quality Control, Inspections, Technical Data Control, Shelf-Life Program, Tool and Test Equipment Calibration, Training, Housing and Facilities, Safety/Security/Fire Protection, Storage, Work Processing, Shipping, and Scrapped Parts.

At the completion of the audit, ValuJet provided SabreTech with a list of discrepancies identified during the audit. A written response was requested within 30 days to address the discrepancies and provide acceptable corrective action. The listed discrepancies were the following:

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[91] According to his testimony at the Safety Board's public hearing, the ValuJet PMI remained at the SabreTech facility for about 2 hours during this inspection.

[92] According to literature published by CASE, it is a nonprofit corporation established by air carriers for the purpose of sharing the vendor surveillance information and tasks required by 121.373(a) and 135.431(a). The literature states that the FAA views the CASE program as an acceptable means of complying with those requirements.

- The facility certificate was not displayed in an area accessible to the public.

- ValuJet's GMM was current; however, the record of revisions was not current. (This discrepancy was corrected on the spot.)

- Technical data were located throughout the facility. (ValuJet was informed that a technical library was being built to store the data in a centrally located area, and the project was expected to take several months to complete.)

- Vendor's shelf-life program was not adequately documented in the manual. This program was in the process of being revised. (During the follow-up visit on March 20, 1996, the program had been updated.)

- In the areas of Storage and Work Processing, it was noted that spray bottles did not adequately identify their contents.

- In the area of Scrapped Parts, the vendor did not maintain a record of life-limited parts scrapped for 7 years, and did not record the part number and the serial number of the part and the date scrapped. (The vendor stated that a new manual revision would address these items.)

During the March 20, 1996, follow-up visit, it was discovered that some of these discrepancies had not been corrected. As of April 15, 1996, ValuJet had not received a letter of response to the discrepancies noted during the audit. On that date, ValuJet sent a letter to SabreTech requesting a written response from SabreTech within 10 business days of its receipt of the letter. According to ValuJet, at the time of the accident, no written response to any of the discrepancies had been received from SabreTech.

ValuJet scheduled quality audits on their vendors at intervals not to exceed 24 months, in accordance with ValuJet's operations specifications. The next audit for SabreTech was scheduled on or before April 30, 1998. According to ValuJet, its Quality Assurance Representative also periodically inspected facilities to monitor their performance and to ensure that the facilities were adequately equipped and personnel were qualified to conduct maintenance on the type of aircraft operated by ValuJet.

Three ValuJet technical representatives were assigned to SabreTech to oversee the work performed on the three MD-80 airplanes (according to Article 8.30 of the Aircraft Maintenance Service Agreement, they could not supervise or control the SabreTech employees who were providing services on the aircraft). Two of the technical representatives were contracted from two separate consultant companies—Accent Aviation Consulting, Inc., in Equality, Alabama, and Aviation Management Group, Inc., in Cooper City, Florida. The third technical representative was a full-time permanent ValuJet employee.

During the time the MD-80 airplanes were at SabreTech, each technical representative concentrated his activity in specific areas. The contracted consultant from Accent Aviation Consulting reported that he started work at 0700 each day, 2 hours earlier than the other two technical representatives. He said that he began the day by checking paperwork associated with any non-routine tasks. He then checked with the project manager or supervisors to go over assignments. He also randomly reviewed some of the work cards to make sure that the tasks were signed off as being completed in accordance with the card's instructions. He would check in with the stockroom and planning. He would also walk around the airplane and talk with the floor mechanics. Each morning, there would be a conference call with the technical representatives from the other facilities and the Vice President of Heavy Maintenance at ValuJet in Atlanta. During this conference call, any problems with work tasks would be discussed. This technical representative stated that safety caps for the generators were not discussed during the conference calls, and he was not aware of any problems. The only discussion about the generators was in regards to a shipment of new generators.

The second contracted technical representative, who was from Aviation Management Group, stated that he worked during the normal day shift (beginning at 0900). His responsibilities consisted of planning and scheduling. He said that he would start his shift by checking the fax machine for any messages from ValuJet. He would then plan to resolve any questions or problems. He stated that he was also responsible for clearing paperwork, resolving discrepancies, reviewing service bulletins and checking the maintenance manuals. He also stated that he did not normally work around the airplane, but instead concentrated on the aforementioned administrative tasks.

The third technical representative, a permanent ValuJet employee, stated that he worked during the normal day shift (beginning at 0900). His responsibilities consisted of walking around the airplanes, oversight, inspecting, and making sure that the work tasks were done in accordance with ValuJet's contract.

1.17.7 FAA Oversight of ValuJet

1.17.7.1 Principal Maintenance Inspector (PMI)

The individual who became the PMI for ValuJet upon its initial certification received his A&P mechanics license on December 15, 1983 (about 7 ½ years before being hired by the FAA). His initial assignment with the FAA Atlanta FSDO as an aviation safety inspector (ASI) included assisting a PMI with oversight of at least one Part 121 certificate. He assisted in the certification of ValuJet, and then became its full-time PMI. He continued as the ValuJet PMI until November 1994, at which time he was assigned to be Assistant PMI for both ValuJet and AvAtlantic. In February of 1996, he became the PMI for AvAtlantic, and no longer assisted with ValuJet. His FAA training record indicated that he had successfully completed 38 separate formal training courses. His performance appraisals for his most recent rating periods were reviewed, and all elements were fully successful or higher.

The individual who became the PMI for ValuJet in November 1994, and who was serving in that position at the time of the accident, received his A&P license on June 28, 1989 (about 2 months before being hired by the FAA). The basis for his application for the A&P certificate was both civil and military experience accumulated between September of 1964 and July of 1973. His initial assignment with the FAA was at the Southern Region Headquarters, where he acted as an accident/incident enforcement coordinator. In December of 1992, he transferred to the Atlanta FSDO as an ASI. His first Part 121 oversight responsibility began about September 1993, when he became the PMI for two small Part 121 operators (Eagle Airlines and Private Jet). He became the PMI for ValuJet and AvAtlantic in November of 1994, and until February of 1996 was assisted by the individual who had previously been the ValuJet PMI. From February of 1996, until the date of the accident, his only Part 121 PMI oversight responsibilities were with ValuJet. His training record indicated that he had successfully completed 30 separate formal training courses, but neither he nor the FAA could provide an FAA Form 3140-2 to document his on-the-job training level. His most recent performance appraisals were reviewed, and all element ratings contained in these appraisals were fully successful or higher.

1.17.7.2 FSDO Staffing Levels

The manager of the Atlanta FSDO testified at the Safety Board's public hearing that the PMI for ValuJet had expressed concern about handling the growth of ValuJet. According to the Atlanta FSDO manager, in response to this concern, he wrote a memorandum to his supervisor, the division manager, requesting "additional inspectors in all categories, operations and airworthiness, for the oversight of ValuJet." According to the Atlanta FSDO manager, the request was denied. He testified, "The feedback that I got was that because of a staffing model that was put together by flight standards, that that model indicated that my office would, did not need any additional staffing and might have been overstaffed in some areas. So therefore, we would not get any positions." According to the Atlanta FSDO manager, the staffing model that flight standards used to make a determination about additional staffing did not account for factors such as a rapidly growing air carrier.

The FAA's POI for ValuJet testified at the Safety Board's public hearing in November 1996 that,

> We had reached the point last year, the latter part of, well, probably starting in August of '95, where ValuJet was running about 40 pilots through their training program each month. I was serving as Principal Operations Inspector with one assistant at that time. And I had him tied up almost totally doing flight checks, all hours of the day and night. …I had to borrow from other units, I used the geographic inspectors in our office to assist me in giving flight checks.

The POI further testified, however, "I don't see that we had any right, from the principal's standpoint. I had no right to step in and request that they be slowed. They were accomplishing everything they were supposed to accomplish."

1.17.7.3 FAA Inspections of ValuJet

From the date of ValuJet's initial certification (October 21, 1993) until the date of the accident, ValuJet's activities, facilities, and programs underwent 1,471 maintenance-related program tracking and reporting system (PTRS)[93] activity coded inspections by the FAA. Of those inspections, 646 were conducted by inspectors from the Atlanta FSDO (ValuJet's certificate management office), and 825 were conducted by inspectors from other FAA offices. In addition, ValuJet was the subject of a regional aviation safety inspection program (RASIP) from October 17 to 28, 1994, and a national aviation safety inspection program (NASIP) from February 18 to February 29, 1995. ValuJet was also the subject of a review by FAA's Office of Aviation Flight Standards Air Carrier Branch (AFS-330), which formed the basis for a February 14, 1996, Summary Report by the Aircraft Maintenance Division (AFS-300). A 120-day special emphasis inspection program began on February 22, 1996, and was still in progress at the time of the accident.

From the time of ValuJet's initial certification until the accident, no ValuJet PMI completed an inspection of the SabreTech facility. According to the PMI at the time of the accident, he made an attempt to inspect SabreTech in January 1996, but "a couple three hours after getting there, I was diverted to another problem that we had with another contractor in Miami. So I didn't finish that one [inspection]."

1.17.7.3.1 Regional Aviation Safety Inspection Program

According to the FAA, the FAA Southern Regional Office initiated the RASIP because ValuJet was a new and fast growing air carrier. This inspection of ValuJet's operational and maintenance procedures and practices produced nine findings in the airworthiness area. These findings were transmitted to ValuJet on November 8, 1994, and ValuJet responded to each of the findings on December 12, 1994. Neither SabreTech nor any of ValuJet's other heavy maintenance contractors were inspected in connection with this RASIP.

1.17.7.3.2 National Aviation Safety Inspection Program Report

According to the FAA, FAA headquarters initiated the NASIP based on a review of PTRS, recent accident and incidents, and other data that revealed trends that warranted further inspection. According to the NASIP inspection report dated 10/31/95, there were 15 findings in the operations area and 43 airworthiness findings. Of the airworthiness findings, 8 were category A (any non-compliance with a Federal Aviation Regulation (FAR)), 16 were category B (failure of the certificate holder to adhere to documented company procedures, related to specific regulatory requirements or safety, that have been developed by the certificate holder and approved or accepted by the FAA), and 19 were category C (lack of systems that ensure the

[93] The PTRS is a centralized computerized recordkeeping system that lists for each "R" [required] item for certificated entities (such as airlines and repair stations), the date the item was "assigned" as a "R" [required] item, the date the inspection was completed, and the findings made during the inspection.

certificate holder of compliance with continuing or reoccurring FAR requirements).[94] ValuJet responded to each of the NASIP findings on December 20, 1995, and all but two of the findings were closed within the deadline set by the FAA. Neither SabreTech nor any of ValuJet's other heavy maintenance contractors were inspected in connection with this NASIP.

1.17.7.3.3 AFS-300 Summary Report

The first page of a report summary, dated February 14, 1996, and prepared by AFS-300 of the Office of Aviation Flight Standards at FAA headquarters in Washington, D.C., stated, "This report summary addresses ValuJet Airline's accident/incidents, enforcement history, NASIP Inspections, and the FAA's surveillance activity. Airworthiness concerns following two (2) recent accidents[95] and a DOT Office of Inspector General audit of the air carrier are the catalyst of this analysis."[96] The report indicated that ValuJet had a total of 46 regulatory violations since 1993, of which 20 remained open at the time the report was written. The report noted that a review of PTRS and safety performance analysis system (SPAS)[97] data for approximately 3 years revealed, "In all areas analyzed [records and procedures, airworthiness surveillance, and aircraft records], [ValuJet] was at the advisory and or alert threshold in the majority of the months studied."[98] The report concluded, "The data reviewed, clearly show some weakness in the FAA's surveillance" of ValuJet and noted, "some critical surveillance activities did not receive much attention." Specifically, the report noted that the PTRS data (for 1994 and 1995) showed only six inspections of manuals and procedures,[99] five inspections of shop and facilities, and no inspections of the carrier's structural inspection program.

Based upon the data reviewed, the report recommended the following actions:

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[94] For example, finding 2.03.1 (a category B finding), states, "There are several forms in the CAS document that do not have forms numbers and are not listed in the GMM Chapter #7." Finding 2.03.10 (a category C finding) states, "The CAS Document shows no sign of FAA acceptance (Stamp) or (Signature)." (See appendix H for the list of airworthiness findings.)

[95] The report cited a June 8, 1995, uncontained engine failure, and a January 7, 1996, hard landing accident. Both were the subject of Safety Board investigations and reports (NTSB/AAR-96/03 and NTSB/AAR-96/07).

[96] This report is included in appendix I.

[97] As defined in the FAA 90-day safety review, SPAS is "a new automated decision support system which is being deployed to help target inspection resources on those areas which potentially pose the greatest aviation safety risk. The system will process data from a variety of sources (currently 25 candidate databases). SPAS can compare the current-to-past performance of an air carrier to its own records or to the average performance of the entire industry segment in which the carrier is categorized. SPAS can also compare the performance of carriers and aircraft to spot early signs of trouble."

[98] According to AFS personnel, the terms "advisory" and "alert" are evaluative terms used to describe air carrier noncompliance with (or potential for deviation from) published safety requirements and standards, based on data retrieved from the FAA's Safety Performance Analysis System. "Advisory" and "alert" correspond to mid- and low-level compliance, respectively.

[99] The report stated, "Although some may argue that six (6) inspections of manuals and procedures is sufficient in two (2) years, you need only look to the recent NASIP Inspection findings to see why more inspections should have been done. 35 of the inspection findings were in the manuals and procedures and shop and facilities area."

1. Consideration should be given to an immediate FAR 121 re-certification of this airline. This recommendation is based on such known safety related issues as the absence of adequate policies and procedures for the maintenance personnel to follow. Additionally, the absence of engine trend monitoring data, and the possibility of a continuous airworthiness maintenance program that may be inadequate because it uses reliability based procedures without a reliability program.

2. The overall surveillance of the air carrier should be increased in FY96. Special attention should be directed toward manuals and procedures, structural inspections, the adequacy of the maintenance program, and shops and facilities. Additionally, the PMI should consider accomplishing two (2) main base inspections every year.

3. The closeout deadline for the NASIP inspection is February 28, 1996. Every effort should be made to meet this deadline with positive corrective action.

4. When a violation of the FARs is detected, the inspector should consider past enforcement history before administrative corrective action is offered. If an air carrier violates the same regulation in a short period of time, escalating the enforcement action may be appropriate.

The AFS-300 Summary Report was not provided to either the Atlanta FSDO or ValuJet until after the accident. According to AFS-300, after the report was completed, a copy was sent to the deputy director of flight standards (AFS-2), and a member of the AFS-300 staff was directed to contact FAA's Southern Region to ensure that the issues discussed in the report were being addressed by the Atlanta FSDO. During a follow-up interview by Safety Board investigators at the Atlanta FSDO, it was confirmed that pertinent issues of concern (but not the report) had been passed on by the AFS-300 staff member. At the Safety Board's public hearing, AFS-2 testified that he had no knowledge of the AFS-300 Summary Report before the accident. According to the manager of AFS-300, he personally delivered a copy of the report to AFS-2, and a copy of the report was also forwarded to AFS-2 as part of a congressional hearing preparation package. Also, officials from both ValuJet and the Atlanta FSDO stated that they had no knowledge of the existence of the report before the accident.

1.17.7.3.4 120-Day Special Emphasis Inspection

On February 22, 1996, the FAA began a 120-day intensive focused surveillance of ValuJet. The manager of the Atlanta FSDO provided the following testimony at the Safety Board's public hearing as to why the inspection was undertaken:

> We were quite concerned about some indicators, certainly the accident/incident rate, the [service difficulty reports]. We were concerned about the rapid growth, ValuJet's rapid growth. We were concerned about the amount of vendors. They were a non-traditional carrier, which proved rather difficult for us to survey. Unlike a traditional carrier that has in-house maintenance, in-house training, and the FSDO is usually in a fairly close location, the inspectors can walk right across the street, observe the training, the records, and oversee a lot. When you have a carrier that contracts out and all over the United States to do that, it's rather difficult to get out there to see it. So it caused further problems.

A letter dated February 29, 1996, to ValuJet's president and chief operating officer signed jointly by ValuJet's POI, PMI, and principal avionics inspector, stated,

> ValuJet Airlines has recently experienced four occurrences.[100] These occurrences, coupled with the preliminary findings of the Federal Aviation Administration's Special Emphasis Review completed on February 28, 1996, give us concern that ValuJet is not meeting its duty to provide service with the highest possible degree of safety in the public interest, as required by Section 44702 of Public Law 103-272. It appears that ValuJet does not have a structure in place to handle your rapid growth, and that you may have an organizational culture that is in conflict with operating to the highest possible degree of safety.

The letter further stated the following:

> In order to uphold the public's interest in safety in air transportation and in accordance with Part 121.79(a)(2), the Atlanta Flight Standards District Office has amended your Operations Specifications as follows:
>
> 1. Paragraph C-70, Airports Authorized for Scheduled Operations. The current list of airports will be placed with the Operations Specification and the reference "SEE ATTACHED LISTING" will be deleted.
>
> 2. Paragraph D-85, Aircraft Listing. The list of current aircraft will be placed within the Operations Specifications and the reference, "ValuJet Airlines general maintenance manual provides the current aircraft listing," will be deleted.

As of May 1, 1996, 306 inspections of ValuJet's operations and airworthiness activities had been conducted. None of these inspections occurred at SabreTech or at any of

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[100] The four occurrences cited in the FAA's letter included (1) "Landing in Atlanta with '0' fuel in the left fuel tank and 1,400 lbs in the right fuel tank instead of landing at the nearest suitable airport" (May 8, 1995); (2) "Continuing to Nashville with a gear problem, which resulted in an accident, instead of returning to Atlanta where maintenance was available" (January 7, 1996); (3) "Runway excursion in Atlanta while landing on a wet runway beyond the landing touchdown zone" (January 26, 1996); and (4) "Runway excursion in Savannah" (February 28, 1996).

ValuJet's other contract heavy maintenance facilities. According to FAA's Preliminary (Interim) Report, which detailed findings as of May 1, 1996, there were 131 findings, including 46 findings attributed to airworthiness categories. The number of findings in each airworthiness category are as follows:

- Manuals and Procedures 8
- Training Programs 1
- MEL/Deferred Maintenance 4
- Maintenance Programs 4
- Aircraft Ramp Inspection 29

According to the report, during the first 7 days of the special emphasis program, ValuJet experienced 132 maintenance delays. This was in comparison to 44.48 maintenance delays per week during January 1996. During the first 7 days of the program, ValuJet's MELs (deferred maintenance items) per day averaged 58.3, as compared to 12.03 in January of 1996. The report also stated that of six airplanes that were inspected by the FAA immediately after having undergone an N or A check, five were found to have discrepancies. According to the report, "The most notable discrepancies were concerning flight attendant seats, loose or missing hardware, etc.…."

The FAA special emphasis inspection program continued past the accident date and through June 16, 1996. According to the FAA's final report on the inspection,[101] the FAA made 584 inspection findings during the program; 412 of these were airworthiness findings. The FAA's final report indicates that after the accident the FAA surveilled some of the subcontract maintenance facilities used by ValuJet and found evidence that one of the air carrier's maintenance subcontractors lacked documentation of training for its personnel in DC-9 maintenance procedures, ValuJet's maintenance control department provided inadequate guidance to a subcontractor, ValuJet failed to audit two maintenance subcontractors, out-of-date ValuJet service check sheets were being used by a maintenance subcontractor, and a maintenance subcontractor lacked ValuJet work cards needed to perform inspections.

1.17.7.3.5 Consent Order

On June 18, 1996, FAA and ValuJet executed a consent order, which stated, "...the Federal Aviation Administration (FAA) has concluded that ValuJet Airlines, Inc., ("ValuJet") under its authority to operate as an air carrier under Part 121 of the FARs (14 CFR

[101] "Special Emphasis Program, Summary of Findings, February 22, 1996 through June 16, 1996, ValuJet Airlines, Air Carrier No. VJ6A465W, Atlanta, Georgia." September 6, 1996. Federal Aviation Administration. Mimeo.

121), conducted airworthiness and aircraft maintenance related activities, and flight operations, contrary to and in violation of the FARs..." In the order, ValuJet agreed to pay the FAA $2,000,000 as a remedial (not punitive) payment,[102] and to "cease all revenue service under 14 CFR Part 121…until such time as the FAA determines that ValuJet is qualified and capable of exercising the privileges of the holder of an Air Carrier Operating Certificate."

Attachment 1 to the consent order described the alleged regulatory violations upon which the FAA based its conclusions (see appendix J). Attachment 2 to the order delineated a plan of action for ValuJet's return to service.

On August 29, 1996, the FAA returned ValuJet Airlines' air carrier operating certificate. The FAA press release of that date stated the following:

> This action will permit ValuJet to resume operations at a future date if the airline is found to be managerially and financially fit by the Transportation Department, which today issued a tentative finding of ValuJet's economic fitness.
>
> The approval follows ValuJet's compliance with a June 18th consent order, and is the result of an intensive FAA review of ValuJet's revised maintenance and operations programs, as well as the airline's management capacity and organizational structure.
>
> In accordance with the consent order, and as a result of the FAA evaluation, ValuJet will fly as a smaller airline upon returning to service, starting with up to nine aircraft and adding up to six more over the next few days when it's back in service.
>
> ValuJet had 51 aircraft in operation when it ceased operations June 18th. The airline has also sharply reduced the number of outside contractors it will use, and will initially fly one configuration of the DC-9 instead of 11 configurations previously in service.
>
> When it returns to service, ValuJet will receive certificate management oversight from the FAA to focus on key areas which have been amended as a result of changes to its policies and procedures.
>
> As part of its rigorous evaluation, the FAA required ValuJet to revise its maintenance program and procedures, and retrain maintenance personnel in those procedures.

[102] The order stated that the payment represented "the costs incurred by the FAA to investigate, review, establish, reinspect, and ultimately enforce this consent order."

The FAA required ValuJet to revise its organizational structure and add additional maintenance and management personnel to increase oversight and strengthen control over its maintenance program.

The FAA conducted complete records review and conformity checks on each ValuJet aircraft before it was returned to service. Required ValuJet to retrain and recheck all ValuJet pilots, instructors, and check airmen. Reviewed all ValuJet maintenance and training contracts. Required the airline to include contractors performing substantial maintenance and training to be listed on its operations specifications, and inspected ValuJet line facilities maintenance bases, maintenance controls, and dispatch operations.

On September 30, 1996, ValuJet resumed operations.

1.17.8 FAA Oversight of SabreTech

1.17.8.1 Principal Maintenance Inspector

The PMI for SabreTech's Miami facility at the time of the accident received his A&P certificate in December 1949 (about 37 years before being hired by the FAA). His initial assignment with the FAA (on August 11, 1986) was as an ASI in the Farmingdale, New York, FSDO. On November 8, 1987, he transferred to the Miami FSDO where he was an ASI in the geographic section. On February 10, 1991, he transferred out of the geographic section and assumed the position of PMI and was assigned responsibility for oversight of several individual repair facilities. He was responsible for oversight of Part 145 repair stations while acting as an ASI both at Farmingdale and Miami. His training record indicated that he had successfully completed 26 separate formal courses, but documentation of his on-the-job training could not be located. His two most recent performance appraisals were reviewed, and all rated elements were fully successful or higher.

At the time of the accident, SabreTech's PMI also served as PMI for a Part 121 operator with 24 aircraft, six Part 135 operators, a Part 137 operator, a Part 91 operator, a Part 141 operator and, in addition to SabreTech, 20 other Part 145 certificate holders. The PMI indicated that he visited the SabreTech facility about every week to 10 days. He said he conducted PTRS inspections on some, but not all, of his visits, and that some of his visits were unannounced.

In the FAA's report on its 90-day safety review undertaken after this accident (see section 1.17.9), the FAA found that

an air carrier's principal inspector is not consistently made aware of discrepancies discovered by an inspection of a contractor performing outsourced work for his or her carrier. This lack of coordination occurs, in part because the PTRS does not require that the contractor deficiencies be "coded" to connect the PTRS entries to the air carrier for which the work is being performed. Therefore, deficiencies found by the repair station principal inspector may or may not be reviewed by the air carrier's principal inspector when evaluating the air carrier's outsourcing.

1.17.8.2 FAA Special Inspection of SabreTech

After the accident, from May 20 through May 24, 1996, five FAA ASIs carried out a special inspection of the SabreTech facility in Miami, Florida. The report issued after the inspection was completed included findings relating to management, operations specifications, manuals and procedures, training programs, records system, maintenance facilities, contractual agreements, and maintenance inspection and required inspection items.

Findings documented in the report are summarized by the Safety Board below:

- Incorrect dates on the Air Agency Certificate, and limited ratings (class I accessory rating, propellers, and non-destructive testing) listed in the operations specifications for which SabreTech did not have the equipment, manuals, or current and trained personnel to hold. (Note: As a result of this inspection, SabreTech's Air Agency Certificate and Operations Specifications were reissued, with a number of the previously held limited ratings eliminated.)

- A lack of standardization in the way inspectors signed off multiple tasks on ValuJet work cards, and references to sections of repair manuals that did not address the type of repair being made.

- A lack of a formal mechanic training program or training syllabus, and individuals who were responsible for making inspector signoffs on DC-9 aircraft who had not been through DC-9 systems training.

- Training classes that some mechanics listed on their job applications at SabreTech were not supported by any type of certificate or proof of training document.

- Parts that had been removed from aircraft were sitting on shelves without any identifying tags, and a part that was found to be tagged with both a green "Repairable parts" tag and a yellow "Serviceable" tag (the serial number on the green tag did not match the serial number of the unit to which it was attached).

- Vendor lists that were both unreadable and not current, and vendors who were not on the approved vendor list performing equipment calibrations at SabreTech.

- A full roll of floor covering in the ValuJet storage area that did not have any identification or burn certification documentation. Also, several gallon containers were filled with fluid and did not have any attached identifying documentation, and whose contents could not be determined by SabreTech personnel.

- Boxes of parts with unreadable labels.

- Some equipment that required calibration did not have current calibration and was not on the calibrated inventory list. Also, two gauges on a nitrogen regulator had certification stickers on them, but calibration records indicated that the regulator had been damaged beyond repair for 6 months. In addition, according to the listing of calibrated tools, many items were overdue for calibration or had been missing for over a year.

- Manuals were not updated with current revisions, and AD notes and technical data sheets in the SabreTech library were not current.

- The director of avionics, the only individual in the SabreTech radio shop who held an A&P certificate, was responsible for supervision of all work accomplished in the radio shop. He worked one shift, 5 days per week, but the shop operated three shifts, 7 days per week.

- All publications in the Electronics/Avionics Shop that provided specifications were marked "for reference only," and were not regularly updated.

In a letter dated January 8, 1997, SabreTech's general manager wrote to the FAA's PMI, "this letter serves as formal notification of SabreTech's intent to cease operations at our Miami Repair Station. In accordance with 14 CFR Part 145.17(c), we intend on surrendering Repair Station License No. RD3R811L to you at the Miami Flight Standard Districts Office by 3:00 p.m. on Wednesday, January 15, 1997."

1.17.9 FAA 90-Day Safety Review of the FAA

On June 18, 1996, the FAA Administrator announced in a news release that a task force would "conduct a 90-day safety review examining areas of immediate concern to the agency, especially with respect to safety inspections, and would make recommendations which could be implemented in the near term." The FAA Administrator further announced that the FAA would be making "major improvements...to FAA inspection policies," and that those

"changes [were being] made specifically to toughen the FAA's oversight of airlines that rely on contract maintenance and training." The announcement included the following:

- Airlines will be required to demonstrate regulatory compliance of each of their major contract maintenance programs at each facility doing substantial heavy maintenance or repairs. We also will review the procedures used to carry out this work, ensuring that the procedures are part of the carrier's approved maintenance program. Also, quality assurance oversight being provided by the carrier will be reviewed to ensure that the work conducted by the contractor conforms with the carrier's approved maintenance program and is carried out in accordance with the regulatory requirements levied on the carrier.

- The FAA's principal inspectors will require that carriers list all contractors performing substantial maintenance and training in an airline's operating specifications. Use of any new contractor will require approval by the principal inspector before it is added to the operations specifications.

- Before use of new contractors is approved by the principal inspector for addition to the operations specifications, the carrier must conduct an audit of the contractor. This audit must demonstrate to the principal inspector that the contractor is capable of performing the contracted work in accordance with the carrier's approved programs.

- The FAA also will create new oversight requirements for inspectors who monitor repair stations and training centers. These new oversight requirements will require new tasks be developed to provide special attention to airline maintenance activities being carried out at repair stations. For example, FAA inspectors now will be required not only to check the compliance of repair activities with the regulations governing the repair station, but also to check that the carrier assures that the maintenance and repairs done by the station are in compliance with the airline's maintenance program.

Since the accident, the FAA has issued airworthiness bulletin HBAW 96-05(B) to FAA Order 8300.10 (Airworthiness Inspector's Handbook). The "Background" section of the bulletin indicates that it was issued as "a result of a recent trend among some air carriers to not take into account their responsibility to control and oversee maintenance performed by contractors." The bulletin requires air carriers to audit and ensure on a continuing basis that their "substantial maintenance"[103] contractors are complying with the carrier's practices and

[103] The HBAW defines "substantial maintenance" as "[a]ny activity involving a C-check or greater maintenance visit; any engine maintenance requiring case separation or tear down; and/or major alterations or major repairs performed on airframes, engines or propellers."

procedures. The bulletin also requires that the FAA Certificate Management Office (CMO) "perform adequate on site inspection of the air carrier's substantial maintenance providers to allow it to validate that the air carrier's contracting system is performing satisfactor[ily]." FAA officials told the Safety Board that this requirement only imposes on the PMI a one-time inspection, and is not a requirement for the PMI to conduct continuing surveillance of contract maintenance facilities.[104]

The Executive Summary of the 90-day safety review, dated September 16, 1996, stated "The review examined Federal regulations and FAA's management of oversight of commercial airlines engaged in substantial outsourcing of maintenance and training functions, as well as the flexibility with which FAA inspection resources can be deployed effectively in response to varied fleet mixes, rapid growth, or other changes by a certificate holder."

As a result of the 90-day review, the task force identified six issue areas (certification policy and process, resource targeting to address safety risks, newly certificated air carrier operations and growth, outsourcing and varied fleet mix, inspector and air carrier guidance material, and inspector resources) and made the following six general recommendations. (Several specific actions were called for under each general recommendation.)

1. Rigorously enforce OST [Office of the Secretary of Transportation] and FAA application procedures.

2. Improve air carrier surveillance systems and follow-up activities to mitigate safety risks and increase the leverage of FAA resources. Ensure that safety information reaches the right people at the right time and continue efforts to improve data quality and analysis.

3. Ensure that newly certificated air carriers have adequate resources and infrastructure to support stable and safe operations and growth.

4. Ensure that all air carriers have adequate resources and infrastructure to support outsourcing and operation of a varied fleet mix. Require specific information related to outsourcing and fleet mix in the OST and FAA applications. Increase OST and FAA scrutiny of these factors in determining an air carrier's initial and continuing qualifications to operate.

5. Ensure consistency, timeliness, usefulness, and accessibility of guidance material provided to inspectors and air carriers.

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[104] The FAA has recently added to the PTRS guidelines a requirement that PMIs annually inspect the internal audit programs used by carriers to inspect and oversee maintenance subcontractors.

6. Ensure that Flight Standards resources and training are adequate to meet safety requirements.

On the issue of outsourcing, the FAA report noted that,

> The current regulatory scheme and FAA policy provide that even when maintenance and training are contracted out, the Part 121 air carrier bears the ultimate responsibility for ensuring that the maintenance and training are conducted in accordance with its manuals and Part 121 rules (See 14 CFR Sections 121.363 and 121.401 in Appendix C, page C-20). When an air carrier contracts maintenance to a Part 145 repair station, the repair station has the responsibility under Section 145.2 to perform the work in accordance with the air carrier's maintenance program. The same applies to a situation where a contractor subcontracts the Part 121 air carrier work to another certificated entity.
>
> Under the current certification scheme, OST does not include any examination or review of an applicant's intent to enter into outsourcing contracts or of the capabilities and experience of the responsible key persons to carry out the contractor oversight responsibilities now imposed by existing FAA regulations. For example, the OST application does not require information on an applicant's intent to outsource maintenance and/or training, although it does require the applicant to provide a first-year business plan. The OST application does not require specific information on corporate roles and responsibilities relating to oversight of contract maintenance and training or information sufficient to evaluate the adequacy of the applicant's budget and personnel when it proposes to operate a mixed fleet of aircraft.

The report also stated that,

> Deficiencies in the certification process (regarding the adequacy of the carrier's infrastructure to support outsourcing and auditing responsibilities), coupled with the past lack of clear guidance to FAA inspectors and the industry, have contributed in some cases to a lack of air carrier accountability for contractor or subcontractor work. While commenters uniformly acknowledge that legal responsibility remains with the air carrier, this does not always translate into adequate oversight. The lack of accountability is often further complicated when multiple layers of subcontracting occur.

1.17.10 FAA's Hazardous Materials Program

The FAA and the Research and Special Programs Administration (RSPA) each have responsibilities pertaining to the shipment by air of hazardous materials. RSPA is responsible for promulgating hazardous materials regulations for all modes of transportation. FAA is responsible for enforcing the regulations relating to air transportation. (The FAA's

Office of Civil Aviation Security (ACS) received this function from the FAA's Flight Standards Service in 1979.) FAA Orders 1650.7B and 1650.9A charge ACS with "maintaining a comprehensive and viable compliance and enforcement program," which includes inspections of U.S. and foreign air carrier stations, enforcement activity for hazardous materials violations and incident investigations, and technical assistance and training.

1.17.10.1 Staff

The FAA's hazardous materials program includes headquarters staff, regional coordinators, and security inspectors. According to the FAA, the headquarters staff (which consisted of three people at the time of the accident) is primarily responsible for developing policies, preparing rulemaking, and providing training and policy guidance to the regional coordinators and security inspectors. Headquarters staff is also responsible for preparing briefings and speeches to industry groups; reviewing and coordinating enforcement reports prepared by the field; participating as technical experts during enforcement actions; reviewing and coordinating exemptions; analyzing data related to hazardous materials; participating in NASIPs;[105] and providing direct interface with RSPA, other DOT modal administrations, and the ICAO dangerous goods panel.

A regional coordinator is located in each of the FAA's 10 regions. The coordinators share the responsibility with the headquarters staff for reviewing enforcement investigative reports, training, and issuing policies. They also participate in NASIPs. The coordinators may assist the security inspectors as part of on-the-job training and to help in documenting complex enforcement actions. Regional coordinators are occasionally assigned to perform short-term, full-time security functions, as necessary. The coordinators are primarily located in the Air Security or Operations Branch within various regions. These branches are managed by the regional manager of ACS. According to the FAA, at the time of the ValuJet accident four of the regional coordinators spent 100 percent of their time in the hazardous materials program; however, the coordinator in Brussels, Belgium, spends only about 10 percent of his time on the hazardous materials program. The other five coordinators reported spending an average of 74 percent of their time on hazardous materials.

While the hazardous materials program had about 13 personnel dedicated to the program at the time of the accident, the program was also supported by security inspectors. The security inspectors are generally located in the ACS field offices and field units. The field offices and field units are managed by the ACS field office managers and unit supervisors. According to the FAA, at the time of the accident, the security inspectors performed most of the hazardous materials inspections, case work,[106] and incident response. The security inspectors spent an

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[105] FAA staff from the hazardous materials program did not participate in the NASIP inspection of ValuJet discussed earlier in this report.

[106] Based on interviews with FAA personnel in the hazardous materials program, inspections involve checking the compliance of air carriers and shippers with the federal hazardous materials regulations including packaging, shipping papers, marking, labeling, recordkeeping, and training requirements. Case work involves preparing enforcement action for noncompliance with the federal hazardous materials regulations.

average of about 3 to 4 percent of their time on the hazardous materials program, and the majority of their time is spent on security functions. Most regions have not identified any of its security inspectors as field office hazardous materials coordinators. However, the Southern Region had identified two field office hazardous materials coordinators because of a concentration of hazardous materials activity in their region. One coordinator (in Atlanta) stated that he spent about 60 percent of his time on the hazardous materials program. According to the FAA, the other hazardous materials coordinator (in Miami) devoted 100 percent of his time to the hazardous materials program.

In 1996, 207 security inspectors had received recent hazardous materials training; 196 of those inspectors performed hazardous materials inspections in 1996. The number of security inspectors trained and performing hazardous materials inspections reached a high of 302 trained with 282 performing inspection in 1992.

A total of 2,402 hazardous materials inspections were performed from January 1, 1996, to October 31, 1996. A total of 3,073 inspections were performed in calendar year 1995, 6,377 inspections were performed in calendar year 1994, and 7,593 inspections in 1993 (the 5-year peak). The director of the FAA's Office of Civil Aviation Security Operations testified at the Safety Board's public hearing that the drop in the number of inspections in 1995 "…[was] actually a function…of two factors. One is the increased security demands. And the other would be the downsizing trends…."

On July 15, 1996, the FAA Administrator announced a realignment of $14 million in fiscal year 1997 to improve the oversight of the movement of hazardous materials by air. This would include the expansion of the hazardous materials inspection and legal workforce by 130 positions. According to the director of ACS, a hazardous materials program manager has been hired to supervise the headquarters' staff and the headquarters' staff will be increased. He also stated that the hazardous materials personnel will not be diverted to security issues but will remain focused on hazardous materials safety, and the funding identified for the hazardous materials program will be dedicated for use only in that program. Further, the hazardous materials databases will be enhanced and trend analysis will be performed to identify areas that could present a hazard to air transportation. As of July 1997, the FAA had begun hiring to fill the additional hazardous materials program positions, and training programs have been established.

1.17.10.2 FAA Programs to Address Undeclared Hazardous Materials

During 1994 and 1995, the FAA initiated more than 1,000 enforcement cases involving shipments of undeclared hazardous materials.[107] Five of these cases were developed through random FAA inspections. The remainder of the cases were developed when the air carriers reported a suspect package or bag. Typically the package or bag had broken open revealing its contents or there was evidence of something leaking inside. According to the FAA,

[107] The database does not indicate whether the shipments of undeclared hazardous materials involved COMAT.

its security inspectors do not have the authority to open a package or bag, even if they have reason to suspect that hazardous materials might be inside. The FAA's standard procedure for opening a suspect package is to request that air carrier personnel open it.

Neither the FAA National Flight Standards Work Programs Functions document (FAA Notice 1800.135), nor FAA Order 8300.10 establishes any requirements for FAA airworthiness inspectors to conduct surveillance of air carriers' hazardous materials practices within maintenance facilities.

Current and former FAA personnel indicated in interviews with Safety Board investigators that they believed the problem of undeclared hazardous materials has been difficult to address. They indicated they believed that the majority of violations were unintentional and resulted from a lack of knowledge of the regulations or of the hazardous nature of their shipment. FAA has sought to address this problem by making presentations at industry conferences, requiring signs at locations in airports where packages and luggage are offered, and issuing pamphlets. The FAA has increased civil penalty assessment amounts on individuals determined to have improperly offered hazardous materials.

According to statements made to Safety Board investigators by former hazardous materials headquarters personnel, the FAA considered two additional methods of addressing the problem of undeclared hazardous materials, but these methods were not implemented. One method was to have the baggage screening staff trained to recognize hazardous materials at screening checkpoints. An FAA internal memorandum in September 1993 discussed implementing this proposal; however, the training never occurred. In response to the Safety Board's staff inquiry of October 30, 1996, about this proposal, the FAA responded in a memorandum dated November 5, 1996, "Existing passenger checkpoint screening, as outlined in 14 CFR 108.9 and 49 U.S.C. 44901 are designed to detect weapons, not all types of contraband. Any effort to use the screening checkpoint to find hazardous materials could result in a review of FAA's authority to require screening and might even jeopardize the screening process itself."

The second method considered was a plan for a nationwide inspection program for air freight forwarders that combined hazardous materials and cargo security. The FAA stated, "a three part inspection consisting of a 'blind test,' a security inspection at the forwarder's facility, and a hazardous materials audit was planned for the spring/summer of 1995." The hazardous materials portion of the inspection program was to focus on training requirements at freight forwarders as a method of stopping unintentional shipments of undeclared hazardous materials. According to FAA hazardous materials personnel, in March of that year, the inspection program was postponed because the DOT Office of Inspector General's audit of FAA's security oversight responsibility at airports was extended into the summer. The inspection program was resumed in August without the blind test, or the hazardous materials audit because that month the FAA issued comprehensive new domestic security requirements in response to possible threats in reaction to various domestic judicial trials. According to the director of ACS, "This initiative placed increased demands on our workforce which caused the focus to be limited to one of the three original planned parts."

In the fall of 1996, the FAA issued shipper endorsement requirements under 14 CFR Part 109 (Indirect Air Carrier Security). These provisions require shippers and freight forwarders, but not postal patrons, to certify that each shipment, not identified as carrying hazardous materials, does not contain any "unauthorized explosives, destructive devices or hazardous materials." (The U.S. Postal Service is discussed in section 1.18.5.) This endorsement also requires that the shipper or freight forwarder "consent to search of this shipment."

On June 16, 1997, the FAA began a series of hazardous materials strike team inspections at major air transportation hubs. The first was in Miami, Florida, where 101 aircraft repair stations were inspected. The current plan is to conduct one hazardous materials strike team inspection per month.

1.17.10.3 Hazardous Materials Transported as Company Materials (COMAT)

The FAA training program for security inspectors stated that hazardous materials carried as COMAT are required to be shipped and transported as any other type of shipment containing a hazardous material.[108] Interviews with FAA employees indicated that the container and markings of COMAT should be looked at by FAA security inspectors (and usually is) when it is observed in the air carrier's cargo area in the airport or being loaded onto an aircraft. The Atlanta field office hazardous materials coordinator also stated that it is difficult to know the status of COMAT. An inspector might see hazardous materials in what appears to be a COMAT shipment in an air carrier's cargo area in the airport but until the shipping papers are completed the inspector would not know if the material was intended to be loaded on an airplane.

On December 13, 1996, the RSPA issued an advisory notice entitled, "Transportation of Air Carrier Company Materials (COMAT) by Aircraft." The summary of the notice stated, "This document provides advisory guidance as to the extent and application of exceptions from the Hazardous Materials Regulations applicable to the transportation of an air carrier's COMAT." Under supplemental information, the notice stated,

> In testimony at a recent hearing conducted by the National Transportation Safety Board (NTSB), and in a position paper prepared for the hearing by the Air Line Pilots Association (ALPA), concerns were expressed with regard to the provisions of 175.10(a)(2) of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180), applicable to an carrier's transportation of its own company materials (COMAT). This advisory guidance is being issued to clarify the application of these provisions of the HMR and to overcome a number of apparent misunderstandings of them.

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[108] The FAA training program, dated August 1995, was titled "Air Transport of Hazardous Materials (Recurrent) Interactive Distance Learning Course."

1.17.10.4 Hazardous Materials Shipped from Maintenance Facilities

According to the FAA, at the time of the accident, the FAA did not have a program to inspect or detect hazardous materials shipped from maintenance facilities. The security inspectors did not inspect maintenance facilities. According to the FAA, the FAA inspections focused on the carriers of hazardous materials. Shippers of the hazardous materials were not inspected unless a problem was discovered with one of its shipments. According to the FAA, aircraft maintenance facilities are hazardous materials shippers and would not be periodically inspected. According to the FAA, the inspection of the maintenance facilities is the responsibility of the PMI.

Beginning on May 29, 1996, FAA security agents assisted by hazardous materials inspectors from RSPA conducted hazardous materials compliance inspections of the FAA-certified repair stations used by ValuJet. With the exception of discrepancies discovered at SabreTech in Miami, no violations were discovered. The FAA plans similar inspections at all FAA-certified repair stations.

1.17.11 RSPA's Hazardous Materials Program

RSPA is responsible for coordinating a program for the safe transportation of hazardous materials by all modes of transportation, including air. Included in this program is the responsibility for developing and issuing the hazardous materials regulations contained in Title 49 CFR Part 175 specifically prescribes additional requirements applicable to aircraft operators accepting hazardous materials for transportation aboard aircraft or transportation of hazardous materials aboard aircraft. (See appendix K.) Additionally, RSPA has responsibility for issuing approvals and exemptions related to the hazardous materials regulations.

1.17.11.1 Enforcement Program

According to RSPA, the Office of Hazardous Material Safety (OHMS) shares enforcement authority of the hazardous material regulations (HMR) contained in Title 49 CFR with the modal administrations within the DOT, which "have primary responsibility for enforcement of the HMR against the carriers they regulate. Accordingly, OHMS places compliance and enforcement emphasis on container manufacturers, retesters, and reconditioners, and multimodal shippers of hazardous materials." The RSPA Office of Hazardous Materials Enforcement, located within the OHMS, is headed by an Office Director who manages the hazardous materials enforcement program. The director, an enforcement officer, the special investigations chief, and three transportation enforcement specialists are located in headquarters. Each of the five regions has four transportation enforcement specialists and a regional chief.

According to RSPA, the enforcement specialists spend 90 percent of their time on inspection and enforcement activities. Hazardous materials interpretations, presentations, and training make up the remaining 10 percent. The special investigations chief and the region chiefs spend about 50 percent of their time on inspections and enforcement. The remainder of their

time is spent supervising employees, reviewing inspection and enforcement reports, and providing hazardous materials interpretations, presentations, and training.

According to RSPA, the program is equally divided between shipper inspections, and container manufacturers, retesters and reconditioners. The shipper program does not focus on any specific mode of transportation, although cooperation with the U.S. Coast Guard has resulted in port inspections. According to RSPA, its enforcement specialists perform random inspections at shippers, and they have the authority to open packages discovered in transportation. In 1995, 562 inspections were performed on shippers and 102 enforcement cases were developed.

Since the accident, RSPA has been granted funding for and is in the process of hiring 18 additional personnel. According to RSPA, these individuals will supplement the current enforcement and legal staff and will be primarily focused on air shipments of hazardous materials.

1.17.11.2 Approvals Program

In 1980, RSPA assumed responsibility for issuing approvals that would allow explosives, not already approved or allowed by 49 CFR 173, to be offered for transportation; before 1980, these approvals were issued by the Bureau of Explosives.[109] Because chemical oxygen generators have a percussion cap that contains small quantities of explosives, the generators are forbidden from being offered for transportation by 49 CFR section 173.21(b), unless the company offering the generators for transportation has been issued an approval by RSPA or holds a previously issued Bureau of Explosives' approval.[110]

Officials of the two current domestic manufacturers of chemical oxygen generators stated that they held Bureau of Explosives' approvals. One of the manufacturers (Scott Aviation, Inc., the manufacturer of the units involved in the accident) provided the Safety Board with a copy of a letter from the Bureau of Explosives stating its chemical oxygen generators were approved for transportation. However, the other manufacturer (Puritan Bennett Aero Systems Company) had no record of an approval and neither RSPA nor the Bureau of Explosives had any records of the approvals for the generators manufactured by either company. RSPA stated that all records of approved designs, testing, or packaging requirements for the chemical oxygen generators issued by the Bureau of Explosives several years ago have been lost.

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[109] The Bureau of Explosives is part of the Association of American Railroads. Based on information provided by the Bureau, since its inception in 1906, the Bureau's mission has been to educate and advise railroads, packing manufacturers and shippers on the safest methods of transporting hazardous materials. In the beginning, no standards existed for the safe packaging and handling of explosives and other dangerous materials carried by rail. Recognizing this, the railroads created the Bureau. Rules developed by the Bureau governing the handling, packaging, marking, and labeling of hazardous materials were later adopted as federal regulations.

[110] RSPA's approvals program is responsible for issuing and oversight of more than 60,000 registrations and approvals of explosives.

At the time of the accident, chemical oxygen generators approved for transportation were classified as an oxidizing solid, n.o.s. (contains sodium chlorate), hazard class 5.1. The shipping papers were required to contain this information, and the outer package was required to display this information and have an "oxidizer" label. The non-bulk packaging requirements for this material were prescribed in 49 CFR section 173.21. One of the authorized combination packagings listed in that section was an outer fiberboard box (4G) and an inner metal receptacle. The maximum quantity limitations of core material that could be offered for transportation in one package by passenger-carrying aircraft was 5 kilograms.[111]

1.18 Additional Information

1.18.1 Other Air Carriers' Handling of Chemical Oxygen Generators

After the accident, the Safety Board was informed by McDonnell Douglas that Delta Air Lines, American Airlines, Trans World Airlines, and Alaska Airlines had fleets of MD-80 airplanes equipped with chemical oxygen generators. In postaccident interviews with Safety Board investigators, representatives of these four air carriers stated that they realized chemical oxygen generators were to be shipped as a hazardous material and were to be disposed of as a hazardous waste once they had reached the end of their service life or were expended in use.

At the time of the accident, Alaska Airlines had instructions on the work card that required the discharge of expired chemical oxygen generators at the maintenance facility where the generators were removed from the airplane. American Airlines, at the time of the accident, had procedures that required disposal of expired chemical oxygen generators. Both carriers had contracted with a waste disposal company to have the expended generators disposed of locally in accordance with the Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act (RCRA) requirements.[112] American Airlines' procedures have been in effect since 1994. Alaska Airlines' procedures have been in effect since 1992.

Until recently, Delta Air Lines and Trans World Airlines maintenance facilities were handling expired chemical oxygen generators removed from aircraft by placing safety caps or safety clips on the actuators, repacking the generators in the manufacturer's packaging in which they received replacement generators, and shipping them as hazardous materials via COMAT to their maintenance facilities in Atlanta, Georgia, and Kansas City, Missouri, respectively.[113] These maintenance facilities were to actuate the chemical oxygen generators and have them disposed of as a hazardous waste.

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[111] Appendix K contains the hazardous materials regulations applicable to the air shipment of oxidizing solids, n.o.s.

[112] Title 42 U.S.C. 6901.

[113] Unlike ValuJet, these carriers were authorized to accept hazardous materials that were properly labeled and packaged.

On January 26, 1996, Delta Air Lines changed its policy and required that the oxygen generators be expended and disposed of at the maintenance facilities where the generators were removed. This policy change was in response to two fires involving packages of expired chemical oxygen generators at the Delta maintenance facility in Atlanta.[114] According to the Delta station maintenance foreman in Seattle, the generators had been removed from an airplane at his facility and were sent to Atlanta for actuation and disposal.

After the crash of flight 592, Trans World Airlines also discontinued its practice of sending expired generators to its maintenance base in Kansas City for actuation and disposal.

1.18.2 Incidents Involving Chemical Oxygen Generators

Incident No. 1.—On August 10, 1986, an American Trans Air DC-10 was destroyed while parked at a gate at Chicago O'Hare International Airport. Passengers and crew from the inbound flight had deplaned, and mechanics and cabin cleaners were servicing the airplane. When smoke began entering the cabin, the onboard personnel unsuccessfully attempted to determine the source of the smoke before they evacuated the airplane at 7:15 a.m. Subsequently, a fire spread rapidly throughout the cabin, and the airplane was destroyed. No one was injured.

The Safety Board's investigation revealed that at about 6:50 a.m., a mechanic had entered the airplane's cargo compartment during servicing to look for a replacement for a broken seatback on the plane. The mechanic stated that while examining seat backs being transported as COMAT, he noticed that the door to a supplemental oxygen compartment on one of the seatbacks would not latch and its associated chemical oxygen generator was loose. The mechanic stated that he handled the generator by the plastic hose and placed the generator back into its compartment. The investigation revealed that the COMAT shipment did not have proper shipping papers, packaging, and labels in accordance with the hazardous materials regulations.

The Safety Board found that the fire was initiated by the mechanic's improper handling of an oxygen generator associated with a seat back temporarily stored in the C1 cargo compartment, and that the oxygen generator had not been packaged in accordance with federal regulations.

Following the incident, the FAA sent a notice dated August 13, 1986, to all domestic air carriers and foreign airworthiness authorities informing them of the circumstances of the incident and reminding them that chemical oxygen generators are oxidizers and therefore classified as hazardous materials which should be properly packaged and stowed securely. The

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[114] The fires occurred on December 22 and 24, 1995. According to the Delta investigators, they believed that the December 22 fire was intentionally started. The investigation of the second fire revealed that the safety clips on the actuating devices had not been fully inserted. The investigators stated that they believed that a partially inserted safety clip could have fallen out during rough handling of the box containing the generators. (These fires were not reported to the FAA, nor were they required to be.)

Safety Board subsequently learned that the FAA did not follow up with periodic advisory or directive information to operators. The 1986 notices expired after 1 year.

Incident No. 2.—On February 19, 1988, a Boeing 757, operated by Eastern Airlines as flight 215, was en route from Atlanta, Georgia, to Tucson, Arizona, when it experienced an in-flight fire caused by a ruptured chemical oxygen generator in the forward galley. There were 6 crewmembers and 131 passengers on board the airplane. There was no damage to the airplane, and there were no injuries.

The Safety Board's investigation revealed that a flight attendant had activated an Aviox portable oxygen unit, containing two chemical oxygen generators, in an attempt to provide oxygen to a passenger complaining of shortness of breath. After activating the unit, the flight attendant did not detect any oxygen flowing; consequently, a second unit was used. The initial Aviox portable oxygen unit was placed on its side on the second shelf of a beverage cart and was covered with a damp linen napkin for cooling; reportedly, the unit was very hot to the touch. The cart was then placed into its forward galley storage cabinet with the cabinet door left open. Several minutes later a fire erupted in the forward galley. Flight attendants used three Halon fire extinguishers to extinguish the fire. The flight continued to its destination without further incident.

Postincident examination by Safety Board investigators revealed that the outer case of the Aviox portable oxygen unit had a 3-inch-diameter hole in the base caused by excessive heat or fire. The copper end cap of one of the two chemical oxygen generators in the unit was separated from the jacket.

The Safety Board found that the chemical oxygen generator had been activated; however, placing the generator on the cart after it was activated caused a full or partial block of the oxygen outlet tube, which resulted in the pneumatic overpressure failure of the generator. The exposed oxidizer continued to burn and produce oxygen creating an oxygen-rich environment resulting in the ignition of the linen napkin and other material in the galley.

Incident No. 3.—On November 7, 1992, an ACS field office responded to a call of a reported air cargo package fire at Wilson UTC, Inc., North Hollywood, California, a freight forwarder facility. Security investigators discovered that an employee had been loading packages into an LD-3 cargo container that would subsequently be loaded onboard a Qantas Airways flight for Brisbane Airport, Australia. During the loading of the cargo container, the employee observed smoke from a package inside the container and promptly removed the package to a concrete area in front of the facility. Flames reached heights of approximately 4 feet. The fire was extinguished with a CO_2 fire extinguisher.

The FAA investigation revealed that a chemical oxygen generator was offered to Wilson UTC for transportation by World Aviation Supply, North Hollywood, California. The generator, manufactured by Scott Aviation, was shipped mounted in a bracket with a retaining pin, lanyards, and masks installed. The FAA's investigation report stated that the shipment was made without proper shipping papers and without the packaging being marked and labeled in

accordance with the hazardous materials regulations. FAA post-fire examination of the generator revealed that the retaining pin was not in the actuating device, the activating pin for the device was down, and there was no evidence of a safety cap over the percussion cap.

Incident No. 4.—On September 24, 1993, an ACS field office responded to a call of a reported fire in a cargo container at Federal Express in Oakland, California. Security investigators discovered that while unloading a Federal Express Boeing 727, employees noticed smoke emitting from a corner of a cargo container. They initially thought the smoke was dry ice or nitrogen condensation vapors but then observed flames inside the container. While waiting for the airport's aircraft rescue and fire fighting unit to respond, employees emptied two Halon-type fire extinguishers but did not extinguish the fire. After an attempt at using water, the firefighters extinguished the fire with foam. Damage to the cargo container was extensive, including melted Lexan on two sides and an 18-inch hole burned in the container's aluminum top.

The FAA investigation revealed that on September 22, 1993, a passenger service unit panel in which was mounted a chemical oxygen generator was sent via Federal Express for a dimensional check of the "No Smoking/Fasten Seat Belt" lens. The dimensional check was performed on September 23, and the unit was sent back the same day on Federal Express. The FAA's investigation report stated that the shipment was made without having proper shipping papers and without the packaging being marked and labeled in accordance with the hazardous materials regulations.

The FAA's post-fire examination revealed that there was no evidence of a shipping cap or a retaining pin for the chemical oxygen generator. The fire did extensive damage to the generator, the panel, the packaging, and the unit load device.

Incident No. 5.—On October 21, 1994, an ACS field office responded to a call of a reported fire in a box at Emery Worldwide in Los Angeles, California. Security investigators discovered that on October 20, while a driver was unloading his truck, he noticed an orange glow coming from the side of one of the boxes in his truck. The box was moved out of the building and the fire was extinguished. The fire department responded but the fire was already out when they arrived.

The FAA investigation revealed that on October 20, 1994, 37 chemical oxygen generators were offered for transportation, via Emery Worldwide. The shipment was consigned to Sun Company Airlines, East Northport, New York. The shipment was made without having proper shipping papers and without the packaging being marked and labeled in accordance with the hazardous materials regulations. Post-fire examination by the FAA revealed that the lanyards attached to the retaining pin were taped to the side of the generator. The hammer for the actuating device on each generator was held in the firing position by the retaining pin and no safety caps were installed. Each generator was wrapped individually in bubble wrap, and all 37 generators were placed in a fiberboard box. One of the generators in the box had the retaining pin out and the hammer was resting on the percussion cap. There was fire damage on the plastic wrap on this and adjacent generators, and there was a hole burned in the side of the box.

Incident No. 6.—On January 26, 1996, an ACS field office responded to a report from America West Airlines in Las Vegas, Nevada, of an undeclared shipment containing 11 oxygen generators. Partially obscured hazardous materials labels were observed by a maintenance technician immediately before loading the package onboard an airplane. The technician opened the package and discovered the oxygen generators placed at random in the box. The hammer for the actuating device on most of the generators was held in the firing position by the retaining pin. However, at least one generator did not have the retaining pin inserted. The lanyards were taped to the actuating mechanism or taped to the body of the generator. Several generators had safety caps over the percussion cap. No evidence of a fire was observed.

Incident No. 7.—On April 25, 1997, Continental Airlines notified the FAA that on April 15, 1997, Santa Barbara Aerospace (an FAA-certified 14 CFR Part 145 repair station and one of Continental Airlines contract maintenance companies) shipped approximately 72 boxes of aircraft parts that included a box of seven chemical oxygen generators on a Continental Airlines DC-10 that was being operated in commercial passenger service.[115] The shipping papers did not reflect the contents of the boxes, other than to indicate "aircraft parts." Continental Airlines' Manager of Regulatory Compliance stated the following in a letter dated May 13, 1997:

> SBA contracted Eagle Freight, a registered indirect air carrier, to convey the materials from SBA to Houston [Continental Airlines headquarters]. Eagle had a courier collect the shipment…[and] the boxes were loaded into an LD-11 shipping container and tendered to Continental Airlines as revenue cargo…
>
> The shipping container was loaded aboard Continental Flight 190, a McDonnell DC-10….The container was downloaded and the contents transported to Continental Airlines Warehousing and Distribution center…for storage and final disposition.

On April 25, Continental Airlines "stores" personnel found the seven oxygen generators, with the safety caps installed and the percussion firing mechanism in a "disarmed" position, loosely packed in a box with one life vest. As of the date of this report, the FAA was continuing with its investigation of this event.

In a briefing on July 29, 1997, for Safety Board staff, the FAA indicated that it had 14 ongoing investigations (which includes the Continental incident discussed above) into the transportation of chemical oxygen generators aboard commercial airplanes since the ValuJet accident. According to the briefing, the incidents under investigation involve air carriers, Part 145 maintenance repair stations and aircraft parts dealers. According to the FAA, despite efforts to heighten the awareness of the dangers of shipping hazardous materials, and in particular chemical oxygen generators, the generators are still being shipped in violation of the regulations.

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[115] Continental Airlines is authorized to carry hazardous materials that are properly packaged and labeled.

1.18.3 Hazardous Waste Requirements

The sodium chloride residue in the oxygen generator contains soluble barium salt. The soluble barium salt remaining in the generator meets EPA toxicity criteria found in Title 40 CFR 261.24.[116] Therefore, when discarded, the expended generators are regulated as a hazardous waste in accordance with the EPA's RCRA, which governs the disposal of environmentally harmful waste products. Further, Scott Aviation's Material Safety Data Sheet (MSDS) for these chemical oxygen generators states, "Generators must be spent before disposal. Due to the barium within the generator it is considered a hazardous waste even after it is spent. The spent generator must be disposed of in accordance with all Federal and State regulations."

Also, according to 40 CFR 261.21, the oxidizer core exhibits the characteristic of ignitability. Therefore, if the chemical oxygen generators were to be disposed of without expending the core, the unexpended generators would also be regulated as a hazardous waste.

Title 40 CFR 262.34 requires generators[117] of hazardous wastes to store wastes before disposal in an area meeting stringent regulatory controls, including proper containment to avoid ignition or other danger, and to periodically inspect that area.

1.18.4 Occupational Safety and Health Administration (OSHA) Requirements

The OSHA regulations in 29 CFR 1910.1200 are "intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees..."

Section 1910.1200(f)(5) states, in part, "the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with...at least general information regarding the hazards of the chemicals...."

Section 1910.1201 states, in part, "Any employer who receives a package of hazardous material which is required to be marked, labeled or placarded in accordance with the U. S. Department of Transportation's Hazardous Materials Regulations (49 CFR Parts 171 through 180) shall retain those markings, labels and placards on the package until the packaging is sufficiently cleaned of residue and purged of vapors to remove any potential hazard." Subsection 1910.1201(c) further states, "Markings, placards and labels shall be maintained in a manner that ensures that they are readily visible."

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[116] Barium compounds, not otherwise specified (n.o.s.), are regulated by the U.S. DOT as a toxic material in class 6 Division.

[117] Under 40 CFR 262.34, a generator of EPA-regulated hazardous waste is defined under the applicable RCRA regulations as "any person, by site, whose act or process produces hazardous waste identified or listed in part 261 of this chapter or whose act first causes a hazardous waste to become subject to regulation."

1.18.5 U.S. Postal Service

According to the U.S. Postal Service, it handled over 21.9 billion pounds of mail in 1996; about 2.3 billion pounds were transported by air. Also, about one million pounds of domestic mail is transported by air per day in packages weighing more than 16 ounces (1 pound). The Postal Service accepts limited quantities of hazardous materials for transportation in the mail provided they are packaged and identified in accordance with the Department of Transportation and U.S. Postal Service regulations. However, several accidents and incidents investigated by the U.S. Postal Service and the Safety Board have involved undeclared hazardous materials inadvertently or unintentionally mailed that exceeded the set quantity limits and were not properly packaged or identified; some of this mail has been transported on aircraft.

Although the February 3, 1988, in-flight fire on American Airlines flight 132 did not involve hazardous materials in the mail, the ATA and the U.S. Postal Service began working together in 1988 as an indirect result of that accident.[118] At that time, these organizations held meetings at which they stated their concerns about packages of undeclared hazardous materials being placed on aircraft through the U.S. mail. Solutions proposed at those meetings to the problem of undeclared hazardous materials included increasing postal customer awareness of hazardous material using posters, brochures, and having acceptance clerks ask questions about the contents of packages.

Since 1988, the U.S. Postal Service has developed an educational poster and a brochure. However, the Postal Service believes that its employees do not have authority to ask questions of customers about the contents of their packages and the customers are not required to tell employees what is inside their mail. According to the U.S. Postal Service Publication 52 *Acceptance of Hazardous, Restricted, or Perishable Matter*, postal personnel may obtain knowledge of the content of mail directly from the mailer only if the mailer asks questions about mailing requirements, marks the outside of the mail so as to indicate its content, or after observing leakage or other escape of contents.

The U.S. Postal Inspection Service investigates packages of undeclared hazardous material found in the mail. The Postal Inspection Service has no civil enforcement authority; it only has criminal enforcement authority, which requires proof that a person willfully violated the regulations before enforcement action can be initiated. In 1992, the U.S. Postal Service proposed legislation to authorize civil enforcement authority. Congress has yet to grant the Postal Service this authority.

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[118] As a result of the flight 132 accident, the Safety Board had issued Safety Recommendation A-88-129, which asked the ATA to "develop…a program to more effectively inform and warn passengers and shippers about restrictions and safety requirements for hazardous materials and to improve methods of detecting undeclared hazardous materials offered for air transportation."

FAA inspectors, who have civil enforcement authority, are not permitted to open mail bags or packages in the U.S. mail that are placed on aircraft without a postal inspector present. Further, on November 16, 1990, Public Law 101-615 specifically excluded the DOT from regulating hazardous materials in the U.S. Postal Service.

On August 16, 1996, the U.S. Postal Service began to require customers to bring each package weighing 16 ounces or more to a post office, and to offer it to a postal employee. According to the Postal Service press release announcing these changes, these packages may no longer be placed in mailboxes, drop boxes, or other receptacles. International or military mail of this weight must also include a return address; return addresses are not required for domestic mail. Further, the U.S. Postal Service stated these requirements "will increase security of commercial airlines carrying U.S. Mail," and "are designed to enhance security measures and to protect the traveling public, postal employees and postal contractors who transport U.S. Mail."

1.18.5.1 Hazardous Materials Incidents in the U.S. Mail on Aircraft

On June 5, 1992, the Safety Board investigated a spill of formaldehyde solution in the U.S. mail aboard USAir flight 1710 at Washington National Airport. During the investigation, the U.S. Postal Service indicated that it had more than 300 reported hazardous materials incidents in its system in fiscal years 1990 and 1991; of these, 8 incidents occurred on aircraft or in the airport ramp area.

Although the U.S. Postal Service no longer maintains centralized information to determine the extent of the problem involving undeclared hazardous materials in the U.S. mail, it was able to provide information about 13 incidents involving air shipments of hazardous materials that occurred from January 6, 1996, through March 18, 1997. One incident involved a spill of about 5 pounds of mercury in the cargo compartment of a Southwest Airlines Boeing 737 airplane on a March 18, 1997, flight to Phoenix, Arizona, from Kansas City, Missouri. The spill was discovered after the mail was removed from the airplane. Immediately upon learning of the spill, Southwest Airlines notified the pilot. The airplane, destined for San Jose, California, returned to Phoenix. Examination of the cargo compartment revealed that the cargo compartment floor was contaminated by mercury.

2.0 ANALYSIS

2.1 General

The flightcrew was properly certificated and had received the appropriate training and off-duty time prescribed by the Federal regulations. The Safety Board considered the medical histories of the flightcrew (including the captain's hypothyroidism and the first officer's diabetes, and their uses of medication to treat those conditions), and determined that there was no evidence that any preexisting medical condition affected the flightcrew's performance. The flight attendants had completed ValuJet's FAA-approved flight attendant training program. Visual meteorological conditions prevailed, and weather was not a factor in the accident.

The evidence indicated that the accident airplane was equipped and maintained in accordance with Federal regulations and approved procedures. At the time of the accident, the three MEL [minimum equipment list] items and the one CDL [configuration deviations list] item had been deferred in accordance with approved lists; of these four items, the inoperative service interphone system will be discussed in section 2.4.3, and the remaining MEL/CDL items were not related to the accident sequence. There was no evidence of preexisting mechanical malfunctions or other discrepancies in the airplane structure, flight control systems, or powerplants that would have contributed to the accident. Based on the observed damage to rotating parts, both engines were developing power at ground impact.

Evidence from the CVR revealed that about 6 minutes after takeoff from Miami, the crew of flight 592 became aware of a fire in the passenger cabin. Approximately 10 minutes after takeoff, flight 592 crashed into the Florida Everglades. The accident was not survivable. The catastrophic impact and destruction of the airplane precluded complete recovery of all airplane components. However, the wreckage that was recovered provided evidence of fire damage throughout the majority of the forward cargo compartment and areas of the airplane above it, with the most severe fire damage found in the ceiling area of the forward part of this compartment. Other areas of the airplane did not show significant fire damage, including the cockpit and the electronics compartment of the airplane located beneath the cockpit.

The airplane's electrical system was examined for indications as to what caused the electrical problems initially noted by the flightcrew. However, because so much of the wiring ran adjacent to the cargo compartment, and because so many of those wires were severely damaged, the source of those electrical anomalies could not be isolated.

Examination of the heat-damaged wire bundles and cables revealed no physical evidence of short circuits or of burning that could have initiated the fire. Further, the heat and fire damage to the interior of the cargo compartment was more severe than the damage to the exterior, consistent with the fire having been initiated inside the cargo compartment. (The cargo compartment liner, which was designed to keep a fire contained within the cargo compartment, would also have functioned to keep an externally-initiated fire out of the compartment.) Finally, the heat-damaged wire bundles were not routed near the breached area of the cargo compartment, whereas the boxes containing the oxygen generators were loaded into the area directly beneath

the breached area of the cargo compartment. Thus, the electrical system was not a source of ignition of the fire.

The investigation revealed that shortly before flight 592's departure from Miami, five boxes of unexpended chemical oxygen generators and three tires (two of which included wheel assemblies)[119] were loaded into the forward cargo compartment in the area where the fire damage was the most severe. The investigation further found that safety caps were not installed over the percussion caps that start a chemical reaction in the oxygen generators; lanyards for the retaining pins for the percussion caps' spring-loaded actuation mechanism were not secured on several generators; and the generators were not packaged adequately to prevent generators from striking the actuation mechanism or dislodging retaining pins on adjacent generators. Based on the results of the Safety Board's fire tests on chemical oxygen generators that were conducted near Atlantic City, New Jersey, after the accident, the physical evidence of fire damage in the forward cargo compartment of the accident airplane, and the lack of other cargo capable of initiating a fire in the forward cargo hold, the Safety Board concludes that the activation of one or more chemical oxygen generators in the forward cargo compartment of the airplane initiated the fire on ValuJet flight 592.

The Safety Board's analysis, therefore, first examines the accident sequence, including the initiation and propagation of the onboard fire, and the adequacy of air carrier and FAA efforts to minimize the hazards posed by fires in cargo compartments of commercial airplanes. The analysis also explores the pilots' performance and actions when they became aware of the fire shortly after takeoff from Miami, and the adequacy of smoke protection equipment and smoke evacuation procedures aboard air carrier aircraft. The analysis then examines the circumstances surrounding the shipment of the oxygen generators and the procedures for shipping company material and hazardous materials.

The analysis also evaluates concerns raised regarding the adequacy of the FAA's hazardous materials program; ValuJet's outsourcing of maintenance and training activity; the company's oversight of its contract maintenance facilities; and the FAA's oversight of ValuJet and ValuJet's contract maintenance facilities. Finally, the analysis addresses the adequacy of ValuJet's procedures for manifesting lap children.

2.2 Propagation and Detection of Fire

The first indication of a problem during the accident flight occurred at 1410:03, approximately 6 minutes after flight 592 took off from Miami, when the CVR recorded an unidentified sound, which prompted the captain to ask "What was that?" Simultaneously, an anomaly in the FDR altitude and airspeed parameters occurred consistent with a static pressure

[119] Although the stock clerk and others who handled the tires believed that all three were mounted on wheel assemblies, evidence recovered at the accident site (including several pieces of oxygen generators and other debris found inside the unruptured main tires) indicated that one of the main gear tires was not mounted on a wheel assembly.

increase of about 69 psf. Within 12 seconds, the captain reported an electrical problem, and at 1410:25, there were voices shouting "fire, fire, fire" in the passenger cabin.

In the Safety Board's fire tests,[120] a main gear tire that had been inflated to 50 psi ruptured 16 minutes after the first oxygen generator was activated, when the fire destroyed 9 of the 12 tire sidewall plies. Because the tires in the accident airplane were loaded just forward of the cargo door, the tires would have been located just above the set of left static ports. The FDR altitude and speed data are based on readings from the left alternate static port, which is located on the left side of the fuselage at FS 341 between longerons 26 and 27, indicating that the unidentified sound on the CVR and the FDR anomaly at 1410:03 were most likely caused by the rupture of an inflated tire in the forward cargo compartment after the tire was partially burned through by the fire. Based on this sequence of events, the investigation analyzed when the fire on board the accident flight might have been initiated.

Activation of a generator would have been most likely to occur during an event that could cause movement or jostling of the contents of the boxes. Accordingly, the Safety Board considered whether the fire might have been started as a result of one or more generators being activated during the loading process, which likely ended before 1340:29 when the passenger safety briefing was recorded on the CVR. The tire ruptured more than 30 minutes later. The Safety Board also considered whether the fire could have resulted from an oxygen generator being activated during the takeoff roll, which began about 1403:34. However, this was only 6 to 7 minutes before the tire ruptured.

The Safety Board recognized that several factors could have affected the rate at which the accident fire developed, as compared to that seen in the Safety Board's fire tests, including the relatively airtight design of the accident cargo compartment, the possible actuation of multiple oxygen generators, and the presence of more combustibles near the actuated generator than there were in the fire tests.[121] Therefore, based on the general timing information obtained from the fire tests, the Safety Board concludes that one or more of the oxygen generators likely were actuated at some point after the loading process began, but possibly as late as during the airplane's takeoff roll.

Given that the fire had progressed sufficiently to cause a tire in the forward cargo compartment to rupture at 1410:03, the investigation examined why there was not an earlier indication of smoke and/or fire in the cabin than the first audible report at 1410:25. Several factors might account for the lack of warning from smoke earlier in the fire sequence. First, the

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[120] The tests were not designed to be an exact replication or simulation of the circumstances of this accident, but were conducted to learn about the overall nature of a fire initiated by an oxygen generator and fed with high concentrations of oxygen released from additional oxygen generators. Because the investigation could not conclusively determine the exact physical arrangement of the generators in each box, the exact size of the boxes, the exact arrangement of the boxes and tires in the cargo compartment, or how many oxygen generators were initially activated, and because of differences between the test chamber and the accident cargo compartment, the Safety Board recognizes that the test results might differ somewhat from what occurred on the accident airplane.

[121] See also the factors outlined in footnote 120, above.

cargo compartment liner is designed to limit the amount of ventilation to and from the cargo compartment; consequently, so long as the liner is intact, the smoke will not readily escape into the passenger compartment. Second, any smoke that did escape would not have readily entered the air flow in the passenger cabin, which comes from overhead and down into the area between the airplane outer skin and the cargo liner, then moves aft and exits through the outflow valve. Third, the oxygen generators would have initially fed the fire with an abundance of oxygen, tending to minimize the amount of smoke and resulting in a very rapidly developing fire. All of these factors in combination most likely prevented any noticeable migration of smoke from the forward cargo compartment into the passenger cabin or cockpit until relatively late in the development of the fire. Although black soot deposits on some of the overhead luggage compartments indicate that black smoke ultimately reached the passenger cabin, this smoke probably did not reach the passenger cabin until after the fire had breached the cargo compartment ceiling.

Because the cargo compartment where the fire occurred was a class D cargo compartment and was not equipped (nor was it required to be equipped) with a smoke detection system, the cockpit crew of ValuJet flight 592 had no way of detecting the threat to the safety of the airplane from the in-flight fire until smoke and fumes reached the passenger cabin. Further, because the cargo compartment was not equipped (nor was it required to be equipped) with a fire suppression system, the cockpit crew had no means available to extinguish or even suppress the fire in the cargo compartment.

If the fire started before takeoff, and a smoke/fire detection warning device had activated, the flightcrew most likely would not have taken off. However, the Safety Board concludes that even if the fire did not start until the airplane took off, a smoke/fire warning device would have more quickly alerted the pilots to the fire and would have allowed them more time to land the airplane. Further, the Safety Board concludes that if the plane had been equipped with a fire suppression system, it might have suppressed the spread of the fire (although the intensity of the fire might have been so great that a suppression system might not have been sufficient to fully extinguish the fire) and it would have delayed the spread of the fire, and in conjunction with an early warning, it would likely have provided time to land the airplane safely.

Although class D cargo compartments are designed to suppress fire through oxygen starvation, this accident and events before this accident illustrate that some cargo, specifically oxidizers, can generate sufficient oxygen to support combustion in the reduced ventilation environment of a class D cargo compartment. The in-flight fire on American Airlines flight 132, a DC-9-83, on February 3, 1988 (see section 1.6.3.2), clearly illustrated the need for systems that would provide flightcrews with the means to detect and suppress fires in the cargo compartments of airplanes. As a result of its investigation of that accident, the Safety Board recommended that the FAA require fire/smoke detection and fire extinguishment systems for all class D cargo compartments (Safety Recommendations A-88-122 and -123). As recently as August 1993, although the FAA had investigated several incidents of fires that were initiated as a result of oxidizers in the cargo compartments of airplanes, the FAA responded to Safety Recommendations A-88-122 and -123 stating that fire/smoke detection and fire extinguishment systems were not cost beneficial, that it did not believe that these systems would provide a

significant degree of protection to occupants of airplanes, and that it had terminated its rulemaking action to require such systems. The Safety Board concludes that had the FAA required fire/smoke detection and fire extinguishment systems in class D cargo compartments, as the Safety Board recommended in 1988, ValuJet flight 592 would likely not have crashed. Therefore, the failure of the FAA to require such systems was causal to this accident.

The crash of ValuJet flight 592 prompted the FAA to state in November 1996 that it would issue an NPRM by the end of the summer of 1997 to require, on about 2,800 older aircraft, the modification of all class D cargo compartments to class C compartments, which are required to have both smoke detection and fire extinguishment systems. The accident also prompted the ATA to announce in December 1996 that its members would voluntarily retrofit existing class D cargo compartments with smoke detectors. As of the date of this report, the Safety Board is unaware that any airplanes have been modified and are in service.

On June 13, 1997, the FAA issued an NPRM that would require the installation of smoke detection and fire suppression systems in class D cargo compartments. According to the NPRM, the airline industry would have 3 years from the time the rule became final to meet the new standards. The FAA indicated that it anticipated issuing a final rule by the end of 1997. The Safety Board is disappointed that more than 1 year after the ValuJet crash and 9 years after the American Airlines accident at Nashville, the class D cargo compartments of most passenger airplanes still do not have fire/smoke detection or suppression equipment and there is no requirement for such equipment. The FAA's recent findings and the continued shipment of undeclared hazardous materials, including oxygen generators, highlight the importance of getting the proper equipment installed as rapidly as possible. Therefore, the Safety Board believes that the FAA should expedite final rulemaking to require smoke detection and fire suppression systems for all class D cargo compartments.

2.3 Acceptance of the COMAT Shipment

The ValuJet lead ramp agent and flightcrew were trained to reject shipments marked with hazardous materials labels and be alert to the potential hazards of undeclared hazardous materials. However, because the five boxes of chemical oxygen generators that were delivered to the ValuJet ramp had no hazardous material markings or labels, and because the shipping ticket that the SabreTech employee provided to the ValuJet lead ramp agent indicated that the boxes contained empty oxygen canisters, neither the ValuJet lead ramp agent nor the ramp agent who loaded the boxes were provided with information to indicate the hazardous nature of the COMAT shipment. Based on the description of the COMAT on the shipping ticket, they might have assumed that the boxes contained empty (non-hazardous) oxygen cylinders. Therefore, the lead ramp agent likely was not prompted to discuss the contents of the COMAT shipment with the SabreTech employee or the flightcrew.

The shipment also included three aircraft tires, the carriage of which was not prohibited by the hazardous materials regulations so long as the tires were not over-inflated. Although the lead ramp agent testified that he had shown the shipping ticket to the first officer, it is unlikely that the first officer would have considered empty oxygen canisters or aircraft tires as

potentially hazardous. Based on the available information, the flightcrew would have had no reason to know or suspect that hazardous materials were being proffered for carriage aboard the airplane. The Safety Board concludes that given the information available, the ramp agents' and flightcrew's acceptance of the COMAT shipment was not unreasonable. (The packaging and labeling of the COMAT will be further discussed in sections 2.6 and 2.7.)

The COMAT was not secured inside the cargo compartment by netting, straps, or any other means of preventing movement of the items. The hazardous materials regulations require that packages containing hazardous materials be secured.[122] Although it is possible that the generator(s) that initiated the fire actuated as a result of being struck by unsecured cargo (such as the tires), and that the accident could have been avoided by securing the cargo, it cannot be conclusively determined whether unsecured cargo played a role in actuating the generators. However, as a "no carry" carrier, ValuJet would generally have had no reason to secure the cargo loaded on its airplanes. More importantly, if the ValuJet ramp agents and flightcrew had been made aware that the packages contained hazardous materials they probably would have rejected the shipment and it would not have been transported aboard the airplane. Accordingly, the Safety Board concludes that ValuJet's failure to secure the cargo was not unreasonable.

2.4 Flightcrew Decisions and Actions

2.4.1 Flightcrew Performance Before the Emergency

The CVR recording indicates that as the airplane taxied out for takeoff and departed from Miami, all checklists were completed adequately, the captain conducted a pre-takeoff briefing, and information was exchanged freely among the captain, first officer, and forward flight attendant. After takeoff, the captain was operating the controls of the airplane and the first officer was handling communications with air traffic controllers. Based on the CVR recording, the flightcrew's performance was appropriate during the portions of the flight that preceded the crew's first awareness that a problem existed.

2.4.2 Flightcrew Decisions and Actions During the Emergency

Beginning at 1410:12, the flightcrew noted and verbalized concerns about electrical problems. At 1410:22, the captain stated, "We need, we need to go back to Miami." This was followed 3 seconds later by shouts in the background of "fire, fire, fire." Seven seconds later, as the first officer transmitted a request to ATC for clearance to return to Miami (and before receiving clearance from ATC), the airplane leveled off and began to descend.

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[122] 49 CFR 175.81(a) states, "[p]ackages containing hazardous materials must be secured in an aircraft in a manner that will prevent any movement in flight which would result in damage to or change in the orientation of the packages."

Based on the shouts from the passenger cabin recorded on the CVR cockpit area microphone at 1410:25 and the comment 2 seconds later, "we're on fire, we're on fire," it should have been clear to both flightcrew members that a very serious emergency situation existed in the cabin. Although the captain decided immediately to return to Miami and initiated a descent, for the next 80 seconds the airplane continued on a northwesterly heading (away from the Miami airport) while the flightcrew accepted ATC vectors for a wide circle to the left and a gradual descent back toward Miami.

The Safety Board evaluated the electrical system, engine, and flight control malfunctions that occurred in the 80 seconds during which the airplane continued northwestward away from MIA. The electrical problems that first made the flightcrew aware of the emergency (at 1410:12) likely were the result of insulation burning on wires in the area of the cargo compartment. Electrical system wiring is routed outside of the cargo compartment of the DC-9, in accordance with 14 CFR Part 25.869, which requires the wiring not to be located against the cargo compartment liner and to incorporate a high temperature insulation. Therefore, the flightcrew's comments about the electrical problems indicate that the fire had probably already escaped the cargo compartment by 1410:12. (However, it probably had not yet burned through the cabin floorboards.) The flightcrew comments recorded by the CVR from 1410:12 through 1410:22 reflect the pilots' concerns about and attention to these electrical problems. It is possible that these concerns continued to occupy some of the pilots' attention during the initial period of their attempt to return to the ground.

Another malfunction began at 1410:26, just as the shouts from the cabin would have alerted the flightcrew to the seriousness of the fire there. According to FDR data, while the left engine remained at its previous EPR setting, the right engine's EPR decreased to the flight idle value. The reduction in thrust would likely have been an intentional act by the flightcrew to reduce power for the descent to return to the ground. The activation of the landing gear warning horn at 1410:28 suggests that the flightcrew had reduced power to idle (the warning horn is activated by one or both throttle levers being positioned at approximately the flight idle position). Because the flightcrew would not have intentionally reduced thrust on one engine only, they must have been unable to reduce the thrust on the left engine because of fire damage to the engine control cable located above the compartment. The inability to reduce left engine thrust could have distracted the flightcrew.

Further, the thrust asymmetry continued throughout the period and resulted in a sideslip and lateral accelerations that were not corrected with rudder application. Therefore, left-wing-down (LWD) aileron deflections would have been necessary to keep the airplane from rolling to the right. Because there were no right roll indications in the FDR heading data, the flightcrew must have been applying the LWD control inputs.

The FDR indicates that at 1411:20, vertical acceleration increased to about 1.4 G, although the control column had not moved. Subsequently, the control column position was moved forward about 5^{o} to reduce the vertical acceleration back to 1 G. At this time, the airplane leveled temporarily at about 9,500 feet. These events indicate that the flightcrew was confronted with a disruption in pitch control (in the elevator or trim systems), and was active in maintaining

at least partial control of the airplane. The pilots could have found the disruption in control to be distracting, and the level off is consistent with their attempts to handle the pitch controls carefully. The development of malfunctions from the electrical system to engine thrust controls and flight controls indicates that the flight experienced a progressive degradation in the airplane's structural integrity and flight controls.

At 1412:00, FDR-recorded altitude suddenly decreased and no longer agreed with the altitudes recorded from radar transponder returns (these altitudes are derived from different static sources). The disagreement between altitude values indicates that the fire damage continued to increase.

Radar data show that at 1412:58, when the airplane was at 7,400 feet, it began a steep left turn toward Miami and a rapid descent. For the next 32 seconds, the descent rate averaged about 12,000 feet per minute, and the airplane turned from a southwesterly heading toward the east. If asymmetric thrust were providing right yaw/rolling moments during this turn, the flightcrew would have had to counter this tendency with continuing left roll control inputs throughout the turn. The radar data indicated that the left turn then stopped on a heading of about 110^{o} at 1413:25, which was toward MIA. Further, the rapid descent rate was being reduced, with the last transponder-reported altitude at 900 feet. The control inputs required to balance asymmetric thrust during the steep left turn, followed by the level-off, indicates that the flightcrew initiated a turn and descent, and that the captain and/or the first officer were conscious and applying control inputs to stop the steep left turn and descent (until near 1413:34). Thus, the airplane remained under at least partial control by the flightcrew for about 3 minutes and 9 seconds after 1410:25.

Ground scars show that the airplane was in a large right roll angle and steep nose-down attitude at impact. To achieve that attitude and fly through the position indicated by the primary radar return recorded at 1413:39, the airplane would have had to start rolling to the right at 1413:34, at least 8 seconds before the crash.

Because of the lack of evidence from the CVR, FDR, and the wreckage, the Safety Board was unable to determine with certainty the reason for the loss of control that occurred at that time. However, examination of the wreckage showed that before the impact the left side floor beams melted and collapsed, which would likely have affected the control cables on the captain's side. It is possible that the first officer might have taken over flying from the captain, but the remaining control cables also were possibly affected by distorting floor beams. Based on the continuing degradation of flight controls and the damage to cabin floorboards in the area of the flight controls, the Safety Board concludes that the loss of control was most likely the result of flight control failure from the extreme heat and structural collapse; however, the Safety Board cannot rule out the possibility that the flightcrew was incapacitated by smoke or heat in the cockpit during the last 7 seconds of the flight.

2.4.3 Crew's Use of Emergency Procedures and Equipment

To help assess the flightcrew's actions in response to the clear evidence of a fire on the airplane, the Safety Board evaluated the ValuJet guidance and training in fire and smoke emergencies provided to the flightcrew. ValuJet had established four emergency procedures for handling fire and smoke from electrical system and air conditioning (pressurization) system malfunctions, removing smoke from a pressurized airplane, and removing cockpit smoke from an unpressurized airplane. (See section 2.5 for a discussion of an alternate cabin smoke removal procedure developed by the airplane manufacturer.)

Given the pilots' clear awareness of smoke and fire aboard the airplane (based on their statements recorded on the CVR), the Safety Board evaluated the effect of the flight attendants' actions on the flightcrew, the flightcrew's use of the ValuJet smoke evacuation procedures and emergency equipment, and the adequacy of that equipment.

When the flight attendant first opened the cockpit door at 1410:52, some smoke from the cabin area was likely introduced into the cockpit environment. However, during the 1 minute 42 seconds in which the CVR operated continuously after the emergency began (including the times that the cockpit door was open), the flightcrew made no comments about breathing or vision difficulties, nor were there any sounds of coughs from the crewmembers during this period.[123] Based on the absence of comments and sounds indicating flightcrew physical impairment on the CVR, the Safety Board concludes that only a small amount of smoke entered the cockpit before the last recorded flightcrew verbalization at 1411:38, including the period when the cockpit door was open.

However, the Safety Board is concerned that if the smoke concentrations on the cabin side of the door had been severe when the flight attendant opened the door, her actions could have resulted in the introduction of incapacitating smoke into the cockpit.

In the event of a cabin fire, the cabin crew needs to immediately communicate information to the flightcrew, while maintaining a smoke barrier between the cockpit and cabin. The interphone would have been the most appropriate way to do this, but it was inoperative. Based on the FAA POI's suggestion that an appropriate "alternate procedure" for an inoperative interphone might consist of a prearranged code for knocking on the cockpit door to gain entry, the Safety Board concludes that the current MEL requirements for the development of an "alternate procedure" for an inoperative service interphone are inadequate for a cabin fire situation. Therefore, the Safety Board believes that the FAA should specify, in air carrier operations master MELs, that the cockpit-cabin portion of the service interphone system is required to be operating before an airplane can be dispatched.

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[123] The first officer coughed several times while the airplane was on the ground at Miami, but no coughing was recorded during the emergency portion of the flight.

Evidence recovered at the accident site indicates that the pilots were active in attempting to remove smoke from the cabin and cockpit before impact, and in doing so they had executed portions of the ValuJet emergency procedures for handling smoke. The soot pattern found on the outflow valve recovered in the wreckage is consistent with the flightcrew having at least partially opened the outflow valve using the manual method, which is part of the ValuJet electrical smoke/fire procedure for evacuating smoke.

The four ValuJet emergency procedures for handling smoke and fire uniformly instructed the pilots to don their oxygen masks and smoke goggles, as the first item to be performed on the emergency checklist. However, the flightcrew comments recorded on the CVR sounded unmuffled. Further, these comments were recorded on the cockpit area microphone channel of the CVR; this microphone would not have picked up verbalizations made under an oxygen mask. This indicates that neither the captain nor the first officer donned their oxygen masks during the period of the emergency in which the CVR was operative and the pilots were speaking. The last recorded verbalization by the captain was at 1410:49; the last by the first officer was at 1411:38. Because smoke goggles of the type provided to the flightcrew must be donned subsequent to the oxygen mask to have any effect, the pilots probably did not don their smoke goggles from the onset of the emergency, at 1410:07, through at least 1411:38. There is no evidence to indicate whether they donned their masks and goggles after 1411:38.

The donning of oxygen masks and smoke goggles at the first indication of smoke anywhere in the airplane can provide flightcrews with a sustained ability to breathe and see in the event of a subsequent influx of smoke into the cockpit. Although in this accident, the donning of oxygen masks and smoke goggles would not have assisted the crew in the initial stages of the emergency (because of the absence of heavy smoke in the cockpit), early donning of the smoke protection equipment might have helped later in the descent, if heavy smoke had entered the cockpit. Consequently, the Safety Board evaluated why the pilots of ValuJet flight 592 did not don their oxygen masks or smoke goggles while the emergency was in its early stages.

The training records of the captain and first officer substantiated that both pilots had received a single session of simulator training in the electrical fire and smoke emergency procedure during the ValuJet initial DC-9 qualification program (the first step of which was to don oxygen masks and smoke goggles). However, in the captain's previous incident involving smoke in the cabin from an overheated air conditioning pack, she had obtained a successful outcome without donning the mask and goggles. This might have predisposed her to decide not to don an oxygen mask and smoke goggles when the emergency began on the accident flight.

In an informal survey of air carriers conducted by the Safety Board, pilots from several air carriers indicated that they would not don oxygen masks and smoke goggles for situations such as reports of galley fire, smoke in the cabin, or a slight smell of smoke in the cockpit. Based on the circumstances of this accident and the results of its survey, the Safety Board concludes that there is inadequate guidance for air carrier pilots about the need to don oxygen masks and smoke goggles immediately in the event of a smoke emergency. The Safety Board believes that the FAA should issue guidance to air carrier pilots about the need to don

oxygen masks and smoke goggles at the first indication of a possible in-flight smoke or fire emergency.

The Safety Board also considered that air carrier pilots, including those involved in this accident, might not don their smoke goggles immediately because the time and effort required to do so might interfere with their flight-related workload. The Board has no indication of problems with donning any of the current designs of quick-donning oxygen masks; however, based on its simulator evaluations of the time and effort required to don the smoke goggles provided to the accident flightcrew, the Safety Board recognizes that donning this equipment immediately could have detracted from crew coordination, aircraft control, and communications between the crewmembers and ATC.

Therefore, as they attempted to return to Miami, the pilots had to balance the workload required to don this equipment against their requirements for crew coordination and airplane control. The Safety Board concludes that the pilots did not don (or delayed donning) their oxygen masks and smoke goggles, and that in not donning this equipment, they were likely influenced by the absence of heavy smoke in the cockpit and the workload involved in donning the type of smoke goggles with which their airplane was equipped.

Title 14 CFR Part 121.333 requires that pilots of pressurized airplanes operating above flight level 250 be provided a "quick-donning type of oxygen mask that…can be placed on the face from its ready position, properly secured, sealed, and supplying oxygen upon demand, with one hand and within five seconds." This regulation also requires that the mask can be "put on without disturbing eyeglasses and without delaying the flight crewmember from proceeding with his assigned emergency duties." The Safety Board notes that FAA regulations do not establish any similar performance requirements for smoke goggles.[124]

Based on the Safety Board's simulator evaluation of the equipment furnished to the flightcrew of ValuJet flight 592 and its informal survey of air carrier pilots, the Board concludes that the smoke goggle equipment currently provided on most air carrier transport aircraft requires excessive time, effort, attention, and coordination by the flightcrew to don. Consequently, the Safety Board believes that the FAA should establish a performance standard for the rapid donning of smoke goggles; then ensure that all air carriers meet this standard through improved smoke goggle equipment, improved flightcrew training, or both.

During its investigation of this accident, the Safety Board learned that many current installations of smoke goggles at a variety of U.S. air carriers place the goggles within sealed plastic wrapping, and this wrapping is sufficiently thick such that it cannot be easily opened (without using one's teeth to tear the plastic material or requiring the pilot to obtain and

[124] The Safety Board has expressed its concerns to the FAA about the performance of smoke goggles beginning in 1974, as a result of its investigation of the Pan American World Airways B-707 freighter accident at Boston and in 1983, as a result of the Air Canada DC-9 accident at Cincinnati. The Board recognizes that the FAA currently has design requirements for smoke goggles in 14 CFR Part 25.1439 and Technical Standard Order (TSO) C99. However, none of these requirements establish minimum performance standards for donning time or difficulty.

manipulate a sharp object and devote both hands to opening the bag). The Safety Board is concerned that flightcrews attempting to don these smoke goggles in an emergency might be unable to open the wrapping material quickly because the configuration of the equipment requires that the oxygen mask be secured over the pilot's face before attempting to don the smoke goggles. The Safety Board concludes that the sealed, plastic wrapping used to store smoke goggles in much of the air carrier industry poses a potential hazard to flight safety. Consequently, the Safety Board believes that the FAA should require that the smoke goggles currently approved for use by the flightcrews of transport-category aircraft be packaged in such a way that they can be easily opened by the flightcrew.

The Safety Board is aware that emergency cockpit vision technology exists that might be applicable to improving flightcrews' ability to see in the event of smoke in the cockpit. In this accident, based on the absence of flightcrew comments about smoke early in the sequence, the light sooting within the cockpit indicated by recovered wreckage, the likelihood that the flightcrew did not don smoke goggles (which need to be used with the emergency cockpit vision device), and the likelihood of severely degraded airplane controllability later in the sequence, the use of emergency cockpit vision technology would not have prevented this accident. Further, the Safety Board is concerned that flightcrews encountering a smoke emergency might devote valuable time and attention to rigging an emergency cockpit vision device, to the exclusion of the timely donning of their oxygen masks/smoke goggles and their execution of smoke removal procedures. However, the Safety Board concludes that emergency cockpit vision devices might have potential safety benefits in some circumstances. Therefore, the Safety Board believes that the FAA should evaluate the cockpit emergency vision technology and take action as appropriate.

As a result of its investigation of the Air Canada DC-9 in-flight fire accident, the Safety Board recommended that the FAA "expedite the research at the Civil Aero Medical Institute necessary to develop the technology, equipment standards, and procedures to provide passengers with respiratory protection from toxic atmospheres during in-flight emergencies aboard transport category airplanes" (Safety Recommendation A-83-76). Based on the development of a joint international standard for passenger protective breathing equipment (PBE), the Safety Board classified this safety recommendation "Closed—Acceptable Action" on March 6, 1995.

The Safety Board acknowledges that there are a variety of concerns about providing PBE to passengers (primarily based on the possibility that an emergency evacuation would be delayed while passengers don this equipment). Further, the Safety Board notes the emergence in recent years of potential alternative technologies for protecting passengers from a toxic cabin atmosphere caused by fires. The Safety Board is also aware that the National Aeronautics and Space Administration (NASA) has undertaken a new research program focused on mitigating the severity of survivable accidents.

The Safety Board concludes that emerging technology, including research being conducted by NASA, might result in improvements in the potential to provide passenger respiratory protection from toxic cabin atmospheres that result from in-flight and post-crash fires. Therefore, the Safety Board believes that the FAA should evaluate and support appropriate

research, including the NASA research program, to develop technologies and methods for enhancing passenger respiratory protection from toxic atmospheres that result from in-flight and post-crash fires involving transport-category airplanes.

2.5 Emergency Procedures for Smoke Removal

Although ValuJet adopted the DC-9 procedures developed by Douglas for clearing smoke from the cockpit (including, as a last resort for smoke originating in the cockpit, depressurizing the airplane and opening a cockpit side window to remove the smoke),[125] ValuJet did not adopt a procedure developed by Douglas for the evacuation of smoke from the passenger cabin. This procedure calls for partially opening the right forward service door at the front of the cabin, then opening the passenger aft (tailcone) entrance door. According to Douglas, if these doors are opened, the "airflow will sweep smoke forward [to the open service door]" and the procedure is effective in clearing smoke from both the cabin and cockpit area. This procedure has been adopted by some operators of the DC-9, and similar procedures have been adopted by some operators of Boeing 747 airplanes, but the procedure has not been adopted by most U.S. carriers.

The Douglas procedure was examined by the Safety Board in 1983 during its investigation of the Air Canada DC-9 in-flight fire accident. In that examination, the Board recognized the efficacy of the procedure in removing cabin smoke (based on flight test results provided by Douglas). Noting concerns expressed by some air carriers and fire protection experts (but not by the manufacturer, which disagreed) that the procedure could intensify a fire, the Safety Board stated that the outcome of using this procedure during the Air Canada accident sequence was highly uncertain.

In this accident, the Safety Board concludes that because of the rapid propagation of the oxygen-fed fire and the resulting damage to the airplane's control cables and structure, the use of the Douglas smoke evacuation procedures would likely not have affected the outcome. The Safety Board also recognizes that airlines that have not adopted these procedures might have what they believe to be legitimate safety reasons for that decision. Nevertheless, the Safety Board also concludes that the Douglas DC-9 procedures involving partial opening of cabin doors for in-flight evacuation of smoke or fumes from the passenger cabin and similar procedures adopted by some operators of other transport-category airplanes might clear smoke sufficiently in the cabin (and prevent entry into the cockpit) to prolong the occupants' survival time during some fire and smoke emergencies. Therefore, the Safety Board believes that the FAA should evaluate the usefulness and effectiveness of the Douglas DC-9 procedures involving the partial opening of cabin doors and similar procedures adopted by some operators of other transport-category airplanes for evacuating cabin smoke or fumes and, based on that evaluation, determine

[125] The Douglas procedure states that the open cockpit window produces a loud noise level in the cockpit that renders communications impossible if airspeed exceeds 165 knots. Because there was no such noise recorded on the CVR, it is apparent that the flightcrew did not open the cockpit side window when the CVR was operating.

whether these or other procedures should be included in all manufacturers' airplane flight manuals and air carrier operating manuals.

2.6 Guidance for the Removal and Disposition of Chemical Oxygen Generators

Because the majority of oxygen generators removed from the MD-80s had exceeded their life limits and could not be used again, they were neither salvageable nor repairable and should have been stored or disposed of in accordance with the MD-80 Maintenance Manual procedures. Although the Douglas MD-80 maintenance manual contains procedures for removal and actuation of oxygen generators, the manual does not specify that the generators should be actuated before they are transported. Based on incidents after the ValuJet accident, the Safety Board is concerned that the potential clearly still exists for expired generators to be transported before they are actuated. The Safety Board concludes that given the potential hazard of transporting oxygen generators and because oxygen generators that have exceeded their service life are not reusable, they should be actuated before they are transported. Therefore, the Safety Board believes that the FAA should require airplane manufacturers to amend company maintenance manuals for airplanes that use chemical oxygen generators to indicate that generators that have exceeded their service life should not be transported unless they have been actuated and their oxidizer core has been depleted.

In this accident, because the generators were hazardous materials, they should not have been transported on a ValuJet airplane because the carrier was not authorized to carry hazardous materials. The Safety Board's investigation, therefore, examined the handling of the chemical oxygen generators after they were removed from the MD-80 airplanes and considered whether actions could have been taken or procedures could have been implemented to prevent the unauthorized placement of these generators on flight 592.

2.6.1 Adequacy of Information on Routine Work Card 0069

Execution of work card 0069 required a signature by a mechanic to confirm the completion of each step in the removal and installation of the chemical oxygen generators. The card also required that a supervisor sign the card confirming that all of the mechanic blocks had been signed off once the entire job was completed. However, it did not require the signature of an individual to confirm that the work of the mechanic had been inspected. Inspection of work performed is a critical step in the maintenance process, particularly maintenance that involves the handling of hazardous materials. The Safety Board concludes that because work card 0069 did not require an inspector's signoff at the completion of each task, and there was no requirement for it to do so, there might have been no inspection of the maintenance work related to the removal of the chemical oxygen generators. The Safety Board further concludes that had work card 0069 required an inspector's signoff, one of the inspectors involved with the two airplanes might have noticed that safety caps had not been installed on any of the generators.

Although work card 0069 warned about the high temperatures produced by an activated generator, it did not mention that unexpended generators required special handling for storage or disposal, that out-of-date generators should be expended and then disposed of, or that

the generators contained hazardous substances/waste even after being expended; further, the work card was not required to contain such information. Although these issues are addressed in the Douglas MD-80 maintenance manual, chapter 35-22-01, given the relative simplicity of the task and the removal instructions already outlined on the work card, and the lack of any reference on the work card to this section of the maintenance manual, the mechanics likely completed the removal of the generators without referring to this section of the maintenance manual.

In contrast, at the time of the accident, another air carrier's work card for the same task included a clear warning about the hazardous nature of the unexpended generator, and clear instructions to dispose of the generators in a specific manner. This air carrier's work card called for the discharge of all removed generators, and included instructions about the method for discharging them. It also clearly identified the discharged generators as hazardous waste. The card also stated specifically that the expended generators must be held at the location where they were removed, and directed the individuals performing the removal task to "immediately notify the environmental affairs manager."

Thus, the mechanics who removed the oxygen generators from the MD-80s were not made fully aware, by reading only work card 0069, of the hazardous nature of the generators or of the existence of an approved, uncomplicated procedure for expending the generators that required no unusual equipment. Some of the mechanics acknowledged that they had (both intentionally and unintentionally) activated some of the generators, and thus they must have been somewhat familiar with the process and the heat generated by the activated generators. However, the Safety Board concludes that had work card 0069 required, and included instructions for, expending and disposing of the generators in accordance with the procedures in the Douglas MD-80 maintenance manual, or referenced the applicable sections of the maintenance manual, it is more likely that the mechanics would have followed at least the instructions for expending the generators.

In view of the above, the Safety Board believes that the FAA should require that routine work cards used during maintenance of Part 121 aircraft (a) provide, for those work cards that call for the removal of any component containing hazardous materials, instructions for disposal of the hazardous materials or a direct reference to the maintenance manual provision containing those instructions, and (b) include an inspector's signature block on any work card that calls for handling a component containing hazardous materials.

2.6.2 Lack of Hazardous Materials Labels on the Removed Generators

The expired generators did not have labels or markings on them warning of the high temperatures generated during activation, or any emblems indicating that the generators were a hazardous material. Although generators manufactured by Scott Aviation since 1988, including those that were delivered to SabreTech for installation on the ValuJet MD-80s, have labels warning of the high temperatures generated during activation, the Safety Board is concerned that they do not adequately communicate the significant dangers posed if the canisters are not handled properly after removal from aircraft. Many of the mechanics who removed the generators recognized that the canisters generated heat, but apparently did not fully understand

the severity of the dangers posed by unexpended generators. Therefore, the Safety Board concludes that had a warning label or emblem clearly indicating the significant danger posed been affixed to each generator, personnel handling the generators, including the personnel in shipping and stores who prepared them for shipment to Atlanta, might have been alerted to the need to determine how to safely handle and ship the generators. Had they done so, they might have learned of the need for (and acquired) safety caps and they might also have learned that unexpended generators demand special packaging and identification requirements (and taken appropriate actions). Even if they did only one of these actions, the accident would not likely have occurred.

Further, in light of the recent incident involving unauthorized transportation of oxygen generators (removed during airplane maintenance) aboard a Continental Airlines passenger flight, and other incidents involving the improper transport of chemical oxygen generators, the Safety Board concludes that the existing prohibition against transporting oxygen generators on passenger aircraft has not been completely effective, and improper handling of oxygen generators could be reduced by affixing an effective warning label or emblem on all existing and newly manufactured chemical oxygen generators to clearly identify the dangers and hazards of unexpended generators and the severe consequences that can occur if mishandled. Therefore, the Safety Board believes that the FAA should require manufacturers to affix a warning label to chemical oxygen generators to effectively communicate the dangers posed by unexpended generators and to communicate that unexpended generators are hazardous materials. The FAA should further require that aircraft manufacturers instruct all operators of aircraft using chemical oxygen generators of the need to verify the presence of (or affix) such labels on chemical oxygen generators currently in their possession. The Safety Board is concerned that other hazardous aircraft components might not be identified or handled properly. Therefore, the Safety Board believes that the FAA should require all air carriers to develop and implement programs to ensure that other aircraft components that are hazardous are properly identified and that effective procedures are established to safely handle those components after they are removed from aircraft.

2.6.3 Lack of Safety Caps

The Safety Board concludes that although the installation of safety caps would not likely have prevented the oxygen generators from being transported on board flight 592, it is very likely that had safety caps been installed, the generators would not have activated and the accident would not have occurred. Based on the Aircraft Maintenance Service Agreement between ValuJet and SabreTech, the safety caps that were required to be installed on the chemical oxygen generators removed from N802VV and N803VV were considered "peculiar" expendables because they were not routinely carried in SabreTech's inventory. (The removal of chemical oxygen generators was an infrequently performed task because of the generators' 12-year life limit.) It appears from the service agreement that ValuJet was responsible for supplying peculiar expendables to SabreTech. However, ValuJet did not ensure that the required safety caps were obtained and installed. Although SabreTech never specifically requested that ValuJet supply it with safety caps, one of the ValuJet technical representatives assigned to the SabreTech facility during the reconfiguration of the MD-80s stated that he had observed generators without

the safety caps installed and had expressed concern to SabreTech mechanics that the generators were "hazardous when set off." He indicated that he asked that the generators be moved and disposed of as hazardous waste, and he said that he followed up to ensure that they were moved. However, he did not address the lack of safety caps, or follow up to determine how the generators were handled after they were moved.

Even if under the terms of the service agreement ValuJet was responsible for providing the safety caps, SabreTech should have ensured that the safety caps were installed on the removed generators. Work card 0069 clearly specified that safety caps were to be installed on any generator that had not been expended after it was removed from an airplane. Although the work cards were signed off by SabreTech mechanics and supervisory personnel indicating that all steps on the work cards had been completed, safety caps were never installed on the oxygen generators. The investigation revealed that some SabreTech supervisory personnel were advised by mechanics of the need for safety caps, but they took no action to acquire them, and that the mechanics who brought this matter to the attention of the supervisory personnel did not follow up to assure that the safety caps were acquired. Further, one of the mechanics who discussed with his supervisor the need for safety caps later carried some of the open boxes of uncapped generators to the SabreTech shipping and stores area and left them there without informing anyone in that area of what the items were, or of their hazardous nature. Moreover, one of the SabreTech inspectors who signed the "final inspection" block on the non-routine work card for one of the airplanes knew that the generators needed safety caps, but signed the card anyway relying on representations by supervisory personnel that this would be "taken care of" in the shipping and stores department, yet he never verified that this had been done.

The Safety Board determines that the failure of both ValuJet and SabreTech to ensure that safety caps were available and installed on the chemical oxygen generators, in accordance with prescribed maintenance procedures, contributed to the cause of the accident.

The Safety Board is alarmed at the apparent willingness of mechanics and inspectors at the SabreTech facility to sign off on work cards indicating that the maintenance task had been completed, knowing that the required safety caps had not been installed, and at the willingness of those individuals and other maintenance personnel (including supervisors) to ignore the fact that the required safety caps had not been installed. The Safety Board has long been concerned about false maintenance entries, and their sometimes catastrophic implications.[126] As a result of the investigation of the accident involving Tower Air flight 41 on December 20, 1995, (which revealed that contrary to representations in company maintenance records, a required functional test of the FDR had not been accomplished), the Safety Board recommended in Safety Recommendation A-96-160 that the FAA

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[126] National Transportation Safety Board. 1992. *Britt Airways, Inc., d/b/a Continental Express Flight 2574, In-flight Structural Breakup, Emb-120RT, N33701, Eagle Lake, Texas, September 11, 1991,* Aircraft Accident Report NTSB/AAR-92/04. Washington, D.C.; National Transportation Safety Board. 1996. *Runway Departure During Attempted Takeoff, Tower Air Flight 41, Boeing 747-136, N605FF, JFK International Airport, New York, December 20, 1995,* Aircraft Accident Report NTSB/AAR-96/04. Washington, D.C.

> Reassess inspectors' methods of evaluating maintenance work, focusing on the possibility of false entries through selective detailed analysis of records and unannounced work site inspections.

In its letter dated February 25, 1997, the FAA responded that it "conducts unannounced work site inspections and analysis of records as part of its oversight methods," and indicated that "[t]he FAA believes that these methods are adequate to ensure effective oversight," to identify false records. However, as this accident and others demonstrate, false maintenance entries continue to go undetected and more effective oversight techniques are needed.

The Safety Board concludes that improper maintenance activities and false entries pose a serious threat to aviation safety and must be curtailed. Thus, the Safety Board believes that the FAA should evaluate and enhance its oversight techniques to more effectively identify and address improper maintenance activities, especially false entries. Therefore, Safety Recommendation A-96-160 is classified "Closed—Unacceptable Action Superseded," to be replaced by a new recommendation.

2.6.4 Use of Improper Parts Tag

According to SabreTech's inspection procedures manual, a Form M020, Condemned Parts Tag (red tag) should have been attached to the removed generators rather than Form M021, Repairable Parts Tag (green tag) that was attached to most of the generators. Repairable Parts Tags should have been attached only to components that could be repaired, and these generators were not repairable items. The Safety Board analyzed whether the stock clerk who packaged the generators for shipment to Atlanta or the receiving clerk who assisted him by preparing the shipping paper would have handled them any differently if they had been appropriately tagged.

The stock clerk who packaged the generators stated in postaccident interviews that he believed green tags indicated that an item was "unserviceable," and that red tags indicated an item was "beyond economical repair" or "scrap." He indicated that red-tagged items were kept in a different area than green-tagged items, but that both would be returned to the customer. The receiving clerk who prepared the shipping ticket stated that when the stock clerk asked for his assistance, the boxes were already packaged and sealed, and he did not see the contents. Thus, based on the stock clerk's confusion regarding the meaning of green and red tags and his practice of shipping both kinds of parts back to the customer, and the receiving clerk's lack of awareness of what type of tag was attached, it appears that these employees would not likely have handled the generators any differently if red tags rather than green tags had been attached to the expired generators. Therefore, the Safety Board concludes that although the use of the wrong parts tag was an additional failure of SabreTech to perform maintenance activity in accordance with prescribed maintenance procedures, it probably did not contribute to the mishandling of the generators that ultimately led to the generators being loaded into the forward cargo compartment on flight 592.

2.6.5 Lack of Communication About Items Left in Shipping and Stores Area

Personnel in the shipping and receiving department were not informed about the generators when they were placed in the ValuJet customer hold area. According to the stock clerk, the boxes were already in the hold area one morning when he arrived at work. SabreTech had no formal procedure in place that required an individual leaving items in the shipping and receiving area to inform anyone in that area of what the items were, or that they were hazardous. The stock clerk said that no one told him anything about the generators or the hazardous nature of the generators. Had SabreTech had a system requiring that items delivered to its shipping and receiving department be properly identified and classified as hazardous or non-hazardous, and if that system had included procedures for tracking the handling and disposition of hazardous materials, it is likely that the hazardous nature of the generators would not have been overlooked, and that they would not have been improperly packaged and delivered to the accident flight.

The Safety Board notes that although the Aircraft Maintenance Service Agreement between ValuJet and SabreTech clearly indicated that SabreTech would retain any material that had been removed from an airplane and was not to be reinstalled until ValuJet authorized disposal of such material in writing, and that although the director of logistics at SabreTech clearly understood this provision, SabreTech personnel shipped the generators to ValuJet without having ValuJet's permission. The director of logistics at SabreTech stated that he did not intend to have any of the ValuJet property shipped until after disposition decisions were made by ValuJet. However, according to the stock clerk who sent the boxes of generators over to the ValuJet ramp, the director of logistics had replied with "Okay" when the stock clerk asked if he should "close up the boxes and prepare them for shipping to Atlanta." The stock clerk said he was concerned about cleaning up the shipping and receiving area, and had made an attempt to ascertain if it was all right to ship the generators back to ValuJet. He came away from his conversation with the director of logistics believing that he had been given permission to make the shipment. However, the director of logistics indicated he did not give permission to ship the boxes, and that nobody had asked him what to do with the boxes.

The Safety Board concludes that the lack of a formal system in SabreTech's shipping and receiving department, including procedures for tracking the handling and disposition of hazardous materials, contributed to the improper transportation of the generators aboard flight 592. Although this problem is no longer relevant to SabreTech's Miami facility in light of the surrender of its repair station certificate, the Safety Board is concerned that air carriers and other Part 145 repair facilities performing heavy maintenance for air carriers might have similar deficiencies. Accordingly, the Safety Board believes that the FAA should review the adequacy of current industry practice and, if warranted, require that Part 121 air carriers and Part 145 repair facilities performing maintenance for air carriers develop and implement a system requiring items delivered to shipping and receiving and stores areas of the facility to be properly identified and classified as hazardous or non-hazardous, and procedures for tracking the handling and disposition of hazardous materials.

2.6.6 SabreTech's Preparation of the COMAT Shipment

Based at least partially on the improper handling and tagging of the oxygen generators by SabreTech mechanics, the SabreTech stock clerk did not prepare or package the generators properly, or attach hazardous materials labeling that likely would have alerted ValuJet's ramp personnel to the hazardous contents of the shipment. Consequently, the Safety Board concludes that the failure of SabreTech to properly prepare, package, and identify the unexpended chemical oxygen generators before presenting them to ValuJet for carriage aboard flight 592 was causal to the accident.

2.6.7 Human Factors in the Maintenance Environment

Many of the shortcomings discussed above (including the SabreTech mechanics' failure to install safety caps, their improper maintenance entries, their use of improper tags, and the inadequate communications between the maintenance shop floor and stores department) result from human failures that might have been avoided if more attention were given to human factors issues in the maintenance environment. Although it is unclear whether it may have played a role in this accident, the Safety Board is also concerned that the SabreTech mechanics did not follow a consistent procedure for accomplishing shift changes or for tracking which specific tasks were performed during each shift. The Safety Board has addressed this issue previously[127] and continues to believe that emphasis should be placed on proper procedures.

The Safety Board recognizes that the FAA has conducted workshops and sponsored research into the human factors issues relevant to air carrier maintenance. However, based on previous accidents involving deficiencies in the performance of maintenance tasks,[128] and the circumstances of this accident, the Safety Board concludes that some aspects of air carrier maintenance programs do not adequately reflect the human factors issues involved in the air carrier maintenance environment. Therefore, the Safety Board believes that the FAA should include, in its development and approval of air carrier maintenance procedures and programs, explicit consideration of human factors issues, including training, procedures development, redundancy, supervision, and the work environment, to improve the performance of personnel and their adherence to procedures.

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[127] National Transportation Safety Board. 1992. *In-flight Structural Breakup, Britt Airways, Inc., d/b/a Continental Express Flight 2574, EMB-120RT, N33701, Eagle Lake, Texas, September 11, 1991,* Aircraft Accident Report NTSB/AAR-92/04. Washington, D.C.

[128] National Transportation Safety Board. 1996. *Uncontained Engine Failure/Fire, ValuJet Airlines Flight 597, Douglas DC-9-32, N908VJ, Atlanta, Georgia, June 8, 1995,* Aircraft Accident Report NTSB/AAR-96/03. Washington, D.C.; National Transportation Safety Board. 1992. *In-flight Structural Breakup, Britt Airways, Inc., d/b/a Continental Express Flight 2574, EMB-120RT, N33701, Eagle Lake, Texas, September 11, 1991,* Aircraft Accident Report NTSB/AAR-92/04. Washington, D.C.; National Transportation Safety Board. 1996. *In-Flight Loss Of Propeller Blade Forced Landing, And Collision With Terrain, Atlantic Southeast Airlines, Inc., Flight 529, Embraer Emb-120RT, N256AS, Carrollton, Georgia, August 21, 1995,* Aircraft Accident Report NTSB/AAR-96/06. Washington, D.C.; and National Transportation Safety Board. 1996. *Runway Departure During Attempted Takeoff, Tower Air Flight 41, Boeing 747-136, N605FF, JFK International Airport, New York, December 20, 1995,* NTSB/AAR-96/04 Washington, D.C.

Further, the Safety Board notes that the regulations of 14 CFR Part 121.377 establish limitations on duty time for individuals performing maintenance on Part 121 airplanes, including those working at a Part 145 repair station. This regulation requires that these individuals be relieved from duty for "24 consecutive hours every seven consecutive days, or the equivalent thereof within any one calendar month." However, because this regulation may result in mechanics working for as many as 26 consecutive days (with all of the required days free from duty being provided consecutively at the end of a month), the Safety Board concludes that the maintenance duty time limitations of 14 CFR Part 121.377 may not be consistent with the current state of scientific knowledge about factors contributing to fatigue among personnel working in safety-sensitive transportation jobs. Accordingly, the Safety Board believes that the FAA should review the issue of personnel fatigue in aviation maintenance; then establish duty time limitations consistent with the current state of scientific knowledge for personnel who perform maintenance on air carrier aircraft.

2.7 Guidance and Procedures for Transporting Hazardous Materials

The Safety Board recognizes that air carriers routinely need to move aircraft equipment items around their route systems. Air carriers that have an approved program for accepting and transporting hazardous materials can and likely would choose to transport hazardous COMAT themselves, pursuant to that program. Air carriers that have no such approved program, such as ValuJet, might transport some aircraft equipment items under FAA-approved special procedures that are documented in manuals, that comply with the hazardous materials regulations, and for which their personnel are specially trained. Or, they might use other approved air carriers or ground transportation.

Guidance issued by ValuJet to its flight operations and station operations personnel in the company's general operations manual and stations operations manual explicitly stated, "ValuJet will not engage in transportation of hazardous materials." Further, both manuals cited the applicable Federal regulations that listed items exempted from the hazardous materials regulations and, therefore, could be carried. Of these exempted items, tires were the only items of aircraft equipment. However, the former senior vice president of operations of ValuJet said in a postaccident interview that he was "led to believe" that the air carrier was authorized to carry internal shipments of certain hazardous items, such as aircraft batteries. A November 28, 1995, internal memorandum from the ValuJet maintenance training manager identified the need to train mechanics at company out-stations on how to "properly ship company hazardous materials." The memorandum stated, "this problem is not just with the out-stations as IAD [Washington Dulles International Airport] has the most activity of improperly shipping hazardous materials." Moreover, the ValuJet dispatcher on duty at the time of the accident stated that he believed the airline was authorized to transport hazardous equipment items. He referred to standard practice 8228, a recently added provision in ValuJet's GMM. Standard practice 8228 specifically listed several hazardous aircraft equipment items that ValuJet apparently believed it

was authorized to carry pursuant to 49 CFR 175.10(a)(2) [129] and provided instructions for preparing and packaging those items. ValuJet indicated to the FAA in a memo dated May 20, 1996, that the publication of standard practice 8228 was an attempt to "ensure that [ValuJet] complies with its duty to ensure that authorized items of [hazardous] company material are labeled, marked and packaged in the appropriate manner."

However, standard practice 8228 was inconsistent with the company's operations and stations manuals and had never been approved by the FAA. (The Safety Board notes that standard practice 8228 was developed by the ValuJet maintenance department and was not provided to the Miami ramp agents, who had been trained not to load packages containing hazardous materials.)

Based on this evidence, the Safety Board concludes that contrary to its authority, ValuJet's practices before the accident might have included the shipment of hazardous aircraft equipment items aboard company airplanes. The Safety Board recognizes that standard practice 8228 was withdrawn by ValuJet shortly after the accident and that the FAA has participated with ValuJet in reviewing and revising many of its manuals and procedures in connection with its resumption of operations. However, the Safety Board found that the manuals of other operators not authorized to accept hazardous materials contained a variety of provisions for the handling of hazardous aircraft equipment items as COMAT, at least some of which do not appear to comply with the hazardous materials regulations. Further, RSPA's Associate Administrator for Hazardous Materials Safety testified at the Safety Board's public hearing that at a recent industry seminar that had explored issues surrounding COMAT, the meaning of 175.10(a)(2) had been discussed at length. On December 13, 1996, in response to concerns raised at the Safety Board's public hearing, RSPA issued guidance "to clarify the application of [175.10(a)(2) and the hazardous materials regulations] and to overcome a number of apparent misunderstandings of them." The guidance makes clear that the hazardous materials regulations apply even to items of replacement for hazardous aircraft equipment being carried pursuant to the limited exceptions in 175.10(a)(2). However, the Safety Board is concerned that air carriers might not have been made aware of, or applied this guidance to the existing procedures for transporting hazardous aircraft components as COMAT and that the FAA has not required air carriers to do so. Based on the Board's review of air carrier manuals and the incidents involving COMAT that continue to

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[129] Section 175.10(a)(2) provides, "[h]azardous materials required aboard an aircraft in accordance with the applicable airworthiness requirements and operating regulations" are exempt from the hazardous materials regulations. It further states, "[u]nless otherwise approved by the Associate Administrator for Hazardous Materials Safety, items of **replacement for such hazardous materials must be transported in accordance with this subchapter [the hazardous materials regulations] except that**" [emphasis added] alternate packagings providing equivalent protection "specifically designed for the transport of aircraft spares and supplies may be used…[a]ircraft batteries are not subject to quantity limitations…and [a] tire assembly with a serviceable tire is not subject to the provisions of [the hazardous materials regulations] provided the tire is not inflated to a gauge pressure exceeding the maximum rated pressure for that tire." Thus, this regulation indicates that with two limited modifications (alternate packaging allowed, and no quantity limit on aircraft batteries), and one exemption (for properly pressurized tire assemblies), items of replacement **are** subject to the hazardous materials regulations, and thus cannot be carried by a carrier unless that carrier is recognized as an approved carrier of hazardous materials, or has other specific approval from the FAA.

occur, the Safety Board concludes that the procedures of many air carriers for handling hazardous COMAT are not fully consistent with the hazardous materials regulations and the guidance provided on December 13, 1996, by RSPA on the transport of COMAT by air carriers. Therefore, the Safety Board believes that the FAA should issue guidance to air carriers on procedures for transporting hazardous aircraft components consistent with RSPA requirements for the transportation of air carrier COMAT. The Safety Board further believes that the FAA should then require POIs to review and amend, as necessary, air carrier manuals to ensure that air carrier procedures are consistent with this guidance.

The investigation revealed that employees at SabreTech's Miami facility had never received guidance or training from SabreTech or ValuJet regarding ValuJet's policy on the transportation of hazardous materials. Although ValuJet had developed a hazardous materials recognition training program for its employees, this training was not provided to SabreTech, and SabreTech had not developed for its employees a formal training program for recognition or shipping of hazardous materials in air transportation. The Safety Board concludes that it is equally important that employees of both the air carrier and of relevant subcontractors be thoroughly versed and trained on the handling of hazardous materials and on the air carrier's authority to transport hazardous materials. The Safety Board recognizes that maintenance subcontractor employees, particularly employees in the shipping department of a subcontractor maintenance facility, might simultaneously be doing work for several air carriers. It might be useful, therefore, to provide, in conjunction with training, air carrier-specific checklists setting forth the hazardous materials authority and items permitted to be carried by each air carrier.

The Safety Board further concludes that had ValuJet implemented a program to ensure that its subcontractor maintenance facility employees were trained on the company's lack of authority to transport hazardous materials and had received hazardous materials recognition training, SabreTech might not have mishandled the packaging and shipment of the chemical oxygen generators that were loaded on flight 592. Given the circumstances of this accident, the Safety Board is concerned that employees at other subcontractor maintenance facilities might also not be adequately trained in hazardous materials recognition, labeling, packaging, and shipment procedures with respect to the specific items of hazardous materials that are handled by each air carrier's maintenance functions. Further, the Safety Board notes that air carriers currently are not required to provide this training to their own maintenance personnel. Therefore, the Safety Board believes that the FAA should require air carriers to ensure that maintenance facility personnel, including mechanics, shipping, receiving, and stores personnel, at air carrier-operated or subcontractor facilities, are provided initial and recurrent training in hazardous materials recognition, and in proper labeling, packaging, and shipment procedures with respect to the specific items of hazardous materials that are handled by the air carrier's maintenance functions.

2.8 ValuJet's Oversight of Subcontractor Maintenance Facilities

The Safety Board recognizes that air carriers can successfully subcontract many of the functional areas of their operations; however, it is the Safety Board's position that air carriers engaging in subcontracting remain responsible for the safety of their operations and the

airworthiness of their airplanes, and therefore must properly oversee their outside contractors. Although the subcontractors, as certificated entities, bear independent responsibility for their activities,[130] an air carrier cannot delegate its responsibility for the safety of its operations and maintenance to its subcontractors.

To properly oversee a subcontractor, the air carrier must verify that the subcontractor has in place the necessary equipment and procedures to perform the air carrier's work, that the individuals hired by the subcontractor to perform the work are qualified and capable of performing it, and that those individuals are in fact using the proper equipment and procedures. As an air carrier choosing to subcontract its heavy maintenance functions to SabreTech (among other contractors), ValuJet should have overseen and ensured that it understood the activities of SabreTech to the same extent that it would oversee its in-house maintenance functions and employees. Although ValuJet conducted an initial inspection and a subsequent audit of SabreTech, and assigned three technical representatives to the facility, there was limited ongoing oversight of the actual work SabreTech was performing for ValuJet.

ValuJet failed to provide significant on-site quality assurance at SabreTech's Miami facility. As a result, ValuJet failed to recognize the need for and coordinate the acquisition of oxygen generator safety caps and failed to discover the improper maintenance signoffs indicating that safety caps had been installed. ValuJet also did not recognize and correct SabreTech's use of the wrong parts tags on the expired oxygen generators or ensure that SabreTech employees were trained on ValuJet's hazardous materials practices and policies. Further, ValuJet failed to recognize and possibly accepted SabreTech's lack of procedures for communicating the hazardous nature of aircraft items left in the shipping and stores area and failed to identify these inadequacies in SabreTech's procedures during its audits and oversight of SabreTech. The FAA's postaccident surveillance findings of inadequate manuals, training, and procedures in the maintenance work being performed for ValuJet by other subcontractors is also suggestive that ValuJet provided inadequate oversight of its maintenance subcontracting before the accident. Accordingly, the Safety Board concludes that ValuJet failed to adequately oversee SabreTech and that this failure was a cause of the accident.

As part of the FAA's efforts to implement changes in its inspection policies, announced after the accident, the FAA issued airworthiness bulletin HBAW 96-05(B) to FAA Order 8300.10 (Airworthiness Inspector's Handbook). The "Background" section of the bulletin indicates that it was issued as "a result of a recent trend among some air carriers to not take into account their responsibility to control and oversee maintenance performed by contractors." The bulletin requires air carriers to audit their substantial maintenance contractors and ensure on a continuing basis that they are complying with the air carrier's practices and procedures. This provides a framework for air carriers to use in designing and executing adequate oversight for their subcontracting activities. The Safety Board is encouraged by these new requirements, and expects that if properly implemented, they will result in air carriers providing the same level of

[130] Issues associated with Part 145 repair stations' internal oversight, and the FAA's oversight of Part 145 repair stations will be addressed in the Safety Board's upcoming special study on repair stations.

oversight over their maintenance contractors as they would if the functions were being performed by their own in-house maintenance departments. The Safety Board will monitor the FAA's implementation of these requirements.

(Air carrier oversight of its maintenance subcontractors will also be addressed in the Safety Board's ongoing special study of safety issues associated with Part 145 maintenance facilities.)

2.9 FAA's Oversight of ValuJet

The surveillance conducted by the Atlanta FSDO, up to and including the special emphasis inspections of February 1996, identified many specific problem areas within ValuJet's flight operations and in-house maintenance functions. The Atlanta FSDO reacted properly in targeting ValuJet for more intensive surveillance, based on its surveillance findings and the air carrier's accident/incident record through the beginning of 1996. The FSDO devoted more of its limited inspection resources to ValuJet surveillance, resulting in a decrease by the FSDO in its surveillance of other air carriers. This additional surveillance of ValuJet resulted in conclusions by the FAA at the local FSDO level that certain system functions of ValuJet (such as the maintenance reliability program) were performing inadequately. Finally, in February 1996, the FSDO attempted to correct the deficiencies it had identified at ValuJet with a systemic remediation—it halted the growth of the air carrier. However, the Safety Board is concerned about the timeliness of this action. By the time ValuJet's growth was halted, it had already outgrown its capability to adequately coordinate and oversee its maintenance functions. This should have been apparent to the FAA earlier, especially given the exceptional pace at which ValuJet was adding airplanes and routes, and its continued outsourcing of its heavy maintenance functions.

As extensive as they were, the FAA surveillance programs did not take into account the extent to which ValuJet had contracted out its operations and maintenance functions. From the time ValuJet received its initial certification until the accident, the ValuJet PMI did not complete an inspection of the SabreTech facility. At one point during that period, he arrived at the facility to participate with ValuJet in an inspection, but left after only about 3 hours to attend to other business. Further, the FAA surveillance of ValuJet conducted before the accident, including the RASIP, the NASIP, and the special emphasis program, did not include any surveillance of ValuJet's heavy maintenance contractors, such as SabreTech, and did not recognize the potential problems inherent in the air carrier conducting only limited oversight of its maintenance subcontractors. After the accident, FAA surveillance during the special emphasis inspection program identified several deficiencies in ValuJet's auditing and oversight of maintenance subcontracting; that these deficiencies were identified by the FAA only after the accident indicates the inadequacy of the FAA's pre-accident surveillance of ValuJet's maintenance subcontracting activities.

The Safety Board concludes that before the accident, the FAA's oversight of ValuJet did not include any significant oversight of its heavy maintenance functions. This is especially disturbing given that by February 1996 the FAA had determined that there were

problems serious enough at ValuJet (including in maintenance)[131] to warrant more than the normal level of surveillance. Had the FAA subjected the Miami facility of SabreTech to the same level of surveillance as it did ValuJet itself, it might have discovered the deficiencies later uncovered in the special FAA inspection of that facility after the accident, which led to the surrender of the facility's operating certificate.[132] Further, FAA headquarters should have responded specifically to the concerns expressed in the AFS-300 summary report (which recommended consideration of "an immediate FAR-121 re-certification" of the airline). Further, the Safety Board concludes that the FAA's inadequate oversight of ValuJet's maintenance functions, including its failure to address ValuJet's limited oversight capabilities, contributed to this accident.

The Safety Board is concerned that a repair station that was performing significant heavy maintenance for ValuJet was never subjected to a complete FAA inspection by ValuJet's PMI from a Part 121 perspective and that the FAA's National Flight Standards Work Program Functions document (FAA Order 1800.135), which establishes the requirements for airworthiness surveillance of Part 121 air carriers, did not instruct a PMI to conduct such an inspection.

In HBAW 96-05(B), in addition to the requirements imposed on carriers (discussed in section 2.8 above), the FAA required that the FAA Certificate Management Office (CMO) "perform adequate on site inspection of the air carriers substantial maintenance providers to allow it to validate that the air carrier's contracting system is performing satisfactor[ily]." However, FAA officials have told the Safety Board that this only imposes on the PMI a one-time inspection requirement, and is not a requirement for the PMI to conduct continuing surveillance of contract maintenance facilities.[133] Moreover, the level of detail contemplated by the one-time inspection requirement is not made clear from the bulletin. Further, the Part 121 PMI might not have the benefit of findings made and entered into the PTRS system by the Part 145 PMI.[134] The Safety Board concludes that the continuing lack of an explicit requirement for the PMI of a Part 121 operator to regularly inspect or surveil Part 145 repair stations that are performing heavy maintenance for their air carriers is a significant deficiency in the FAA's oversight of the

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[131] The February 29, 1996, letter to ValuJet from its three principal inspectors indicated, "we have some concerns regarding ValuJet's maintenance. The first concern is the quality of maintenance inspections performed, and second, the management of repetitive discrepancies." Further, the February 14 summary report prepared by AFS-300 based its recommendation for an immediate re-certification of ValuJet on "such known safety related issues as the absence of adequate policies and procedures for the maintenance personnel to follow."

[132] This report addresses the FAA's surveillance of SabreTech only in the context of that facility's role as a heavy maintenance provider to ValuJet. This issue will be further addressed in the Safety Board's upcoming special study on Part 145 repair stations.

[133] The FAA has recently added to the PTRS guidelines a requirement that PMIs inspect the internal audit programs used by their carriers to inspect and oversee maintenance subcontractors. There is still no requirement, however, for PMIs to personally inspect or surveil these subcontractor facilities.

[134] As the FAA noted in its 90-day safety review, deficiencies found by a Part 145 repair station's PMI might not be "coded" in the PTRS system to connect these entries to the air carrier for which the work is being performed. (See section 1.17.9.)

operator's total maintenance program. Therefore, the Safety Board believes that the FAA should ensure that Part 121 air carriers' maintenance functions receive the same level of FAA surveillance, regardless of whether those functions are performed in house or by a contract maintenance facility.

Reviewing the workload of both the maintenance and operations inspectors assigned by the Atlanta FSDO to the ValuJet certificate, it appears to the Safety Board that the staffing levels for the surveillance by FAA of ValuJet's operations and airworthiness failed to keep pace with the rapid growth of the air carrier. In contrast, the FAA Southern Region's staffing model for FSDO staffing levels indicated, at the same time ValuJet was growing rapidly, that the Atlanta FSDO was overstaffed. It was on the basis of this model that the Southern Region denied the requests of the Atlanta FSDO manager for additional inspector resources. The Safety Board concludes that the manner in which the FAA's Southern Region applied the results of the FSDO staffing level models was not sufficiently flexible to account for a rapidly growing and complex air carrier and resulted in an inadequate level of inspector resources in the Atlanta FSDO. This issue was addressed in the FAA's 90-day safety review that followed the accident, and resulted in an internal recommendation to "[d]evise a new Flight Standards staffing model which…respond[s] more timely to changes in workload and productivity and…express[es] field office needs as a holistic requirement." It was also recommended, "[a]s an interim measure, [the FAA should] issue policy and guidelines on the authority of regions to adjust field office staffing based on 'spikes' which occur due to operator growth and other unanticipated workload changes." The Safety Board is encouraged by these recommendations and supports their implementation.

As a result of its investigation of the December 20, 1995, runway departure during attempted takeoff of Tower Air flight 41, the Safety Board issued Safety Recommendation A-96-163 to the FAA. This safety recommendation requested that the FAA develop, by December 31, 1997, standards for enhanced surveillance of air carriers based on rapid growth, change, complexity, and accident/incident history; then revise national flight standards surveillance methods, work programs, staffing standards, and inspector staffing to accomplish the enhanced surveillance that is identified by the new standards.

On February 25, 1997, the FAA replied to the Safety Board and cited the initiatives in progress as a result of the FAA's 90-day safety review; specifically, the Surveillance Improvement Project that addresses reengineering the FAA surveillance process. The FAA also stated that it was developing additional surveillance requirements for new entrant air carriers, establishing an analytical unit within the Flight Standards Service to target surveillance based on the air carriers' relative risk levels, and developing a new flight standards staffing model to respond to changes in inspector workload in a more timely manner. The Safety Board will monitor the FAA's response to its internal recommendations, generated as a result of the FAA's 90-day safety review.

An additional, potential source of FAA surveillance for ValuJet's heavy maintenance program was the PMI assigned to the oversight of SabreTech's Miami facility. However, based on the substantial workload from his assignment to oversight of 30 other

certificate-holding entities, including an additional 20 Part 145 repair stations, the Safety Board concludes that the PMI assigned to oversight of the SabreTech facility in Miami was unable to provide effective oversight of the ValuJet heavy maintenance operations conducted at that facility. Based on the circumstances of this accident, the Safety Board believes that the FAA should review the volume and nature of the work requirements of its PMIs assigned to 14 CFR Part 145 Repair Stations that perform maintenance for Part 121 air carriers, and ensure that these inspectors have adequate time and resources to perform surveillance.

2.10 Adequacy of FAA's Hazardous Materials Program

The circumstances surrounding the fire on board ValuJet flight 592 raised concerns about the effectiveness of the FAA's hazardous materials program in addressing the dangers of chemical oxygen generators. Before the crash of flight 592, the FAA knew of five separate incidents that occurred between August 10, 1986, and October 20, 1994, involving chemical oxygen generators that initiated fires in transportation. The worst of these fires destroyed an American Trans Air DC-10 airplane on the ground at O'Hare International Airport, in Chicago, Illinois, on August 10, 1986. Immediately following this fire, the FAA issued a warning to all air carriers about the hazards of chemical oxygen generators. However, despite the series of chemical oxygen generator fires that occurred since 1986, the FAA took no substantive action before the ValuJet accident near Miami to address the safety hazard posed by these generators.

Further, although the FAA's investigations of the chemical oxygen generator fires between 1986 through 1994 determined that the generators were being removed from airplanes during maintenance, the FAA did not adjust its resources to inspect aircraft maintenance facilities; no inspections regarding hazardous materials were performed at maintenance facilities during this period.

A factor in the failure of the FAA to develop an effective hazardous materials program to address the dangers of chemical oxygen generators might have been the inadequate allocation of resources to, and the inadequate emphasis on, compliance with the regulations regarding the transportation of hazardous materials by air. Before the ValuJet flight 592 accident, resources had been shifted from the FAA's hazardous materials program to the FAA's security program. Further, some security inspectors who performed the hazardous materials compliance inspections used only 3 to 4 percent of their work time performing such inspections; the remainder of their time was devoted to security issues. The Safety Board recognizes the importance to the traveling public of allocating resources to airport and airline security issues; however, the FAA should have allocated sufficient resources to its hazardous materials program. The Safety Board concludes that had the FAA responded to the prior chemical oxygen generator fires and allocated sufficient resources and initiated programs to address the potential hazards of these generators, including issuing follow-up warnings and inspecting the shipping departments of aircraft maintenance facilities, the chemical oxygen generators might not have been placed on flight 592 on May 11, 1996.

Since the accident, proposed changes to the FAA's hazardous materials program might address the deficiencies in the program that have been noted. Hiring a program manager and increasing staff dedicated to the hazardous materials program by 130 personnel from about 13 at the time of the accident should provide the leadership and personnel necessary to develop and oversee an effective hazardous materials program. Better data bases and trend analysis might enable staff to recognize potential hazards to air transportation, like chemical oxygen generator fires, and to take remedial actions before a serious accident occurs. A field staff dedicated to hazardous materials inspections should help the FAA maintain a comprehensive working knowledge of the hazardous materials regulations, and to begin to develop the contacts, resources, and familiarity with the entire hazardous materials transportation environment necessary to perform effective oversight and inspections. The dedication of staff and funding to the hazardous materials program should allow the program to continue even when special security concerns arise and need to be addressed. The Safety Board will monitor the FAA's progress in fulfilling these proposed improvements in its hazardous materials surveillance programs.

2.10.1 Undeclared Hazardous Materials

As a result of the February 3, 1988, accident on American Airlines flight 132, the Safety Board stated that the safe transportation of hazardous materials depended on sufficient information to identify the materials and the hazards presented during transportation. Accordingly, the Board noted that both shippers and carriers had a responsibility to determine if materials offered for transportation were hazardous and in proper condition to ensure their safe transportation.

The Board noted after the 1988 American Airlines accident that the procedures for accepting packages that contain declared hazardous materials were thorough and American would likely have rejected the fiber drum containing the oxidizer (the hazardous material in the accident) had it been properly identified; however, American Airlines' procedures for accepting ordinary freight (not declared as hazardous materials) were not adequate. These procedures did not include routine inquiries about the possibility that hazardous materials might be included but not identified as such.

Although the ATA and the International ATA, in response to the Safety Board's Safety Recommendation A-88-129 (previously discussed), developed and distributed brochures and information about the dangers of chemicals and other items that should not be shipped or carried in luggage, the circumstances surrounding the shipment of the chemical oxygen generators on ValuJet flight 592 have raised concerns that the practices, procedures, and training of the personnel involved in the identification and handling of undeclared hazardous materials have remained inadequate.

Although the FAA had developed more than 1,000 enforcement cases on undeclared shipments of hazardous materials in 1994 and 1995 combined, these cases were primarily developed in reaction to a package in air cargo or a passenger bag that had broken open revealing its contents, or evidence of leakage on the package or bag. Further, nearly all of the FAA's

enforcement cases concerning undeclared hazardous materials were developed using information provided by the air carriers.

The FAA's only proactive methods of addressing the problem of undeclared hazardous materials have involved making presentations at industry conferences, requiring signs at locations in airports where packages and luggage are offered, and developing pamphlets. The FAA also had considered, but did not implement, two additional methods of addressing the problem of undeclared hazardous materials—requiring baggage screening staff to be trained to recognize hazardous materials at screening checkpoints and a nationwide combined hazardous materials and cargo security inspection program of air freight forwarders with a focus on stopping unintentional or undeclared shipments of hazardous materials.

The ValuJet accident and the incidents that have occurred since clearly demonstrate that the shipment of undeclared hazardous materials in air transportation is a serious problem that has not been adequately addressed. However, the FAA has initiated the evaluation requested by the Safety Board in Safety Recommendations A-96-25 and -26 of the practices and training provided by all air carriers for accepting passenger baggage and freight shipment (including COMAT) and for identifying undeclared or unauthorized hazardous materials that are offered for transport and, based on this evaluation, to require air carriers to revise as necessary their practices and training in this area.

Further, the FAA is developing a hazardous materials education and enforcement program that will focus on air freight forwarders. Also, shortly after August 1996, the FAA issued, under 14 CFR Part 109 (Indirect Air Carrier Security), shipper endorsement requirements that require all shippers, and freight forwarders to certify that all packages being shipped do not contain unauthorized explosives, destructive devices, or hazardous materials. Signing the endorsement also gives permission to search the shipment. Because the transport of oxygen generators has continued since the accident, despite the regulations, the Safety Board will closely monitor the FAA's progress in fulfilling these proposed improvements.

The American Airlines flight 132 accident also focused attention on the issue of undeclared hazardous materials being placed on aircraft through the U.S. mail. Efforts to address this issue have been hindered by the apparently limited authority of Postal Service employees to ask questions of customers about the contents of their packages and the lack of authority for FAA inspectors to open mail bags or packages carried in the U.S. mail without a U.S. postal inspector present. Also, because of the 1990 Public Law 101-615, which specifically excludes the DOT from regulating hazardous materials in the U.S. Postal Service, the FAA's efforts to monitor hazardous materials on airplanes have been further hindered. Additionally, because the U.S. Postal Service has only criminal enforcement authority to address willful violations, and does not have civil authority, the Postal Service is limited in dealing with unintentional shipments of hazardous materials. In contrast, DOT's civil enforcement authority is one of the primary tools used by the FAA in dealing with unintentional shipments by air of hazardous materials discovered during investigations.

The Safety Board concludes that the limited authority of the U.S. Postal Service and the FAA to inspect and thus successfully identify undeclared hazardous materials in U.S. mail loaded on airplanes creates a situation in which undeclared shipments of hazardous materials can readily find their way on board passenger airplanes. Although the shipper endorsement requirements for non-U.S. mail shipments issued under 14 CFR Part 109 might help to reduce the number of undeclared hazardous materials shipments by shippers and freight forwarders, this action does not help to identify undeclared hazardous materials in the U.S. mail. Additional measures to focus on air passengers and postal patrons are needed given the significant number of packages that are transported by aircraft. Therefore, the Safety Board believes that the FAA, in cooperation with the U.S. Postal Service and the ATA, should develop programs to educate passengers, shippers and postal customers about the dangers of transporting undeclared hazardous materials aboard aircraft and about the need to properly identify and package hazardous materials before offering them for air transportation. The programs should focus on passenger baggage, air cargo, and mail offered by U.S. Postal Service customers. Further, the Safety Board believes that the U.S. Postal Service should develop a program for U.S. Postal Service employees to help them identify undeclared hazardous materials being offered for transportation. Finally, the Safety Board believes that the U.S. Postal Service should continue to seek civil enforcement authority when undeclared hazardous materials shipments are identified in transportation.

2.11 RSPA's Program for Approving Explosives for Transportation

Although the two current domestic manufacturers of chemical oxygen generators stated that they held previously authorized approvals by the Bureau of Explosives for the transportation of the generators, only one of the manufacturers of chemical oxygen generators had proof of that approval. Because all records of approved designs, testing, or packaging requirements for the chemical oxygen generators issued by the Bureau of Explosives were lost several years ago, RSPA has no knowledge of what approvals were issued or the limitations of these approvals.

The Safety Board supports the NPRM issued by RSPA on December 30, 1996, to require a special approval to ship chemical oxygen generators given the hazards posed by shipping the oxidizer with its actuator attached.[135] This approval would require the DOT Associate Administrator for Hazardous Materials to determine the hazard classification of chemical oxygen generators submitted for approval. The approval for the generators would require at least two safety features to prevent unintentional activation of the generator, and the generator would be required to be contained in a packing prepared and originally offered for transportation by the approval holder when transported.

The Safety Board is concerned, however, that other products approved for transportation by the Bureau of Explosives and for which RSPA has no record might pose a safety

[135] The approval would be for the transportation of these generators by any mode other than passenger-carrying aircraft. The final rule issued by RSPA on the same date (December 30, 1996) prohibits the transportation of these generators on passenger-carrying aircraft.

hazard in the transportation environment. Further, without RSPA having a record of what products have been approved, the Safety Board questions how RSPA can be proactive in its inspection and enforcement of the transportation of these products. The Safety Board concludes that because of the lack of information regarding products approved for transportation by the Bureau of Explosives, RSPA cannot adequately ensure that these products are being packaged and shipped safely in the transportation environment. Therefore, the Safety Board believes that RSPA should develop records for all approvals previously issued by the Bureau of Explosives and transferred to RSPA and ensure all records, including designs, testing, and packaging requirements are available to inspectors to help them determine that products transported under those approvals can be done safely and in accordance with the requirements of its approval.

2.12 ValuJet's Procedures for Boarding and Accounting for Lap Children

The Safety Board is concerned that one passenger aboard the accident flight, an unticketed passenger who was boarded by ValuJet as an under-2-year-old lap child (but who was actually 4 years old), was not immediately accounted for postaccident by ValuJet. The child was not listed on the passenger manifest for the accident flight or on any other record maintained by ValuJet. However, 14 CFR 121.693(e) requires that the load manifest maintained by an air carrier for each flight must contain, in part, "names of passengers, unless such information is maintained by other means by the air carrier." The FAA has made it clear in ACOB 8-91-2 that the word "passenger," as used in this regulation, means any passenger, regardless of age.

ValuJet used an open seating policy and controlled passenger boarding with numbered, plastic cards. The Safety Board learned that some time after the air carrier began operations, ValuJet management had expressed concern about boarding control of lap children, and that in response to this concern, the air carrier implemented a procedure in which the adult associated with each lap child was issued an unnumbered plastic boarding card at the time of check-in. This card was to be collected at the time of boarding, thus providing the air carrier with a post-departure record of the number of passengers (including lap children) aboard the flight. Based on the failure of the ValuJet passenger manifest and other post-departure records to account for the lap child on the accident flight, the Safety Board concludes that ValuJet did not follow its internal procedures for boarding and accounting for lap children. Further, the Safety Board notes that although 14 CFR 121.693(e) requires airlines to maintain a list of the names of all passengers aboard its flights, the procedures established by ValuJet did not call for recording the names of lap children aboard its flights.

The Safety Board recognizes that the manifesting of lap children by name is a challenge for the entire air carrier industry, because adults traveling with infants might not always provide the names of the infants to the airline or travel agent making the reservation. Despite this challenge, the Safety Board concludes that it is essential that air carriers maintain easily accessible and accurate records of the names of both ticketed and unticketed passengers

aboard their flights for retrieval in the event of an accident or other emergency.[136] Therefore, the Safety Board believes that the FAA should instruct POIs to review their air carriers' procedures for manifesting passengers, including lap children, and ensure that those procedures result in a retrievable record of each passenger's name.

The Safety Board is concerned that the lap child in this case far exceeded the 2-year age limit set by FAA regulations. The Safety Board has identified at least seven accidents, involving various air carriers, in which children over 2 years old were permitted to travel as lap children. The lapse in this case is especially disturbing in light of the fact that similar concerns were expressed to ValuJet in connection with the Safety Board's investigation of an uncontained engine failure of a ValuJet DC-9 at Atlanta, Georgia, on June 8, 1995, during which it was also discovered that a child over 2 years old had been boarded as a lap child.

As a result of the accident in Atlanta, the Safety Board issued Safety Recommendation A-96-84 asking that the FAA "provide guidance on how to implement the requirement that occupants who are more than 24 months old are restrained during takeoffs, landings, and during turbulence." The FAA issued flight standards information bulletin FSAT 97-01 effective on January 7, 1997, addressing the issue, and the Safety Board subsequently classified A-96-84 "Closed—Acceptable Action" on June 16, 1997. Although the Safety Board continues to disagree with the FAA's decision to permit children under 2 years old to be unrestrained, the Safety Board is hopeful that the guidance in FSAT 97-01 will ensure that only those children who are under 2 years old will be permitted to sit unrestrained on an adult's lap.

[136] The "Aviation Disaster Family Assistance Act of 1996" (Public Law 104-264, October 9, 1996) states that the National Transportation Safety Board's Director of Family Support Services has the responsibility "to request, as soon as practicable, from the air carrier or foreign air carrier involved in the accident, a list, which is based on the best available information at the time of the request, of the names of the passengers that were aboard the aircraft involved in the accident." The Act also requires the establishment of a task force to develop recommendations and guidelines to the airlines on a number of issues, including steps that air carriers would have to take to ensure that an accurate list of passengers on board the aircraft would be available within 1-3 hours after the accident. The task force is working on the manifest issues, including the subject of lap children. A report from the Secretary of Transportation is due to Congress by October 8, 1997.

3. CONCLUSIONS

3.1 Findings

1. The flightcrew was properly certificated and had received the appropriate training and off-duty time prescribed by the Federal regulations.

2. There was no evidence that any preexisting medical condition affected the flightcrew's performance.

3. The flight attendants had completed ValuJet's Federal Aviation Administration-approved flight attendant training program.

4. Weather was not a factor in the accident.

5. The accident airplane was equipped and maintained in accordance with Federal regulations and approved procedures, and there was no evidence of preexisting mechanical malfunctions or other discrepancies in the airplane structure, flight control systems, or powerplants that would have contributed to the accident.

6. The activation of one or more chemical oxygen generators in the forward cargo compartment of the airplane initiated the fire on ValuJet flight 592. One or more of the oxygen generators likely were actuated at some point after the loading process began, but possibly as late as during the airplane's takeoff roll.

7. Even if the fire did not start until the airplane took off, a smoke/fire warning device would have more quickly alerted the pilots to the fire and would have allowed them more time to land the airplane.

8. If the plane had been equipped with a fire suppression system, it might have suppressed the spread of the fire (although the intensity of the fire might have been so great that a suppression system might not have been sufficient to fully extinguish the fire) and it would have delayed the spread of the fire, and in conjunction with an early warning, it would likely have provided time to land the airplane safely.

9. Had the Federal Aviation Administration required fire/smoke detection and fire extinguishment systems in class D cargo compartments, as the Safety Board recommended in 1988, ValuJet flight 592 would likely not have crashed.

10. Given the information available, the ramp agents' and flightcrew's acceptance of the company materials shipment was not unreasonable.

11. ValuJet's failure to secure the cargo was not unreasonable.

12. The loss of control was most likely the result of flight control failure from the extreme heat and structural collapse; however, the Safety Board cannot rule out the possibility that the flightcrew was incapacitated by smoke or heat in the cockpit during the last 7 seconds of the flight.

13. Only a small amount of smoke entered the cockpit before the last recorded flightcrew verbalization at 1411:38, including the period when the cockpit door was open.

14. The current minimum equipment list requirements for the development of an "alternate procedure" for an inoperative service interphone are inadequate for a cabin fire situation.

15. There is inadequate guidance for air carrier pilots about the need to don oxygen masks and smoke goggles immediately in the event of a smoke emergency.

16. The pilots did not don (or delayed donning) their oxygen masks and smoke goggles, and in not donning this equipment, they were likely influenced by the absence of heavy smoke in the cockpit and the workload involved in donning the type of smoke goggles with which their airplane was equipped.

17. The smoke goggle equipment currently provided on most air carrier transport aircraft requires excessive time, effort, attention, and coordination by the flightcrew to don.

18. The sealed, plastic wrapping used to store smoke goggles in much of the air carrier industry poses a potential hazard to flight safety.

19. Emergency cockpit vision devices might have potential safety benefits in some circumstances.

20. Emerging technology, including research being conducted by the National Aeronautics and Space Administration, might result in improvements in the potential to provide passenger respiratory protection from toxic cabin atmospheres that result from in-flight and post-crash fires.

21. Because of the rapid propagation of the oxygen-fed fire and the resulting damage to the airplane's control cables and structure, the use of the Douglas smoke evacuation procedures would likely not have affected the outcome. The Douglas DC-9 procedures involving partial opening of cabin doors for in-flight evacuation of smoke or fumes from the passenger cabin and similar procedures adopted by some operators of other transport-category airplanes might clear smoke sufficiently in the cabin (and prevent entry into the cockpit) to prolong the occupants' survival time during some fire and smoke emergencies.

22. Given the potential hazard of transporting oxygen generators and because oxygen generators that have exceeded their service life are not reusable, they should be actuated before they are transported.

23. Because work card 0069 did not require an inspector's signoff at the completion of each task, and there was no requirement for it to do so, there might have been no inspection of the maintenance work related to the removal of the chemical oxygen generators. Had work card 0069 required an inspector's signoff, one of the inspectors involved with the two airplanes might have noticed that safety caps had not been installed on any of the generators.

24. Had work card 0069 required, and included instructions for, expending and disposing of the generators in accordance with the procedures in the Douglas MD-80 maintenance manual, or referenced the applicable sections of the maintenance manual, it is more likely that the mechanics would have followed at least the instructions for expending the generators.

25. Had a warning label or emblem clearly indicating the significant danger posed been affixed to each generator, personnel handling the generators, including the personnel in shipping and stores who prepared them for shipment to Atlanta, might have been alerted to the need to determine how to safely handle and ship the generators.

26. The existing prohibition against transporting oxygen generators on passenger aircraft has not been completely effective, and improper handling of oxygen generators could be reduced by affixing an effective warning label or emblem on all existing and newly manufactured chemical oxygen generators to clearly identify the dangers and hazards of unexpended generators and the severe consequences that can occur if mishandled.

27. Although the installation of safety caps would not likely have prevented the oxygen generators from being transported on board flight 592, it is very likely that had safety caps been installed, the generators would not have activated and the accident would not have occurred.

28. Improper maintenance activities and false entries pose a serious threat to aviation safety and must be curtailed.

29. Although the use of the wrong parts tag was an additional failure of SabreTech to perform maintenance activity in accordance with prescribed maintenance procedures, it probably did not contribute to the mishandling of the generators that ultimately led to the generators being loaded into the forward cargo compartment on flight 592.

30. The maintenance duty time limitations of 14 CFR Part 121.377 may not be consistent with the current state of scientific knowledge about factors contributing to fatigue among personnel working in safety-sensitive transportation jobs.

31. The lack of a formal system in SabreTech's shipping and receiving department, including procedures for tracking the handling and disposition of hazardous materials, contributed to the improper transportation of the generators aboard flight 592.

32. The failure of SabreTech to properly prepare, package, and identify the unexpended chemical oxygen generators before presenting them to ValuJet for carriage aboard flight 592 was causal to the accident.

33. Some aspects of air carrier maintenance programs do not adequately reflect the human factors issues involved in the air carrier maintenance environment.

34. Contrary to its authority, ValuJet's practices before the accident might have included the shipment of hazardous aircraft equipment items aboard company airplanes.

35. The procedures of many air carriers for handling hazardous company materials (COMAT) are not fully consistent with the hazardous materials regulations and the guidance provided on December 13, 1996, by the Research and Special Programs Administration on the transport of COMAT by air carriers.

36. It is equally important that employees of both the air carrier and of relevant subcontractors be thoroughly versed and trained on the handling of hazardous materials and on the air carrier's authority to transport hazardous materials.

37. Had ValuJet implemented a program to ensure that its subcontractor maintenance facility employees were trained on the company's lack of authority to transport hazardous materials and had received hazardous materials recognition training, SabreTech might not have mishandled the packaging and shipment of the chemical oxygen generators that were loaded on flight 592.

38. ValuJet failed to adequately oversee SabreTech and this failure was a cause of the accident.

39. Before the accident, the Federal Aviation Administration's (FAA) oversight of ValuJet did not include any significant oversight of its heavy maintenance functions. The FAA's inadequate oversight of ValuJet's maintenance functions, including its failure to address ValuJet's limited oversight capabilities, contributed to this accident.

40. The continuing lack of an explicit requirement for the principal maintenance inspector of a Part 121 operator to regularly inspect or surveil Part 145 repair stations that are performing heavy maintenance for their air carriers is a significant deficiency in the Federal Aviation Administration's oversight of the operator's total maintenance program.

41. The manner in which the Federal Aviation Administration's Southern Region applied the results of the Flight Standards District Office (FSDO) staffing level models was not sufficiently flexible to account for a rapidly growing and complex air carrier and resulted in an inadequate level of inspector resources in the Atlanta FSDO.

42. In part because he was responsible for so many operators, the principal maintenance inspector assigned to oversee the SabreTech facility in Miami was unable to provide effective oversight of the ValuJet heavy maintenance operations conducted at that facility.

43. Had the Federal Aviation Administration responded to prior chemical oxygen generator fires and allocated sufficient resources and initiated programs to address the potential hazards of these generators, including issuing follow-up warnings and inspecting the shipping departments of aircraft maintenance facilities, the chemical oxygen generators might not have been placed on flight 592.

44. The limited authority of the U.S. Postal Service and the Federal Aviation Administration to inspect and thus successfully identify undeclared hazardous materials in U.S. mail loaded on airplanes creates a situation in which undeclared shipments of hazardous materials can readily find their way on board passenger airplanes.

45. Because of the lack of information regarding products approved for transportation by the Bureau of Explosives, Research and Special Programs Administration cannot adequately ensure that these products are being packaged and shipped safely in the transportation environment.

46. ValuJet did not follow its internal procedures for boarding and accounting for lap children.

47. It is essential that air carriers maintain easily accessible and accurate records of the names of both ticketed and unticketed passengers aboard their flights for retrieval in the event of an accident or other emergency.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable causes of the accident, which resulted from a fire in the airplane's class D cargo compartment that was initiated by the actuation of one or more oxygen generators being improperly carried as cargo, were (1) the failure of SabreTech to properly prepare, package, and identify unexpended chemical oxygen generators before presenting them to ValuJet for carriage; (2) the failure of ValuJet to properly oversee its contract maintenance program to ensure compliance with maintenance, maintenance training, and hazardous materials requirements and practices; and (3) the failure of the Federal Aviation Administration (FAA) to require smoke detection and fire suppression systems in class D cargo compartments.

Contributing to the accident was the failure of the FAA to adequately monitor ValuJet's heavy maintenance programs and responsibilities, including ValuJet's oversight of its contractors, and SabreTech's repair station certificate; the failure of the FAA to adequately respond to prior chemical oxygen generator fires with programs to address the potential hazards; and ValuJet's failure to ensure that both ValuJet and contract maintenance facility employees were aware of the carrier's "no-carry" hazardous materials policy and had received appropriate hazardous materials training.

4. RECOMMENDATIONS

As a result of the investigation of this accident, the National Transportation Safety Board made the following recommendations:

—to the Federal Aviation Administration:

Expedite final rulemaking to require smoke detection and fire suppression systems for all class D cargo compartments. (A-97-56)

Specify, in air carrier operations master minimum equipment lists, that the cockpit-cabin portion of the service interphone system is required to be operating before an airplane can be dispatched. (A-97-57)

Issue guidance to air carrier pilots about the need to don oxygen masks and smoke goggles at the first indication of a possible in-flight smoke or fire emergency. (A-97-58)

Establish a performance standard for the rapid donning of smoke goggles; then ensure that all air carriers meet this standard through improved smoke goggle equipment, improved flightcrew training, or both. (A-97-59)

Require that the smoke goggles currently approved for use by the flightcrews of transport-category aircraft be packaged in such a way that they can be easily opened by the flightcrew. (A-97-60)

Evaluate the cockpit emergency vision technology and take action as appropriate. (A-97-61)

Evaluate and support appropriate research, including the National Aeronautics and Space Administration research program, to develop technologies and methods for enhancing passenger respiratory protection from toxic atmospheres that result from in-flight and post-crash fires involving transport-category airplanes. (A-97-62)

Evaluate the usefulness and effectiveness of the Douglas DC-9 procedures involving the partial opening of cabin doors and similar procedures adopted by some operators of other transport-category airplanes for evacuating cabin smoke or fumes and, based on that evaluation, determine whether these or other procedures should be included in all manufacturers' airplane flight manuals and air carrier operating manuals. (A-97-63)

Require airplane manufacturers to amend company maintenance manuals for airplanes that use chemical oxygen generators to indicate that generators that have exceeded their service life should not be transported unless they have been actuated and their oxidizer core has been depleted. (A-97-64)

Require that routine work cards used during maintenance of Part 121 aircraft (a) provide, for those work cards that call for the removal of any component containing hazardous materials, instructions for disposal of the hazardous materials or a direct reference to the maintenance manual provision containing those instructions and (b) include an inspector's signature block on any work card that calls for handling a component containing hazardous materials. (A-97-65)

Require manufacturers to affix a warning label to chemical oxygen generators to effectively communicate the dangers posed by unexpended generators and to communicate that unexpended generators are hazardous materials; then require that aircraft manufacturers instruct all operators of aircraft using chemical oxygen generators of the need to verify the presence of (or affix) such labels on chemical oxygen generators currently in their possession. (A-97-66)

Require all air carriers to develop and implement programs to ensure that other aircraft components that are hazardous are properly identified and that effective procedures are established to safely handle those components after they are removed from aircraft. (A-97-67)

Evaluate and enhance its oversight techniques to more effectively identify and address improper maintenance activities, especially false entries. (A-97-68)

Review the adequacy of current industry practice and, if warranted, require that Part 121 air carriers and Part 145 repair facilities performing maintenance for air carriers develop and implement a system requiring items delivered to shipping and receiving and stores areas of the facility to be properly identified and classified as hazardous or non-hazardous, and procedures for tracking the handling and disposition of hazardous materials. (A-97-69)

Include, in its development and approval of air carrier maintenance procedures and programs, explicit consideration of human factors issues, including training, procedures development, redundancy, supervision, and the work environment, to improve the performance of personnel and their adherence to procedures. (A-97-70)

Review the issue of personnel fatigue in aviation maintenance; then establish duty time limitations consistent with the current state of scientific knowledge for personnel who perform maintenance on air carrier aircraft. (A-97-71)

Issue guidance to air carriers on procedures for transporting hazardous aircraft components consistent with Research and Special Programs Administration requirements for the transportation of air carrier company materials; then require principal operations inspectors to review and amend, as necessary, air carrier manuals to ensure that air carrier procedures are consistent with this guidance. (A-97-72)

Require air carriers to ensure that maintenance facility personnel, including mechanics, shipping, receiving, and stores personnel, at air carrier-operated or subcontractor facilities, are provided initial and recurrent training in hazardous materials recognition, and in proper labeling, packaging, and shipment procedures with respect to the specific items of hazardous materials that are handled by the air carrier's maintenance functions. (A-97-73)

Ensure that Part 121 air carriers' maintenance functions receive the same level of Federal Aviation Administration surveillance, regardless of whether those functions are performed in house or by a contract maintenance facility. (A-97-74)

Review the volume and nature of the work requirements of principal maintenance inspectors assigned to Part 145 repair stations that perform maintenance for Part 121 air carriers, and ensure that these inspectors have adequate time and resources to perform surveillance. (A-97-75)

Develop, in cooperation with the U.S. Postal Service and the Air Transport Association, programs to educate passengers, shippers and postal customers about the dangers of transporting undeclared hazardous materials aboard aircraft and about the need to properly identify and package hazardous materials before offering them for air transportation. The programs should focus on passenger baggage, air cargo, and mail offered by U.S. Postal Service customers. (A-97-76)

Instruct principal operations inspectors to review their air carriers' procedures for manifesting passengers, including lap children, and ensure that those procedures result in a retrievable record of each passenger's name. (A-97-77)

—to the Research and Special Programs Administration:

Develop records for all approvals previously issued by the Bureau of Explosives and transferred to the Research and Special Programs Administration and ensure all records, including designs, testing, and packaging requirements are available to inspectors to help them determine that products transported under those approvals can be done safely and in accordance with the requirements of its approval. (A-97-78)

— to the U.S. Postal Service:

Develop, in cooperation with the Federal Aviation Administration and the Air Transport Association, programs to educate passengers, shippers and postal customers about the dangers of transporting undeclared hazardous materials aboard aircraft and about the need to properly identify and package hazardous materials before offering them for air transportation. The programs should focus on passenger baggage, air cargo, and mail offered by U.S. Postal Service customers. (A-97-79)

Develop a program for U.S. Postal Service employees to help them identify undeclared hazardous materials being offered for transportation. (A-97-80)

Continue to seek civil enforcement authority when undeclared hazardous materials shipments are identified in transportation. (A-97-81)

— to the Air Transport Association:

Develop, in cooperation with the U.S. Postal Service and the Federal Aviation Administration, programs to educate passengers, shippers and postal customers about the dangers of transporting undeclared hazardous materials aboard aircraft and about the need to properly identify and package hazardous materials before offering them for air transportation. The programs should focus on passenger baggage, air cargo, and mail offered by U.S. Postal Service customers. (A-97-82)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, Jr.
Member

August 19, 1997

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5. APPENDIXES

APPENDIX A—INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident by the Federal Aviation Administration about 1430 eastern daylight time on May 11, 1996. A full go-team was dispatched to Miami, Florida. Vice Chairman Robert Francis was the Board member on scene. The go-team consisted of specialists from the following areas: operations, structures, systems, powerplants, maintenance, aircraft performance, hazardous materials, survival factors, meteorology, air traffic control, and human performance.

Parties to the investigation were the Federal Aviation Administration, ValuJet Airlines, SabreTech Corporation, McDonnell Douglas Aircraft Company, Pratt & Whitney, Association of Flight Attendants, Scott Aviation, Federal Bureau of Investigation, the Research and Special Programs Administration, and the National Air Traffic Controllers Association.

2. Public hearing

A public hearing chaired by Member John Goglia was held in Miami, Florida, from November 19-23, 1996.

APPENDIX B—COCKPIT VOICE RECORDER TRANSCRIPT

Transcript of a Fairchild A-100 cockpit voice recorder (CVR), s/n 57xxx, installed on an ValuJet Douglas DC-9-32, N904VJ, which was involved in an in-flight fire and subsequent collision with terrain in the Everglades, Florida, on May 11, 1996.

LEGEND

RDO	Radio transmission from accident aircraft
CAM	Cockpit area microphone voice or sound source
ALL	Sound source heard on all channels
INT	Transmissions over aircraft interphone system
GND	Radio transmission from Miami approach control
TWR	Radio transmission from Miami tower
DEP	Radio transmission from Miami departure control
AA960	Radio transmission from American flight 960
UNK	Radio transmission received from unidentified source
PA	Transmission made over aircraft public address system
-1	Voice identified as Pilot-in-Command (PIC)
-2	Voice identified as Co-Pilot
-3	Voice identified as female flight attendant
-?	Voice unidentified
*****	Unintelligible word
@	Non pertinent word
#	Expletive
%	Break in continuity
( )	Questionable insertion
[ ]	Editorial insertion
....	Pause

Note : Times are expressed in eastern daylight time (EDT).

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**

START of RECORDING
START of TRANSCRIPT

1340:29 {00:10}
PA-3 [announcement heard through both the CAM channel and the fourth CVR channel] *cates you have reached or are near the exit. the cabin has been pressurized for your comfort. if oxygen is ****, the compartment above your seat. reach up, pull down on the mask until the tubing is fully extended. place the mask over your nose and mouth, secure it with the elastic band and breathe normally. the oxygen bag may not appear to inflate, however, oxygen is flowing. for those of you traveling with small children, adjust your mask first and then assist the child. and passenger seat cushions on this aircraft may be used as a flotation device and detailed instructions may be found on the safety information card. smoking is not permitted at any time while on board this aircraft. also, federal law * tampering, disabling, or destroying these detectors ** lavatory. your compliance with all crew *structions, all placards, light seat belt and no smoking signs, is required. also keep in mind, due to possible interference with navigational or communications systems, the following electronic devices may not be used during takeoff or landing. portable compact disk players, portable computers, and cellular phones which should be in the off position and stowed. now in preparation for takeoff, please fasten your seatbelt, return your seatback and tray tables to the full upright and locked position. your carry-on luggage must be stowed in the overhead compartments or underneath the seat in front of you. on behalf of all ValuJet employees, we'd like to thank you for selecting us today. we hope you enjoy your flight.

1340:41 {00:22}
CAM-2 [sound of cough]

1340:51 {00:31}
CAM [sound of several clicks]

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1341:17 **CAM-1**	{00:57} below the line.		
1341:18 **CAM-2**	{00:58} cleared to start?		
1341:19 **CAM-1**	{00:59} received.		
1341:20 **CAM-2**	{01:00} shoulder harness?		
1341:20 **CAM-1**	{01:00} on.		
1341:21 **CAM-2**	{01:01} parking brakes.		
1341:22 **CAM-1**	{01:02} set.		
1341:23 **CAM-2**	{01:03} fuel quantity?		
1341:23 **CAM-1**	{01:03} twenty two three.		
1341:24 **CAM-2**	{01:04} twenty two three.		
1341:25 **CAM-2**	{01:05} pneumatic crossfeeds?		
1341:26 **CAM-1**	{01:06} open.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1341:26 **CAM-2**	{01:06} anti-collision light.		
1341:27 **CAM-1**	{01:07} on.		
1341:29 **CAM-2**	{01:09} air conditioning supply switches?		
1341:30 **CAM-1**	{01:10} off.		
1341:31 **CAM-2**	{01:11} fuel boost pumps?		
1341:32 **CAM-1**	{01:12} on.		
1341:33 **CAM-2**	{01:13} ignition?		
1341:33 **CAM-1**	{01:13} on.		
1341:33 **CAM-2**	{01:13} before start checklist complete.		
1341:48 **CAM-3**	{01:27} do you want me to tell them * mention *** information about connections.		
1341:52 **CAM-1**	{01:31} you can tell them as we get closer ***.		
1341:56 **CAM-2**	{01:35} oil pressure and N one.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1341:57 **PA-3**	{01:36} and ladies and gentlemen for those of you that are all concerned about your connections, captain Kubec just informed me as soon as we get a little bit closer to Atlanta, we're able to re, relay * messages to them		
1342:02 **ALL**	{01:41} [sound of increasing frequency similar to generator increasing in RPM]		
1342:08 **ALL**	{01:47} [beep sound similar to momentary power interruption to CVR]		
		1342:09 **GND**	{01:48} Critter five ninety two, ground?
1342:08 **PA-3**	{01:47} ... we'll give you more information as we get it. thank you.		
		1342:11 **RDO-2**	{01:50} five ninety two.
		1342:12 **GND**	{01:51} yes sir, **** when you're ready to taxi ** I think they're gonna put a stop here in Atlanta pretty soon again.
1342:18 **CAM-1**	{01:57} they're gonna put a stop on us?		
		1342:18 **RDO-2**	{01:57} I'm sorry, say again, five ninety two.
		1342:19 **GND**	{01:58} yes sir. let me know when you're ready to taxi. they're gonna put a hold again on Atlanta here in a few more minutes.

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1342:24 **CAM-1**	{02:03} OK, we'll be ready in about two minutes.		
		1342:24 **RDO-2**	{02:03} OK uh, 'bout two minutes here for five ninety two.
1342:27 **GND**	{02:06} OK thanks.		
1342:31 **CAM-2**	{02:09} uuuuuh.		
1342:37 **CAM-1**	{02:15} ****.		
1342:47 **INT-4**	{02:25} ground to captain. set brakes please.		
1342:49 **CAM**	{02:27} [sound similar to parking brakes being set]		
1342:50 **INT-1**	{02:28} brakes are set.		
1342:51 **INT-4**	{02:29} thank you.		
1342:57 **CAM-2**	{02:35} **..... fuel.		
1342:58 **CAM**	{02:36} [sound of increasing frequency similar to generator increasing in RPM]		
1343:00 **CAM-2**	{02:38} thirty... five.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1343:05 **CAM**	{02:43} [sound of numerous clicks]		
1343:14 **CAM**	{02:52} [sound similar to two cabin chimes]		
1343:18 **INT-?**	{02:56} yeah.		
1343:19 **CAM-1**	{02:57} before taxi please.		
1343:21 **CAM-2**	{02:59} electrical panel?		
1343:23 **CAM-1**	{03:00} set.		
1343:23 **CAM-2**	{03:00} ignition?		
1343:24 **CAM-1**	{03:01} off.		
1343:24 **CAM-2**	{03:01} pitot static heat?		
1343:25 **CAM-1**	{03:02} on.		
1343:26 **CAM-2**	{03:03} ice protection?		
1343:26 **CAM-1**	{03:03} off.		
1343:27 **CAM-2**	{03:04} center tank pumps?		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1343:27 **CAM-1**	{03:04} on.		
1343:28 **CAM-2**	{03:05} flight attendant signal?		
1343:28 **CAM-1**	{03:05} given.		
1343:29 **CAM-2**	{03:06} air conditioning supply?		
1343:30 **CAM-1**	{03:07} auto.		
1343:30 **CAM-2**	{03:07} door lights?		
1343:31 **CAM-1**	{03:08} checked and out.		
1343:32 **CAM-2**	{03:09} and hydraulic pumps? are set, before taxi check list complete.		
1343:34 **CAM-1**	{03:11} OK, I'll pull up a little. zero two.		
1343:37 **CAM-2**	{03:14} [sound of cough]		
		1343:46 **RDO-2**	{03:23} Critter five ninety two, taxi.
		1343:47 **GND**	{03:24} Critter five ninety two, turn right on Papa. taxi to runway niner left and I've also got the amendment for you.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1343:53 **RDO-2**	{03:30} ah, right turn Papa nine left Critter five ninety two and go ahead with your clearance.
		1343:57 **GND**	{03:34} Critter five ninety two, you're cleared to Atlanta via the Miami Seven departure, WINCO transition...
1344:01 **CAM-2**	{03:38} WINCO?		
1344:01 **CAM-1**	{03:39} yes.		
		1344:01 **GND**	{03:39} ..... Lakeland, Tallahassee, LaGrange Six arrival. maintain five thousand. expect flight level three five zero one zero minutes after departure. rest of clearance unchanged.
		1344:10 **RDO-2**	{03:47} ah, five ninety two's cleared to Atlanta the Miami Seven uh, WINCO uh, Lakeland, Tallahassee, LaGrange Six and five thousand. uh, five ninety two.
1344:22 **CAM-1**	{03:58} clear **.		
1344:23 **CAM-2**	{03:59} clearance ***.		
		1344:23 **GND**	{03:59} Critter five ninety two, roger. stay on Papa. hold short [brief interruption in audio] and uh, and, plan to depart on time.
		1344:29 **RDO-2**	{04:05} down to Papa, hold short of Zulu, five ninety two.

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1344:32 **CAM-1**	{04:08} flaps five please we'll have to hold short of Zulu.		
1344:36 **CAM**	{04:12} [sound of click similar to flap handle being moved]		
1344:41 **CAM-1**	{04:17} Single engine taxi, please.		
1344:42 **CAM-2**	{04:18} Single engine.		
1344:49 **CAM-?**	{04:25} ***.		
1344:52 **CAM-2**	{04:28} APU electric and air is set. air conditioning uh, supply on the right side is HP off. air conditioning auto shuttoff is over-ride. ice protection number two is off. right pneumatic crossfeed, open. number two fuel control lever is off.		
1345:09 **CAM-2**	{04:44} [sound of cough]		
1345:10 **CAM**	{04:45} [beep sound similar to momentary power interruption to CVR]		
1345:22 **CAM-1**	{04:57} Zulu is way down by the end.... OKayy.		
1345:31 **CAM-2**	{05:06} [sound of cough]		
1345:34 **CAM-1**	{05:09} before takeoff check.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1345:35 **CAM-2**	{05:10} performance data & bugs, for a hundred and five thousand flaps five, V two one forty six?		
1345:39 **CAM-1**	{05:14} one forty six set and....		
1345:41 **CAM-2**	{05:16} trim?		
1345:43 **CAM-1**	{05:18} .... and uh, one point nine nine across,		
1345:45 **CAM-2**	{05:20} yeah.		
1345:48 **CAM-1**	{05:23} ... point nine nine set cross-checked.		
1345:50 **CAM-2**	{05:25} trim controls eight ANU?		
1345:51 **CAM-1**	{05:26} eight ANU, set.		
1345:52 **CAM-2**	{05:27} flaps and slats are five and a blue light?		
1345:54 **CAM-1**	{05:29} five gauge blue light.		
1345:56 **CAM-2**	{05:31} flight controls yaw damper?		
1345:57 **CAM-1**	{05:32} yaw damper's on, bottoms are checked.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1345:59	{05:34}		
CAM-2	tops are checked, passenger briefing done ** to the line.		
1346:03	{05:37}		
CAM-1	OK, um, let's see.. where do we go? three twenty two off Dolphin. it's a vector to Dolphin.... and I'll set three twenty two.		
1346:26	{06:00}		
CAM-1	after WINCO it was where?		
1346:27	{06:01}		
CAM-2	[sound of coughing]		
1346:30	{06:04}		
CAM-2	WINCO Lakeland Tallahassee. we gotta LaGrange six.		
1346:34	{06:08}		
CAM-1	OK.... LaGrange OK..... Atlanta itself had descent weather. I'm sure it's (already) changed.... OK, five grand gets blocked.		
1346:49	{06:23}		
CAM-2	yep, three three one forty.		
1346:51	{06:25}		
CAM-1	the departure is?		
1346:52	{06:26}		
CAM-2	is uh, nineteen forty five.		
1346:55	{06:28}		
CAM-1	OK... it's my takeoff, it's my abort, flaps are five, V one min is one thirty six. runway heading to five. if we lose on takeoff. depending which runway we go on, we'll uh, do a visual back down the runway.		
1347:09	{06:42}		
CAM-2	OK, if we go off fou* uh, twelve then I think it's four hundred feet.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1347:12	{06:45}		
CAM-1	right, to come back, OK ***.		
1347:13	{06:46}		
CAM-2	four hundred feet.		
1347:14	{06:47}		
CAM-1	alright.		
1347:16	{06:49}		
CAM-1	uh, when we're about number three for takeoff, we'll start number two.		
1347:19	{06:52}		
CAM-2	*.		
1347:20	{06:53}		
CAM-1	questions... no question?		
1347:23	{06:56}		
CAM-2	no questions.		
1347:58	{07:30}		
CAM-1	all these airlines ya never see normally ** BizJet.		
1348:01	{07:33}		
CAM-?	yeah.		
1348:04	{07:36}		
CAM-1	is that a old Connie back there? behind those buildings?		
1348:07	{07:39}		
CAM-2	aah, actually it's one of those L-1011s.		
1348:11	{07:43}		
CAM-1	just behind this dirt pile here.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1348:12 **CAM-2**	{07:44} OK, yeah. *******.		
1348:18 **CAM-1**	{07:50} doesn't even have paint on it. twin tails right there. about two o'clock.		
		1348:26 **GND**	{07:58} Critter five ninety two, hold short of Zulu taxiway.
		1348:28 **RDO-2**	{08:00} hold short of Zulu, five ninety two.
1348:30 **CAM-1**	{08:02} hold short of Zulu, see it right there, off to the right?		
1348:33 **CAM-2**	{08:05} aah, I see a seven forty seven there.		
1348:36 **CAM-1**	{08:08} it's real close to us, right behind us.		
1348:38 **CAM-2**	{08:10} ***.		
1348:39 **CAM-1**	{08:11} the antenna ‘s off to our right here by that building.... it's kinda camouflaged.		
1348:47 **CAM-2**	{08:18} oh this, this twin tailed thing here.		
1348:47 **CAM-1**	{08:18} yeah.		
1348:48 **CAM-2**	{08:19} oh, that's a uh, that's uh..		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1348:50 **CAM-1**	{08:21} Connie?		
1348:51 **CAM-2**	{08:22} a one, Connie one twenty one.		
1348:52 **CAM-1**	{08:23} yeah.		
1348:53 **CAM-2**	{08:24} son-of-a-gun. ****.		
1349:44 **CAM-1**	{09:14} ******.		
1349:51 **CAM-1**	{09:21} you want to test out the PA and talk to the people. um you can ask if, they hear or what ever you want. understood whatever you use for words.		
1350:00 **CAM-2**	{09:30} [sound of cough]		
1350:04 **PA-2**	{09:34} ladies and gentlemen from the cockpit uh, we're on a hold right here right now for crossing traffic on the ground. ah, and we only anticipate maybe a five or ten minute ground delay here but uh, we are cleared to, Atlanta just as soon as they can get us out through all the traffic here in Miami.		
1350:28 **CAM-2**	{09:57} *** flying all of a sudden.		
		1352:27 **GND**	{11:54} Critter five ninety two your sequence is off your right side, the American Boeing seven twenty seven. pull forward. he'll pull in front of you at the second intersection, ahead and to your right. tower's eighteen three.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1352:36 **RDO-2**	{12:03} tower's eighteen three. we've got the seven twenty seven on the right there. uh, five ninety two.
1352:38 **CAM-1**	{12:05} which runway?..... it's.... probably nine left. follow the Boeing.		
1354:02 **CAM-2**	{13:27} [sound of cough]		
1354:24 **CAM-2**	{13:49} three oh eight now.		
1354:26 **CAM-1**	{13:51} three oh eight, set.		
1355:32 **CAM-3**	{14:56} there's a woman up. she wants to use the bathroom.		
1355:35 **CAM-1**	{14:59} yeah, hurry.		
1355:39 **CAM-2**	{15:03} did you say warm it up?		
1355:41 **CAM-1**	{15:05} no, a woman's using the restroom.		
1355:43 **CAM-2**	{15:07} aah.		
1356:52 **CAM-1**	{16:14} engine re-start check list.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1357:00 **CAM-2**	{16:22} [sound of cough] left pneumatics closed, right pneumatic is open, right air conditioning supply switch off. APU air is on. fuel pumps are on. ignition's on. before start check list complete.		
1357:11 **CAM-1**	{16:33} ignition is on.		
1357:13 **CAM-2**	{16:35} number two.		
1357:14 **CAM-1**	{16:36} Jen, is she still up?		
1357:16 **CAM-?**	{16:38} yes * up.		
1357:21 **CAM-1**	{16:43} nobody else up from here on in.		
1357:24 **CAM-2**	{16:46} oil pressure.		
1357:24 **CAM-1**	{16:46} check.		
1357:33 **CAM**	{16:54} [sound of increasing frequency similar to generator increasing in RPM]		
1357:37 **CAM-2**	{16:58} light's out.		
1357:39 **CAM**	{17:00} [beep sound similar to momentary power interruption to CVR]		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1357:41 **CAM-1**	{17:02} sorry about that. I got carried away.		
1357:50 **CAM-1**	{17:11} below the lines for re-start.		
1357:52 **CAM-2**	{17:13} electrical panel?		
1357:53 **CAM-1**	{17:14} is set.		
1357:54 **CAM-2**	{17:15} APU air.		
1357:55 **CAM-1**	{17:16} is off.		
1357:56 **CAM-2**	{17:17} ignition?		
1357:57 **CAM-1**	{17:18} is off.		
1357:57 **CAM-2**	{17:18} ice protection number two engine?		
1357:59 **CAM-1**	{17:20} is off.		
1358:00 **CAM-2**	{17:21} air conditioning supply switches?		
1358:01 **CAM-1**	{17:22} auto.		
1358:02 **CAM-2**	{17:23} air conditioning auto shut-off		

TIME & SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME & SOURCE	AIR-GROUND COMMUNICATION CONTENT
1358:03	{17:24}		
CAM-1	armed.		
1358:04	{17:25}		
CAM-2	re-start checklist complete.		
1358:26	{17:46}		
CAM-2	[sound of coughing]		
1359:02	{18:22}		
CAM-1	why don't you shut down the APU.		
1359:03	{18:23}		
CAM-2	**.		
1359:20	{18:39}		
CAM-1	*** takeoff ** left side. if we have to go back, we'll back it up with the ILS. if we have to abort, I'll abort, you'll tell the tower we're abortin'.		
1359:26	{18:45}		
CAM-2	OK.		
1359:27	{18:46}		
CAM-1	altimeters?		
1359:31	{18:50}		
CAM-2	[sound of cough]		
1359:40	{18:59}		
CAM-1	once we get past WINC, I'll probably have to set Tallahassee on your side.		
1359:50	{19:09}		
CAM-2	must be a big conference **** lurch ***.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1359:55 **CAM-1**	{19:14} yeah.		
0200:15 **CAM-1**	{19:33} we're next up.		
1400:17 **CAM-2**	{19:35} yeah.		
1400:28 **CAM-2**	{19:46} ***.		
1400:29 **CAM-1**	{19:47} yeah.		
1400:38 **CAM-2**	{19:56} that's gotta be frustrating for those, American guys, have to wait for the company to give them their takeoff data.		
1400:51 **CAM-1**	{20:09} I'd kinda like to have that problem.		
1400:52 **CAM**	{20:10} [sound of chuckle]		
1401:43 **CAM-2**	{21:00} [sound of cough]		
		1402:22 **TWR**	{21:38} Critter five ninety two, runway nine left, taxi into position and hold.
		1402:25 **RDO-2**	{21:41} * position and hold nine left, Critter five ninety two.
1402:27 **CAM-1**	{21:43} position and hold below the line.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1402:30 **PA-2**	{21:46} ladies and gentlemen, we've been cleared to the runway for departure. flight attendants please be seated.		
1402:42 **CAM-2**	{21:58} anti-skid coming on?		
1402:43 **CAM-1**	{21:59} yep.		
1402:46 **CAM**	{22:02} [sound similar to cockpit door being closed]		
1402:47 **CAM-2**	{22:03} cockpit door is locked, ignition on, APU, is off, flight attendant signal is given, anti-skid is, armed, and TA, transponder is TA RA, pneumatic crossfeeds are closed.....		
1402:58 **CAM-1**	{22:13} OK.		
1402:58 **CAM-2**	{22:13} ....annunciator panel is checked, takeoff briefing is complete. flood and logo lights.		
1403:01 **CAM-1**	{22:16} OK.		
1403:02 **CAM-2**	{22:17} ****.		
		1403:24 **TWR**	{22:39} Critter five ninety two, fly runway heading, runway nine left, cleared for takeoff.
		1403:28 **RDO-2**	{22:43} runway heading, cleared to go nine left, Critter five ninety two.

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1403:31 **CAM-1**	{22:46} ** lights are on.		
1403:34 **CAM**	{22:49} [sound similar to engines increasing in RPM]		
1403:35 **CAM-1**	{22:50} bleeds are closed.		
1403:39 **CAM-1**	{22:54} set takeoff power.		
1403:42 **CAM-2**	{22:56} * power is set, we have ninety five, ninety four.		
1403:47 **CAM**	{23:01} [sound of clunks increasing in frequency similar to aircraft nose tire traveling over bumps in runway]		
1403:57 **CAM-2**	{23:11} * hundred knots.		
1403:58 **CAM-1**	{23:12} check.		
1404:07 **CAM-2**	{23:21} V one.		
1404:07 **CAM-1**	{23:21} check		
1404:09 **CAM-2**	{23:23} V r.		
1404:15 **CAM-2**	{23:29} positive rate.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1404:15 **CAM-1**	{23:29} gear up.		
1404:16 **CAM-2**	{23:30} V two		
1404:20 **CAM-2**	{23:34} five.		
1404:21 **CAM**	{23:35} [sound similar to stabilizer-in-motion indicator]		
		1404:24 **TWR**	{23:38} Critter five ninety two, contact departure, good day.
		1404:27 **RDO-2**	{23:41} good day sir.
1404:31 **CAM-1**	{23:45} flaps up.		
		1404:33 **RDO-2**	{23:47} afternoon departure, Critter five ninety two's out of five hundred goin' to five thousand.
		1404:36 **DEP**	{23:50} Critter five ninety two, departure, good afternoon. radar contact. climb and maintain seven thousand.
		1404:40 **RDO-2**	{23:54} seven thousand, five ninety two.
1404:43 **CAM-1**	{23:57} slats retract.		
1404:44 **CAM-2**	{23:58} slats retract.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1404:46 **CAM**	{24:00} [sound of click]		
1404:50 **CAM**	{24:04} [sound similar to stabilizer-in-motion indicator]		
1405:05 **CAM-2**	{24:19} following the Boeing straight ahead of us in a turn.		
1405:07 **CAM-1**	{24:21} OK.		
1405:08 **CAM**	{24:22} [sound similar to stabilizer-in-motion indicator]		
1405:18 **PA-3**	{24:32} and, ladies and gentlemen, captain Kubeck will turn off the fasten seat belt sign, just as soon she feels it's safe for you to get up and move about the cabin. until that time, please remain comfortably seated with your seat belts securely fastened. we also suggest for your safety that seatbelts be fastened even after the sign has been turned off. shortly we will begin our inflight service. we are pleased to offer you a variety of soft drinks, coffee, and juices. cocktails are available for three dollars. beer and wine are available for two dollars. as always, correct change is greatly,, greatly,, appreciating. for a complete listing of our complimentary beverages, they may be found on page five of our Good Times magazine. for now we just ask that you sit back and relax and enjoy your flight to Atlanta, Georgia.		
		1405:45 **DEP**	{24:58} Critter five ninety two, turn left heading three six zero.
		1405:48 **RDO-2**	{25:01} three six zero, five ninety two.
1405:49 **CAM-1**	{25:02} three six zero.... climb power, climb check.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1405:56 **CAM-2**	{25:09} power's set.		
1406:29 **CAM-2**	{25:41} gears up and checked, flaps up, lights out, spoilers, is dis-armed, the ignition is off, fuel pumps are set, air conditioning shutoff is override, hydraulic pumps off and low, flood and logo lights at ten, and altimeters at eighteen.		
1406:40 **CAM-1**	{25:52} thank you.		
1406:42 **CAM**	{25:54} [sound similar to stabilizer-in-motion indicator]		
		1406:50 **DEP**	{26:02} Critter five ninety two, turn left heading three three zero.
		1406:53 **RDO-2**	{26:05} three three zero, five ninety two.
1406:55 **CAM-1**	{26:07} three three zero **.		
1407:18 **CAM-1**	{26:29} six for seven.		
1407:18 **CAM-2**	{26:29} six for seven.		
1407:22 **CAM**	{26:33} [tone similar to altitude alert signal]		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1407:24 **DEP**	{26:35} Critter five ninety two, turn left heading three zero zero. join the WINCO transition. climb and maintain one six thousand.
		1407:29 **RDO-2**	{26:40} three zero zero the heading. join the WINC at sixteen thousand, Critter five ninety two.
1407:33 **CAM-1**	{26:44} *****.... clear left.		
1407:41 **CAM-2**	{26:52} [sound of cough]		
1407:42 **CAM-1**	{26:53} ****. lets turn on the radar. *****.		
1408:00 **CAM-2**	{27:11} got something out there about eighty miles out.		
1408:02 **CAM-1**	{27:13} OK.		
1408:03 **CAM-2**	{27:14} that must be that thunderstorm.		
1408:08 **CAM-1**	{27:18} there's a break here like.. *****.		
1408:28 **CAM-1**	{27:38} I'd hate to be in this thing at a hundred and eight thousand and in through this weather.		
1408:32 **CAM-2**	{27:42} yeah.		

	INTRA-COCKPIT COMMUNICATION	AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1409:18 **CAM-2**	{28:27} [sound of cough]		
1409:21 **CAM-1**	{28:30} **.		
1409:26 **CAM**	{28:35} [sound similar to stabilizer-in-motion indicator]		
1409:30 **CAM-2**	{28:39} you don't want to hold them down for a while, did ya ?		
1409:32 **CAM-1**	{28:41} no, they're OK for right now.		
1409:36 **PA-2**	{28:45} flight attendants, departure check please.		
1409:44 **CAM-1**	{28:53} we're ** turbulence ****.		
1409:02 **CAM**	{29:00} [sound of click]		
1410:03	{29:11}		
CAM	[sound of chirp heard on cockpit area microphone channel with simultaneous beep on public address/interphone channel]		
1410:07 **CAM-1**	{29:15} what was that?		
1410:08 **CAM-2**	{29:16} I don't know.		
1410:12 **CAM-1**	{29:20} ** ('bout to lose a bus?)		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1410:15 **CAM-1**	{29:23} we got some electrical problem.		
1410:17 **CAM-2**	{29:25} yeah.		
1410:18 **CAM-2**	{29:26} that battery charger's kickin' in. ooh, we gotta.		
1410:20 **CAM-1**	{29:28} we're losing everything.		
		1410:21 **DEP**	{29:29} Critter five nine two, contact Miami center on one thirty two forty five, so long.
1410:22 **CAM-1**	{29:30} we need, we need to go back to Miami.		
1410:23 **CAM**	{29:31} [sounds of shouting from passenger cabin]		
1410:25 **CAM-?**	{29:33} fire, fire, fire, fire [from female voices in cabin]		
1410:27 **CAM-?**	{29:35} we're on fire, we're on fire.		
1410:28 **CAM**	{29:36} [sound of tone similar to landing gear warning horn for three seconds]		
1410:30 **CAM-1**	{29:38} ** to Miami.		
		1410:29 **DEP**	{29:37} Critter five ninety two contact Miami center, one thirty two forty five.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1410:32 **RDO-2**	{29:40} uh, five ninety two needs immediate return to Miami.
		1410:35 **DEP**	{29:43} Critter five ninety two uh, roger, turn left heading two seven zero. descend and maintain seven thousand.
1410:36 **CAM**	{29:44} [sounds of shouting from passenger cabin subsides]		
		1410:39 **RDO-2**	{29:47} two seven zero, seven thousand, five ninety two.
		1410:41 **DEP**	{29:49} what kind of problem are you havin'.
1410:42 **CAM**	{29:50} [sound of horn]		
1410:44 **CAM-1**	{29:51} fire.		
		1410:46 **RDO-2**	{29:53} uh, smoke in the cockp... smoke in the cabin.
		1410:47 **DEP**	{29:54} roger.
1410:49 **CAM-1**	{29:56} what altitude?		
1410:49 **CAM-2**	{29:56} seven thousand.		
1410:52 **CAM**	{29:59} [sound similar to cockpit door moving]		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1410:57 **CAM**	{30:04} [sound of six chimes similar to cabin service interphone]		
1410:58 **CAM-3**	{30:05} OK, we need oxygen, we can't get oxygen back there.		
1411:00 **INT**	{30:07} [sound similar to microphone being keyed only on interphone channel]		
1411:02 **CAM-3**	{30:09} *ba*, is there a* way we could test them? [sound of clearing her voice]		
		1411:07 **DEP**	{30:14} Critter five ninety two uh, when able to turn left heading two five zero. descend and maintain five thousand.
1411:08 **CAM**	{30:15} [sound of chimes similar to cabin service interphone]		
1411:10 **CAM**	{30:17} [sounds of shouting from passenger cabin]		
		1411:11 **RDO-2**	{30:18} two five zero seven thousand.
1411:12 **CAM-3**	{30:19} completely on fire.		
1411:14 **CAM**	{30:21} [sounds of shouting from passenger cabin subsides]		
1411:19 **CAM-2**	{30:26} outta nine.		
1411:19 **CAM**	{30:26} [sound of intermittent horn]		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1411:21 **CAM**	{30:28} [sound similar to loud rushing air]		
		1411:38 **RDO-2**	{30:44} Critter five ninety two we need the uh, closest airport available.
		1411:42 **DEP**	{30:48} Critter five ninety two, they're gonna be standing standing by for you. you can plan....
1411:45 **CAM**	{30:51} [one minute and twelve second interruption in CVR record-ing]		
1412:57 **CAM**	{30:51} [sound of tone similar to power interruption to CVR]		
1412:57 **CAM**	{30:51} [sound similar to loud rushing air]		
1412:57 **ALL**	{30:51} [sound of repeating tones similar to CVR self test signal start and continue]		
		1412:58 **DEP**	{30:52} ..contact Miami approach on, correction you, you, keep on my frequency.

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1413:05 **DEP**	{30:59} American nine sixty turn left heading two seven zero, join the WINCO transition.
		1413:09 **AA960**	{31:03} heading two seven zero to join the WINCO transition, Amer...
1413:11 **CAM**	{31:05} [interruption of unknown duration in CVR recording]		
		14??:?? **UNK**	{31:08} *** . [radio transmission from unknown source]
14??:?? **ALL**	{31:09} [sound of repeating tones similar to CVR self test signal, starts and continues]		
14??:?? **CAM**	{31:09} [sound similar to louder rushing air]		
14??:?? **END of RECORDING**	{31:19}		

END of TRANSCRIPT

APPENDIX C—SHIPPING TICKET FOR THE COMPANY MATERIAL

SabreTech™
A Sabreliner Company

B-1

SHIPPING TICKET

NO: 01041

REPLY TO: P.O. Box 6063 • Miami, Florida 33102-6063 • Phone: (305) 871-6650

SHIP TO: Valujet Airlines
Concourse C/Gate 28 Hartsfield Airport
Atlanta, GA 30320

DATE: 5/10/96

VIA: VALUJET (COMAT)

WEIGHT: _____ P/O#: _____

ATTENTION: Stores

B/L NO.

ITEM	QTY.	U/M	PART NUMBER	SERIAL NUMBER	COND.	DESCRIPTION
1	5	each	"5" boxes"			Oxy Canisters
						"Empty"
2	1	each	9560892	Jul89-333		Main Disc./WHEEL
3	1	each	9550267	NOV68-553		NOSE TIRE/WHEEL
4	1	each	A9560892-oct.	CR 236.	1	Main disc/WHEEL ASSY.

CUSTOMER FURNISHED MATERIAL RETURNED PER CUSTOMER INSTRUCTIONS

Sale ☐
Exchange ☐
Loan ☐

RECD. AT VALUJET AIRLINES (ATL)
DATE 5/10/96
BY Christopher

☐ Collect
☐ Prepaid
☐ C.O.D.

Andrew Dolan 58040
SHIPPED BY

IT IS SPECIFICALLY UNDERSTOOD AND AGREED THAT TITLE TO ALL MATERIALS INCLUDED ON ABOVE SHIPPING ORDER REMAINS IN DynAir Tech UNTIL FULL PAYMENT OF SAME HAS BEEN RECEIVED. INTEREST AT 1 1/2% PER MONTH WILL BE CHARGED FOR PAST DUE ACCOUNTS. PURCHASER AGREES TO PAY ALL COSTS OF COLLECTION INCLUDING A REASONABLE ATTORNEY'S FEE IN EVENT IT BECOMES NECESSARY TO ENFORCE PAYMENT THEREOF.

White / Accounting Canary / Stores Pink / Customer / Vendor

Form/5005

ValuJet MD-80	REV DATE December 1995	PAGE NO. 1 of 6	INSP CHK 12 YRS	STATION
				CARD NO. 0069
	ATA CHAP 35	AREA ZONE 58	INSP DATE	A/C NO.

INSTRUCTION	MECH SIGNOFF

CHEMICAL OXYGEN GENERATOR **REMOVE/INSTALL**

Note: Removal/installation procedures for all generators are identical unless otherwise noted.

1. Remove Generator (Figure 1).

WARNING: UNEXPENDED OXYGEN GENERATORS CONTAIN LIVE IGNITION TRAINS, AND, WHEN ACTIVATED, GENERATE CASE TEMPERATURES UP TO 500°F. USE EXTREME CAUTION WHILE HANDLING TO PREVENT INADVERTENT REMOVAL OF FIRING PIN. IF GENERATOR SHOULD BECOME ACTIVATED, IMMEDIATELY PLACE ON A NONCOMBUSTIBLE SURFACE.

Note: Passenger overhead environmental panels contain unitized oxygen insert units. If generator is to be replaced in these units, remove and replace insert unit (Reference: MM Chapter 35-22-03).

A. Manually open oxygen module door slowly, making certain that firing pin lanyards are free and will not pull firing pin on live generator.

Note: Oxygen masks in attendant's modules will drop out if door is allowed to swing open.

B. If generator has not been expended, install shipping cap on firing pin.

CAUTION: USE CAUTION NOT TO PULL OXYGEN GENERATOR FIRING PIN WHILE DISCONNECTING LANYARDS.

C. Disconnect firing pin lanyards from oxygen mask.

Note: Lanyards remain attached to firing pin.

D. Press heat shield towards generator until heat shield bracket lugs can be lifted out of mounting holes in oxygen module and remove heat shield.

Note: Heat shield is not incorporated in forward attendant's module.

ALL ITEMS SIGNED	EMP. NO.	DATE

INSTRUCTION	MECH SIGNOFF

E. Lift bracket at center of generator and remove generator from mounting hat.

Note: Generator is spring-loaded and could pop out if not held in position when center bracket is lifted.

F. Remove oxygen supply hoses from generator oxygen outlets.

G. Coil firing pin lanyards and secure to generator body.

2. Install Generator.

A. Clear lanyards from generator body.

CAUTION: DO NOT USE ANY LUBRICANT TO EASE HOSE ONTO OUTLET. IF ANY EVIDENCE INDICATES LUBRICANT WAS PREVIOUSLY USED, WIPE OFF OUTLET AND TRIM ABOUT ONE INCH (25.4 MM) OFF HOSE.

B. Connect oxygen supply hoses to generator oxygen outlets and check that hoses are installed at least 1/2-inch (12.7 mm) over outlets.

C. Lift center bracket and engage generator side having two pins into holes in mounting hat, then lower center bracket over generator upper mounting pin.

CAUTION: MINIMUM 5/8-INCH (15.9 MM) CLEARANCE MUST BE MAINTAINED TO ALLOW PROPER COOLING WHEN GENERATOR IS ACTIVATED.

D. Insert heat shield bracket lugs into mounting holes in bottom of oxygen module. Check that 5/8-inch (15.9 mm) clearance exists between heat shield and oxygen generator.

Note: Heat shield is not incorporated in forward attendant's module.

CAUTION: USE CAUTION NOT TO PULL GENERATOR FIRING PIN WHILE CONNECTING LANYARDS.

ALL ITEMS SIGNED	EMP. NO.	DATE

INSTRUCTION	MECH SIGNOFF

E. Connect firing pin lanyards to masks using bowline knot installation (Figures 1 and 2). With module door in open position, make certain that lanyard length is as follows:

Oxygen Module Location	Lanyard Length
Forward attendants console	17(±1) inches (431.8(±25.4) mm)
Aft attendants console	23 (±1) inches (584.2 mm)
Lavatory	10 inches (254.0 mm)
Lavatory (overhead)	69.00(±0.50) inches (1752.6(±12.7) mm) measuring from floor to mask attach point
Lavatory (overhead)	12.00(±0.50) inches (304.8(±12.7) mm) measuring below mask from mask attach point to streamer attach point
Intermediate attendants seat	50(±1.00) inches (1270.0(±25.4) mm) measuring from floor to mask attach point
5th attendants seat	1.00(±0.50) inch (25.4(±12.7 mm) slack

F. Remove excess lanyard.

G. If required, fold oxygen mask (Figure 2).

H. Reset door latching mechanism by placing release lever flush with latching coil.

Note: As door is closed, the door mounted latch strike will engage strike retainer and will be held in place by an internal spring-loaded mechanism.

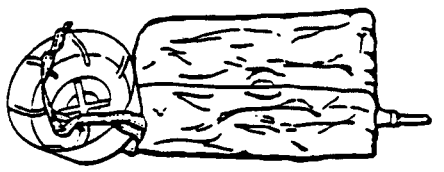
ALL ITEMS SIGNED	EMP. NO.	DATE

ValuJet MD-80	REV. DATE December 1995	PAGE NO. 4 of 6	INSP CHK 12 YRS	CARD NO. 0069
	ATA CHAP 35	AREA ZONE 58	INSP DATE	A/C NO.

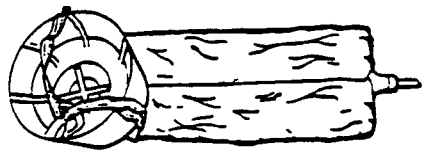
INSTRUCTION	MECH SIGNOFF
I. Remove safety cap from generator primer and check that firing mechanism of the oxygen generator is in cocked position. J. Close oxygen module door slowly.	

ALL ITEMS SIGNED	EMP. NO.	DATE

ValuJet MD-80	REV DATE December 1995	PAGE NO. 6 of 6	INSP CHK 12 YRS	CARD NO. 0069
	ATA CHAP 35	AREA ZONE 58	INSP DATE	A/C NO.

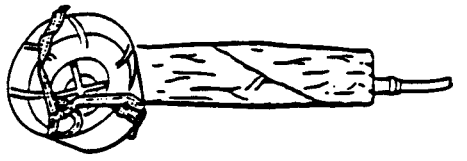


1. RESERVOIR BAG- FIRST FOLD.

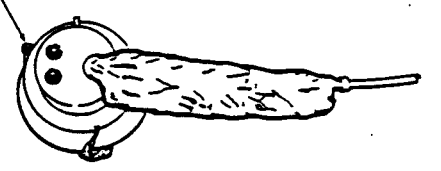


2. RESERVOIR BAG- SECOND FOLD

LANYARD ATTACHMENT HOLE OR MASK DISCONNECT RING.

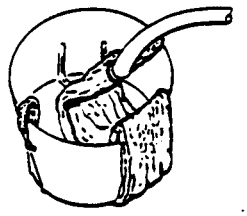


3. RESERVOIR BAG- FINAL FOLD

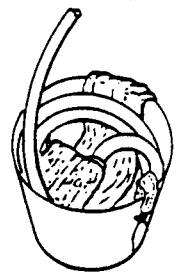


4. FOLD RESERVOIR BAG AWAY FROM LANYARD ATTACHMENT HOLE OR MASK DISCONNECT RING.

5. TURN MASK OPEN SIDE UP AND FOLD HEADSTRAP INTO FACE PIECE.



6. BRING FOLDED RESERVOIR BAG UP OVER SIDE OF FACE PIECE AND PLACE INSIDE IN DOUBLE FOLD.

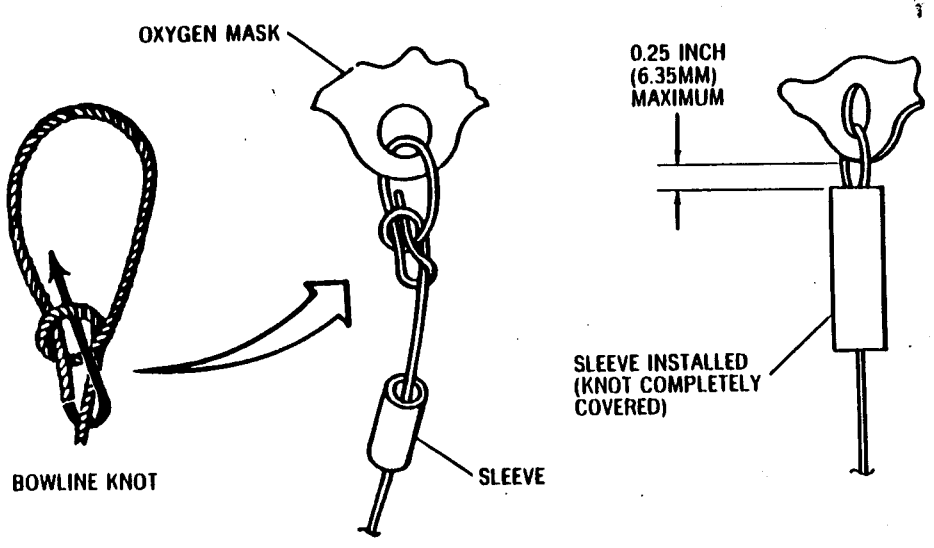


7. WITH RESERVOIR BAG FOLDED IN FACE PIECE, COIL MASK SUPPLY TUBE CLOCKWISE ON FOLDED BAG.

FIGURE 2

BBB2-35-34

CS/jf



BOWLINE KNOT INSTALLATION

FIGURE 1

BBB2-35-33A

CS/jf

APPENDIX E—EXCERPTS FROM AIRCRAFT MAINTENANCE SERVICES AGREEMENT

AIRCRAFT MAINTENANCE SERVICES AGREEMENT

This Aircraft Maintenance Services Agreement is hereby entered into this 15th day of September, 1995 between DynAir Tech of Florida, Inc. with its office at 4900 N. W. 36th Street, Bldg 25, Miami, Florida 33102 ("SELLER"), and ValuJet Airlines, Inc., a Nevada corporation with its office located at 1800 Phoenix Boulevard, Suite 126, Atlanta, Georgia 30349 ("ValuJet").

WHEREAS, SELLER maintains and operates facilities for the maintenance and servicing of jet aircraft and component parts; and

WHEREAS, ValuJet requires certain Maintenance Services and Engineering Services as more specifically described in Exhibit I, to be performed on Aircraft which it owns or operates, from time to time, and/or Components used or usable in the operation of such Aircraft and SELLER is willing to provide or cause to be provided such Services upon the terms, provisions and conditions hereinafter set forth.

NOW, THEREFORE, in consideration of the mutual covenants herein contained, the parties agree as follows:

ARTICLE 1
TERM OF AGREEMENT

1.05 This Agreement shall be effective as of the 1st day of August, 1995 and shall continue in effect until the 31st day of July, 1997 unless extended or terminated as provided herein.

ARTICLE 2
DEFINITIONS

2.05 The following definitions shall apply to the terms used in this Agreement or employed by SELLER in the course of performance of its obligations under this Agreement, unless otherwise defined herein:

(a) **"AIRCRAFT"** shall mean the aircraft types listed on Exhibit VII owned or operated by ValuJet, including all attached engines and any instrument, equipment, apparatus, assembly, part, appurtenance or accessory attached to, incorporated, or installed in such aircraft.

(b) **"AIRCRAFT WORKSCOPE"** shall mean the ValuJet written Statement of Work to be performed on the individual Aircraft under this Agreement. The Aircraft Statement of Work shall be included in Exhibit I of this Agreement.

(c) **"AIRWORTHINESS DIRECTIVES"** shall mean amendments to 14 CFR Section 121.709 (b) (2) issued by the Federal Aviation Administration which specify required inspections, modifications or operations of affected equipment.

(d) **"COMMON"** shall mean those components, hardware, and expendables which are used on the Aircraft which are carried in SELLER's inventory.

(e) **"COMPONENTS"** shall mean those materials (excluding bare engines) that are removable and controllable on a unit basis and have a definite potential for reuse through inspection, overhaul, repair or calibration.

(f) **"CUSTOMER REQUEST ITEMS"** shall mean items of work requested by ValuJet , through not specifically a portion of the Maintenance Program.

(g) **"DISCREPANCY"** shall mean any confirmed abnormal condition of an item or the Services whether or not this condition could eventually result in failure of the item or of the Aircraft.

(h) **"DOCUMENTATION"** shall mean all data, reports, forms and information required by FARs, maintenance manual, manufacturer's overhaul manual, the Maintenance Program "ValuJet procedures and ATA specifications in a prescribed format, content and method (hardcopy or electronically).

(I) **"ENGINEERING SERVICES"** shall mean technical support and engineering work rendered for the Aircraft.

(j) **"EXPENDABLE"** shall mean those materials and supplies used in the service of the Aircraft and Components which, when issued from inventory, have no potential for reuse and are considered consumed during the repair process.

(k) **"FAA"** shall mean the Department of Transportation and Federal Aviation Administration or any successor agency or other agency at the time charges with the duties of the Federal Aviation Administration as such duties exist on the date hereof.

(l) **"FAR"** shall mean federal aviation regulations promulgated by the FAA from time to time, and amended from time to time, as set forth in 14 CFR Parts 1-199 (1989), which are applicable to the performance of the Services hereunder.

(m) **"MAINTENANCE PROGRAM"** shall mean ValuJet's aircraft maintenance processes, work content, associated time limits, and supplementary inspections applicable to the Aircraft. Revisions to the Maintenance Program will be controlled by ValuJet's reliability control program.

(n) **"MAINTENANCE SERVICES"** shall mean Routine Maintenance, Non-Routine Maintenance, Customer Request Items and related maintenance.

(o) **"NON-ROUTINE MAINTENANCE"** shall consist of corrective work to be performed during the performance of Routine Maintenance resulting from findings by SELLER during the performance of Routine Maintenance.

(p) **"OVERHAUL"** shall mean the disassembly, inspection, Repair and/or check of a repairable Component to determine, as substantiated by SELLER's service experience or accepted practices, that it is in an unsatisfactory condition to operate one complete Overhaul period.

(q) **"PECULIAR"** shall mean those Components and Expendables which are used on the Aircraft but which are not carried in the SELLER's inventory.

(r) **"REPAIR"** shall mean the restoration of the Aircraft or Component to an airworthy condition after damage or deterioration.

(s) **"REPAIR FACILITY"** shall mean the SELLER's maintenance base or such other repair facility mutually agreed upon by SELLER and ValuJet.

(t) **"ROUTINE MAINTENANCE"** shall mean those items of inspection or work specifically called out in the Maintenance Program or the Aircraft Workscope.

(u) **"SERVICEABLE"** shall mean those Aircraft and Components that meet all specified standards for airworthiness following Repair as defined by applicable FAR's and the Maintenance Program, and have no known defects which would render them unfit for their intended use.

(v) **"SERVICES"** shall mean Maintenance Services and Engineering Services collectively.

(w) **"SERVICE BULLETINS"** shall mean those technical documents issued by manufacturers which describe changes to materials or configurations of products which may, at the option of ValuJet, be incorporated into the Services.

ARTICLE 3
GENERAL TERMS AND CONDITIONS

3.05 During the term of this Agreement SELLER will provide the facilities, labor, fixtures, equipment, material, tooling, planning and administration necessary to perform the Services in compliance with the Maintenance Program and the Aircraft Workscope unless otherwise provided herein.

3.10 Unless otherwise agreed to in writing, ValuJet will provide to SELLER, upon delivery of the Aircraft, all applicable work cards, work instruction, known material requirements, engineering authorizations or other specific documentation necessary to perform the Services on the Aircraft as described in Exhibit I.

3.15 ValuJet shall, at its sole cost and expense, deliver the Aircraft and components to SELLER at the Repair Facility or such other location as may be mutually agreed upon in writing between the parties hereto. SELLER shall acknowledge receipt of the Aircraft by execution of a delivery receipt in the form of Exhibit VIII. Redelivery of the Aircraft and Components to ValuJet at the Repair Facility upon completion of the Services hereunder shall be as acknowledged by execution of a redelivery receipt in the form of Exhibit IX.

3.20 All parts furnished by SELLER pursuant to this Agreement shall be an approved part from an FAA approved source per 14 CFR Section 21.303. SELLER will extend to ValuJet benefit of any warranties available from the manufacturer(s) of such parts or suppliers which provide warranty periods more favorable than offered in Exhibit IV.

ARTICLE 4
GENERAL TERMS AND CONDITIONS

4.05 During the period this Agreement is in effect, SELLER will, upon request and as mutually agreed in writing as part of the Aircraft Workscope, perform Maintenance Services on the Aircraft as follows:

(a) Routine Maintenance, Non-Routine Maintenance and special inspections or Repairs of the Aircraft.

(b) Accomplishment of any Airworthiness Directives, supplemental structural inspections or Service Bulletins applicable to the Aircraft.

(c) Component Overhaul, Repair, functional check and modification required to be performed on Components removed from the Aircraft during the performance of the Maintenance Services for which SELLER has shop capability at its Repair

Facility. SELLER may arrange with subcontractors for the performance of Component work for which SELLER does not have shop capability. Subcontractors must be approved in advance by ValuJet and appear on Exhibit V. In those cases where the Components removed cannot be repaired during performance of Services, ValuJet will provide Serviceable Components or, upon mutual agreement, SELLER will supply such Serviceable Components on a unit exchange basis.

4.10 SELLER will provide Common Expendables which are required to perform the Maintenance Services. Such Common Expendables shall meet ValuJet's standards as specified in article 3.20 and/or in accordance with ValuJet's General Maintenance Manual. Peculiar Expendables will be provided by ValuJet or, upon mutual agreement, by SELLER at the rates specified in Exhibit II.

4.15 SELLER shall provide to ValuJet upon completion of any or all of the Maintenance Services, the weight change data resulting form the Services incorporated into the Aircraft.

4.20 SELLER shall provide to ValuJet planning services that include assistance in the preparation of work instructions, the ordering of material not furnished by ValuJet and scheduling the accomplishment of work included in the Maintenance Services to be provided.

4.25 If during performance of the Services, SELLER becomes aware of any condition which could lead to resultant damage to the Aircraft or any Component, SELLER shall advise ValuJet immediately and obtain ValuJet's written approval to perform recommended Non-Routine Maintenance on such Aircraft or Component. In the event that SELLER fails to advise ValuJet of a known defective/damaged condition, SELLER shall be liable for any damage which results from the unrepaired condition, less the amount it would have cost ValuJet to repair the condition.

4.30 After completion of Services, ValuJet may perform flight tests on the Aircraft. All test flights will be carried out by ValuJet at its sole risk and Expense.

ARTICLE 5
ENGINEERING SERVICES

5.05 If requested by ValuJet and mutually agreed to, SELLER will provide, or cause to be provided, Engineering Services (including documentation) in support of Maintenance Services which are not related to normal aircraft in-service problems but involve the Repair of damage and/or the performance of modifications to the Aircraft or Components at the rates set forth in Exhibit II. Engineering Services provided hereunder shall be in support of the Maintenance Services and include, without limitation, those relating to interior refurbishment/reconfiguration, stripping and

to authorize in writing performance of the Services and furnishing of materials, sign work orders and purchase orders, and in general to represent ValuJet in connection with the services ("Customer Representative"). SELLER shall provide appropriate office accommodation, telephone and access to fax machines and use of such telephone and fax machines. All out of pocket expenses, telephone and fax expenses incurred by the Customer Representative shall be borne by ValuJet. SELLER will allow the Customer Representative access to all work being performed.

STORAGE OF VALUJET FURNISHED MATERIALS

13.55 SELLER agrees to provide at no cost to ValuJet a secure and dedicated area to store ValuJet furnished material.

13.60 An inventory list of any ValuJet furnished material will be maintained by SELLER and all receipts or issues will be properly recorded. SELLER will further provide ValuJet with a copy of the ValuJet furnished material movement trail list upon request.

13.65 Any material removed and not to be reinstalled during the performance of Services must be retained by SELLER for ValuJet's Customer Representative to authorize disposal in writing. Should such authorization not be provided within thirty (30) days of inspection of the material removed and not to be reinstalled then SELLER will provide written notice to ValuJet of its intent to dispose of such material. Absent a response by ValuJet within thirty (30) days after the date of such notice SELLER may dispose of the material at its discretion.

TIME OF ESSENCE

13.70 Time is of the essence in performance of this Agreement and the Services hereunder.

EQUAL EMPLOYMENT OPPORTUNITY/AFFIRMATIVE ACTION

13.75 Each party hereto will comply with all applicable federal, state and local laws and executive orders and regulations issued pursuant thereto, including without limitation, and the extent applicable to this Agreement, the provisions contained within Section 202 of Executive Order 11246, as amended, and the implementing regulations of the office of Federal Contract Compliance Programs, 41 CFR Parts 60-1, et seq. which provides for incorporated herein by reference as if set forth in full.

APPENDIX F—PART III OF APPENDIX F TO 14 CFR PART 25

Part III—Test Method to Determine Flame Penetration Resistance of Cargo Compartment Liners.

(a) *Criteria for Acceptance.* (1) At least three specimens of cargo compartment sidewall or ceiling liner panels must be tested.

(2) Each specimen tested must simulate the cargo compartment sidewall or ceiling liner panel, including any design features, such as joints, lamp assemblies, etc., the failure of which would affect the capability of the liner to safely contain a fire.

(3) There must be no flame penetration of any specimen within 5 minutes after application of the flame source, and the peak temperature measured at 4 inches above the upper surface of the horizontal test sample must not exceed 400 °F.

(b) *Summary of Method.* This method provides a laboratory test procedure for measuring the capability of cargo compartment lining materials to resist flame penetration with a 2 gallon per hour (GPH) #2 Grade kerosene or equivalent burner fire source. Ceiling and sidewall liner panels may be tested individually provided a baffle is used to simulate the missing panel. Any specimen that passes the test as a ceiling liner panel may be used as a sidewall liner panel.

(c) *Test Specimens.* (1) The specimen to be tested must measure 16±¼ inches (406±3 mm) by 24+¼ inches (610±3 mm).

(2) The specimens must be conditioned at 70 °F.±5 °F. (21°C.±2 °C.) and 55%±5% humidity for at least 24 hours before testing.

(d) *Test Apparatus.* The arrangement of the test apparatus, which is shown in Figure 3 of Part II and Figures 1 through 3 of this part of Appendix F, must include the components described in this section. Minor details of the apparatus may vary, depending on the model of the burner used.

(1) *Specimen Mounting Stand.* The mounting stand for the test specimens consists of steel angles as shown in Figure 1.

(2) *Test Burner.* The burner to be used in tesing must—

(i) Be a modified gun type.

(ii) Use a suitable nozzle and maintain fuel pressure to yield a 2 GPH fuel flow. For example: an 80 degree nozzle nominally rated at 2.25 GPH and operated at 85 pounds per square inch (PSI) gage to deliver 2.03 GPH.

(iii) Have a 12 inch (305 mm) burner extension installed at the end of the draft tube with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide as shown in Figure 3 of Part II of this appendix.

(iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 GPH of #2 Grade kerosene or equivalent.

Burner models which have been used successfully in testing are the Lenox Model OB-32, Carlin Model 200 CRD and Park Model DPL. The basic burner is described in FAA Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedure for Flexible Hose Assemblies, dated March 1978; however, the test settings specified in this appendix differ in some instances from those specified in the report.

(3) *Calorimeter.* (i) The calorimeter to be used in testing must be a total heat flux Foil Type Gardon Gage of an appropriate range (approximately 0 to 15.0 British thermal unit (BTU) per ft.² sec., 0–17.0 watts/cm²). The calorimeter must be mounted in a 6 inch by 12 inch (152 by 305 mm) by ¾ inch (19 mm) thick insulating block which is attached to a steel angle bracket for placement in the test stand during burner calibration as shown in Figure 2 of this part of this appendix.

(ii) The insulating block must be monitored for deterioration and the mounting shimmed as necessary to ensure that the calorimeter face is parallel to the exit plane of the test burner cone.

(4) *Thermocouples.* The seven thermocouples to be used for testing must be 1/16 inch ceramic sheathed, type K, grounded thermocouples with a nominal 30 American wire gage (AWG) size conductor. The seven thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the test stand during burner calibration as shown in Figure 3 of this part of this appendix.

(5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of 8 inches from the ceiling liner panel and 2 inches from the sidewall liner panel. The burner stand should have the capability of allowing the burner to be swung away from the test specimen during warm-up periods.

(6) *Instrumentation.* A recording potentiometer or other suitable instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.

(7) *Timing Device.* A stopwatch or other device must be used to measure the time of flame application and the time of flame penetration, if it occurs.

(e) *Preparation of Apparatus.* Before calibration, all equipment must be turned on and allowed to stabilize, and the burner fuel flow must be adjusted as specified in paragraph (d)(2).

(f) *Calibration.* To ensure the proper thermal output of the burner the following test must be made:

(1) Remove the burner extension from the end of the draft tube. Turn on the blower portion of the burner without turning the fuel or igniters on. Measure the air velocity using a hot wire anemometer in the center of the draft tube across the face of the opening. Adjust the damper such that the air velocity is in the range of 1550 to 1800 ft./min. If tabs are being used at the exit of the draft tube, they must be removed prior to this measurement. Reinstall the draft tube extension cone.

(2) Place the calorimeter on the test stand as shown in Figure 2 at a distance of 8 inches (203 mm) from the exit of the burner cone to simulate the position of the horizontal test specimen.

(3) Turn on the burner, allow it to run for 2 minutes for warm-up, and adjust the damper to produce a calorimeter reading of 8.0±0.5 BTU per ft.^{2} sec. (9.1±0.6 Watts/cm^2).

(4) Replace the calorimeter with the thermocouple rake (see Figure 3).

(5) Turn on the burner and ensure that each of the seven thermocouples reads 1700 °F. ±100 °F. (927 °C. ±38 °C.) to ensure steady state conditions have been achieved. If the temperature is out of this range, repeat steps 2 through 5 until proper readings are obtained.

(6) Turn off the burner and remove the thermocouple rake.

(7) Repeat (1) to ensure that the burner is in the correct range.

(g) *Test Procedure.* (1) Mount a thermocouple of the same type as that used for calibration at a distance of 4 inches (102 mm) above the horizontal (ceiling) test specimen. The thermocouple should be centered over the burner cone.

(2) Mount the test specimen on the test stand shown in Figure 1 in either the horizontal or vertical position. Mount the insulating material in the other position.

(3) Position the burner so that flames will not impinge on the specimen, turn the burner on, and allow it to run for 2 minutes. Rotate the burner to apply the flame to the specimen and simultaneously start the timing device.

(4) Expose the test specimen to the flame for 5 minutes and then turn off the burner. The test may be terminated earlier if flame penetration is observed.

(5) When testing ceiling liner panels, record the peak temperature measured 4 inches above the sample.

(6) Record the time at which flame penetration occurs if applicable.

(h) *Test Report.* The test report must include the following:

(1) A complete description of the materials tested including type, manufacturer, thickness, and other appropriate data.

(2) Observations of the behavior of the test specimens during flame exposure such as delamination, resin ignition, smoke, ect., including the time of such occurrence.

(3) The time at which flame penetration occurs, if applicable, for each of the three specimens tested.

(4) Panel orientation (ceiling or sidewall).

APPENDIX G—VALUJET DC-9 EMERGENCY PROCEDURES

VALUJET DC-9 EMERGENCY PROCEDURES

ENGINE FAILURE/ INFLIGHT ENGINE SHUTDOWN

Throttle	IDLE
FUEL Control Lever	OFF
(Ensure correct engine prior to shutdown)	
APU (If available)	START
PNEU X-FEED VALVE (Affected Side)	CLOSE
AUX and ALT GEAR PUMPS	AS REQUIRED
APU BUS Switch(Affected Side)	ON
ELECTRICAL LOADS	CHECK
FUEL TANK Pumps and X FEED	AS REQUIRED
GEN CONTROL Switch	OFF
AIR COND AUTO SHUTOFF Switch	OVRD
AIR CONDITIONING SUPPLY Switch (Affected Side)	OFF
ONE ENGINE LDG. CKLIST	ACCOMPLISH

[END]

ENGINE FIRE/ DAMAGE/SEPARATION

THROTTLE	IDLE
If light goes out - test Fire Warning. If OK, continued Eng Operation optional. If Fire Warning will not test continue with cklist.	
FUEL Control. Lever	OFF
(Ensure Correct engine prior to Shutdown)	
ENG FIRE Shutoff Handle	PULL
FIRE AGENT	DISCH
AGENT LOW LIGHT	ON

If fire warning still on after 30 seconds:	
REMAINING BOTTLE	DISCHARGE
APU (If available)	START
PNEU X-FEED Lever (Affected Side)	CLOSE
ENG HYD PUMP Switch	OFF
AUX and ALT GEAR PUMPS	AS REQUIRED
APU BUS Switch (Affected side)	ON
ELECTRICAL LOADS	CHECK
FUEL TANK Pumps and X FEED	AS REQUIRED
GEN CONTROL Switch	OFF
AIR COND AUTO SHUTOFF Switch	OVRD
AIR CONDITIONING SUPPLY Switch(Affected Side)	OFF
ONE ENG LDG CKLIST	ACCOMPLISH

[END]

TWO ENGINE FLAMEOUT

EMER PWR Switch	ON
ENG IGN Switch	OVRD

CABIN PRESSURE Control	MANUAL
Airspeed - (NOT LESS THAN 170 KIAS)	MINIMUM MANEUVERING
THROTTLES	IDLE
ENG ANTI-ICE Switches	ON
BATT Switch	ON
DC START PUMP Switch	ON
Fuel Boost Pump Switches (All)	ON
GEN Switches	OFF
ENG HYD PUMP Switches	OFF
Fuel Control Levers	ON
FUEL X FEED Lever	OFF
NOTE: If Neither Engine Restarted:	
APU	START
L and R APU BUS Switches	ON
NOTE: If APU Does not start:	
Continue engine/APU start attempts.	
NOTE: When one or both engines are started:	
ELECTRICAL SYSTEM	AS REQUIRED
ENG HYD PUMP Switches	ON
CABIN PRESSURE CONTROL	AUTO
DC START PUMP Switch	OFF
ENG Anti-Ice Switches	AS REQUIRED
ENG IGN Switch	AS REQUIRED

[END]

Robert E. Bruce 2-14-96

Approved Date

NOTE: This checklist to be used in conjunction with the Emergency Procedures Section of the ValuJet AOM. Refer to ValuJet AOM for further details and expanded procedures for these written procedures.

ELECTRICAL SMOKE OR FIRE

OXYGEN MASKS AND SMOKE GOGGLES	ON/100%
RADIO RACK Switch	VENTURI
CABIN PRESSURE Control	MANUAL
EMER PWR Switch	ON
GEN Control and APU Bus Switches	OFF

NOTE: Wait a reasonable time to determine whether to follow step A or B below.

A If smoke continues:	
AC and DC BUS X TIE Switches	OPEN
R & L GEN or APU BUS Switches	ON
F/O FLT INSTRUMENTS	CHECK
EMER PWR Switch	OFF
AC EMERG FEED C/B's (K10 & L11)	PULL
NOTE: If smoke disappears, fault is on AC emergency bus. If smoke continues:	
AC EMERG FEED C/B's (K10 & L11)	RESET
DC EMERG FEED C/B (M36) [930, 960 Series A/C (N37)]	PULL
NOTE: If smoke disappears, fault is on DC emergency bus. If smoke continues:	
DC EMERG FEED C/B (M36) [930, 960 Series A/C (N37)]	RESET
BATT Switch	OFF
NOTE: If smoke disappears, fault is on battery bus. If smoke continues:	
BATT Switch	ON
BATT DIRECT BUS C/B's(Overhead)	PULL
NOTE: If smoke continues:	
BATT DIRECT BUS C/B's(Overhead)	RESET
DC TRANSFER BUS FEED C/B(M35) [930, 960 Series A/C (N37)] [A/C #960 (M36)]	PULL
B If smoke stops or decreases, at Captain's discretion:	
AC & DC X-TIE Switches	OPEN
LEFT GEN Switch	ON
NOTE: If smoke reappears, fault is on left gen bus, left AC bus, left DC bus, or AC X-tie is shorted:	
L GEN Switch	OFF
R GEN Switch	ON
F/O FLT INSTRUMENTS	CHECK
EMGNCY POWER Switch	OFF
NOTE: If smoke reappears, fault is on right gen bus, right AC bus, right DC bus, ground service AC bus, battery charger, or AC X-tie is shorted:	

[END]

AIR CONDITIONING SMOKE

OXYGEN MASKS AND GOGGLES	ON/100%
L AIR CONDITIONING SUPPLY Switch	OFF

NOTE: If smoke continues:	
L AIR CONDITIONING SUPPLY Switch	AUTO
R AIR CONDITIONING SUPPLY Switch	OFF
SMOKE REMOVAL procedure	ACCOMPLISH

[END]

SMOKE REMOVAL - PRESSURIZED

OXY MASKS & SMOKE GOGGLES	ON & 100%
COCKPIT AIR OUTLETS	FULL OPEN
CABIN ALTITUDE	RAISE TO 10,000 FT
RADIO RACK Switch	VENTURI
COCKPIT DOOR LOUVER PANEL	CLOSE
NOTE: If Smoke is in Cockpit Only:	
COCKPIT DOOR	LOCK OPEN

[END]

COCKPIT SMOKE REMOVAL -UNPRESSURIZED

Oxygen Masks and Goggles	ON/100%
ENG HYD PUMPS HIGH & AUX & ALTERNATE GEAR PUMP Switches	ON
FLAPS/SLATS.	15°/EXT
Airspeed	165 KTS
Either Cockpit Window	½ to ⅔ OPEN

RAM AIR Switch	ON
After smoke removal:	
RAM AIR Switch	AS REQUIRED

[END]

APPENDIX H—1995 NASIP INSPECTION REPORT FINDINGS

10/31/95

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

FLIGHT STANDARDS DIVISION

NATIONAL AVIATION SAFETY INSPECTION PROGRAM

INSPECTION REPORT

VALUJET AIRLINES, INC. (VJ61)
AIR CARRIER NO: VJ6A465W
ATLANTA, GEORGIA

(SEPTEMBER 18-29, 1995)

TEAM LEADER:

KENNETH G. JOHNSON
ANE-BOS-02

10/31/95

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FAR **121**

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2.00 AIRWORTHINESS

2.03 Manuals and Procedures
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2.07 Contractual Arrangements
2 14 Continuing Analysis and Surveillance Program
2.18 Aircraft Ramp Inspection

10/31/95

EXECUTIVE SUMMARY

In accordance with the National Aviation Safety Inspection Program (NASIP), a team of eight (8) Aviation Safety Inspectors conducted an inspection of ValuJet Airlines, Inc. from September 18 through September 29, 1995. The inspection was focused on specific areas as directed by the National NASIP coordinator and are listed in the Table of Contents of this report.

ValuJet Airlines, Inc. operates 34 DC-9-30 series aircraft. The airline operates utilizing a main hub and a secondary hub system. Their main hub is at the Hartsfield Airport, Atlanta, Georgia; a secondary hub is located at Washington Dulles Airport in Virginia. They employ 3,200 people and operate 228 daily departures serving 26 cities. There are two (2) maintenance facilities, the primary one being in Atlanta GA and the secondary at Dulles Airport in VA. These facilities conduct all routine maintenance and inspections through "B" checks. "C" checks and above are contracted out to certified facilities. There are no other maintenance facilities throughout their system.

The inspection took place at the Atlanta, GA Hartsfield International Airport, the location of their main base of operations. The Washington Dulles hub was inspected to insure that the maintenance is performed in accordance with their approved program. The contract facility in Miami, FL was "visited to ensure compliance with ValuJet's program.

Findings determined during the inspection that were documented and are being investigated for possible non-compliance with the Federal Aviation regulations (FAR) are:

Operations:

1. Operations Specifications
2. Operations Training
3. Crew Qualifications
4. Manuals & Procedures
5. Flight Operation

Airworthiness:

1. Manuals & Procedures
2. Records System
3. Maintenance Facilities
4. Contractual Arrangements
5. Continuing Analysis and Surveillance
6. Aircraft Ramps

Issues raised, that were of great importance were discussed with the airline and the Certificate Management Unit (CMU) personnel. Issues that were satisfied are not included in the report. Those issues that could not be resolved became findings and are included. Where enforcement action is anticipated, evidence and supporting documentation has been provided to the CMU.

ValuJet Airlines, Inc., does not have an Internal Evaluation Program at this time. They do departmental audits and independent audit teams come in 3-4 time a year. They stated they are preparing to develop a Internal Evaluation Program in the future.

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They have a Director of Safety and Regulatory Compliance who reports directly to the office of the CEO, ocedures and Senior Vice President of Operations.

The team would like to thank both the ValuJet Airlines, Inc. and the CMU personnel for their cooperation and support given the team during the inspection. The team wouId also hope the inspection results will provide the information needed by individuals responsible for the airline to properly address the areas of concern. The Principal Inspectors should emphasize to ValuJet Airlines, Inc., adherence to their Company Procedures Manuals and Federal Aviation Regulations

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1.00 OPERATIONS

1.02 OPERATIONS SPECIFICATIONS

DESCRIPTION- ValuJet Airlines, Inc. has been issued Operations Specifications which authorize domestic and flag operations in common carriage.

INSPECTION DATA: Operations Specifications

FINDING 1.02.1: Operations Specifications C-70 list of airports show Montreal, Canada (YUL) and Macon, GA (MCN) as regular airports. ValuJet does not serve these stations.

FINDING 1.02.2: Operations Specifications Section D85-Aircraft Listing and ValuJet Airlines General Maintenance Manual, page 1-11, do not address the aircraft type.

1.03 OPERATIONS TRAINING

DESCRIPTION -ValuJet Airlines, Inc. employs approximately 312 pilots, of which nine (9) are proficiency check pilots and nine (9) are line check pilots.

ight Safety, Inc. provides five (5) simulator instructors and five (5) simulator proficiency check, pilots. Training and checking is conducted at Flight Safety in Miami and Atlanta Flight Safety Instructors are trained in ValuJet procedures and approved by the POI to conduct ValuJet training.

There are eleven (11) certified dispatchers and three (3) flight followers. There is one (1) Director of Systems Operations Control.

All pilot training records are maintained in a manual folder system and kept in the Chief Pilot's office, at the Atlanta Airport. There is a computer database being used as a back-up, and this system will be approved for use shortly. Flight Safety, Inc. also keeps a copy of training records in Miami, Florida Dispatcher training is conducted by Transcon, Inc. and the records are maintained by the Director of Systems Operations Control at headquarters.

The ValuJet Inflight Training Department is responsible for providing all categories of Flight Attendant Training. This training includes Initial New Hire and Recurrent Training.

Flight Attendant training is conducted in Atlanta for all domiciles. ValuJet currently employs approximately 400 flight attendants and maintains their qualification on DC-9 type aircraft. ValuJet utilizes the aircraft and cabin mockups to instruct flight attendants on exit operation in the normal and emergency modes.

INSPECTION DATA: The Flight Operations Training Manual, which contains the Flight Attendant Training ogram, was reviewed to determine compliance with applicable Federal Aviation Regulations. Classroom training was not conducted during the time of inspection. A representative sampling of Pilot Training records

were reviewed for compliance with FAR 121.683 and subparts N and D. All dispatcher training records were reviewed. The following qualification events were observed during the Inspection:

Initial New Hire Ground Training.
Initial New Hire Simulator Training

FINDING 1.03.1: The Flight Attendant Training Program does not contain a list of all training devices and training aids to be used by the Certificate Holder as required by Federal Aviation Regulation (FAR) 121.403 (b)(2).

FINDING 1.03.2: The Flight Attendant Training Program does not contain information in crew communication and crew coordination among crewmembers during instruction of emergency assignment and procedures (FAR 121.417 (b)(l)) and the handling of hijacking and other unusual situations (FAR 121.417 (b)(3)(v)).

FINDING 1.03.3: Dispatcher recurrent training conducted on 5/2 1/95 and 5/22/95 shows that training received by three dispatchers did not comply with the ValuJet approved recurrent training program as required by Federal Aviation Regulations (FAR) 121.427.

1.04 CREW QUALIFICATIONS

DESCRIPTION - ValuJet Airlines, Inc. qualifies flight crew members utilizing instructors and designated check airmen of Flight Safety International in Miami, Fl. and Atlanta, GA. (See Operations Training section of this report for further details). Records of training and qualification are maintained for pilots in the Chief pilot's office located in Concourse C at Atlanta Airport.

Flight Attendant training and qualification records are maintained at company headquarters at 1800 Phoenix Blvd. Suite 126, Atlanta, GA.

ValuJet Airlines, Inc. maintains qualifications of the Flight Attendants in accordance with the provisions of the Federal Aviation Regulations. Flight Attendant Training Records are maintained using a manual written system at ValuJet Headquarters.

INSPECTION DATA: A representative sampling of pilot and flight attendant records were reviewed to determine compliance with the FARs and other written guidance regarding crew qualifications. Instructors, check airmen and designated examiners were reviewed. The following qualification events were observed during the inspection:
Initial New Hire Ground School
Initial New Hire Simulator School

Inspection of Flight Attendant Training records was accomplished by a random sampling (3.7%) of the folders.

FINDING 1.04.1:. The latest pilot certificate in the records of one captain shows a DC-9 type rating on a temporary certificate that expired on 9/13/95 .(Date of Inspection 9-19-95.) This is contrary to FAR 121.683. This record was corrected on 9/25/95.

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1.05 OPERATIONS MANUALS AND PROCEDURES

DESCRIPTION - The ValuJet Flight Attendant Manual provides all flight attendants with the ValuJet company policies, flight attendant duties and responsibilities, emergency procedures and references to the Federal Aviation Regulations. A newly published Flight Attendant Manual was issued to all Flight Attendants effective September 19, 1995. A standard manual revision/bulletin distribution process assures that all additions and changes are issued to all flight attendants ina a timely manner.

Flight crewmembers are provided a Company operations Manual (COM) and Minimum Equipment List **(MEL)** which contain company policies, procedures, and crew duties and responsibilities.

INSPECTION DATA: The ValuJet Flight attendant Manual was evaluated for compliance with the Federal Regulation and appropriate FAA guidance. The COM, MEL and Flight Operations Training Manual were reviewed for compliance with applicable FARs.

FINDING 1.05.1: The Flight Attendant Manual does not contain a procedure to provide notification to the Captain that the aircraft is ready for push-back. This is contrary to FAR 121.570(a).

FINDING 1.05.2: The Flight Attendant Manual does not contain a procedure to comply with 43.3. & 121.375 regarding the inspection program of the emergency medical kit.

FINDING 1.05.3 ValuJet Airlines Flight Operations Training Manual does not contain requalification training curriculum.

FINDING 1.05.4: The non-precision instrument approaches listed in ValuJet's Operations Specifications paragraph C-52 are not listed as training events in the Flight Operations Training Manual's Flight Training Modules., contrary to FAR 121.567 and 121.403.

FINDING 1.05.5: The Flight Attendant Manual does not reflect an announcement for inflation of the life vest or the operation of the life vest light under normal operations, nor does it contain a procedure to pull the red inflation handle as a back up system in the even the slide does not inflate. It also does not contain a procedure for the flight attendants to use the emergency light swith in an emergency. FAR 121.397(b).

FINDING 1.05.6: A non-duty flight attendant (non-revenue passenger) assisted on-duty flight attendants while the seat belt sign was turned on. The Flight Attendant Manual should include instructions for flight attendants who occupy the 4th Flight Attendant jumpseat to only assist with the beverage service when the seat belt sign is turned off.

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1.06 FLIGHT CONTROL

DESCRIPTION - ValuJet Airlines, Inc. operates a central dispatch center in its headquarters building at 1800 Phoenix Boulevard, Suite 126, Atlanta,GA. The dispatch center operates 24 hours a day, except from 11 PM local time Saturday evenings until 7 AM local time Sunday morning. Operational conditions may require the dispatch center to be open during these normally closed hours.

The dispatch center is staffed with a Director of Systems Operations Control and eleven (11) dispatchers. The dispatch center issues approximately 220 releases per day utilizing a fleet of 34 DC-9 aircraft.

ValuJet utilizes Jeppesen flight planning and weather services. The dispatch center is co-located with maintenance control. Weight and balance is accomplished in Atlanta with an approved computer program, backed up with hand generated copies. All other weight and balance forms are hand prepared at the departure station by the First Officer on form VJWB102.

INSPECTION DATA: The ValuJet Airlines, Inc. dispatch center was observed for two (2) days. The Director of Systems Operations Control and (2) dispatchers were interviewed. The center was observed and evaluated for compliance with FAR 121, Company Procedures and Operations Specifications.

FINDINGS: None

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1.07 FLIGHT OPERATIONS

DESCRIPTION - ValuJet Airlines Inc. is authorized to conduct domestic and flag operations in the 48 contiguous United States, the District of Columbia, and Canada. ValuJet operates a fleet of 34 DC-9 Aircraft.

ValuJet computes weight and balance using an approved computer program for the departures from its Atlanta GA station only. All other weight and balance computations are hand prepared by the First Officer on company form VJWB102.

ValuJet Airlines, Inc. operates primarily in the Eastern and Southeastern United States with hubs in Atlanta, GA and Washington - Dulles.

INSPECTION DATA: Ten (10) ramps, four (4) cabin, sixteen (16) cockpit enroute and three (3) station inspections were accomplished.

FINDING 1.07.1: On September 22, 1995, a cockpit enroute inspection was scheduled on Flight 580 from Atlanta to Boston. The aircraft to be operated was DC-9, N903VJ. Upon arrival at the gate, it was noted that the packet containing the airworthiness and registration certificates was missing. The First Officer had noticed this discrepancy and had called maintenance in order to locate these documents. They were not found and an aircraft change for the flight was affected. Further inspection revealed that document package was found at Aero Corporation Lake City, FL, a maintenance contractor for ValuJet Airlines, Inc.. The aircraft had received a "C" check and was returned to service on 9-18-95.

Aircraft N903VJ was operated from 9-18-95 to 9-22-95 on approximately 28 flights without the required document package. This is contrary to FAR 91.203 (a) (1) and(b) and FAR 121.153 (a)(1) which states that no person may operate a civil aircraft unless it has within it an appropriate and current Airworthiness Certificate and an effective U.S. Registration Certificate issued to its owner.

FINDING 1.072 A station inspection was conducted at Washington-Dulles. A review of the trip records and weight and balance papers disclosed that fuel receipts are not being attached to or kept with these papers. This is contrary to ValuJet's Fueling Manual which requires fuel receipts to be filed with the trip papers.

FINDING 1.07.3 ValuJet Airlines does not have a written policy or procedure for the deplanement of passengers necessitated by an aircraft change or other circumstances. If necessary to deplane, passengers are issued boarding cards as they exit the aircraft. The passengers are then enplaned in accordance with Station Operations Manual (S.O.M) page 5-1-4, items 9-14, at the new gate or aircraft. This lack of procedure could cause a security violation.

10 / 31 / 95

AIRWORTHINESS

2.03 MANUALS & PROCEDURES

DESCRIPTION - The ValuJet Airlines, Inc., General Maintenance Manual (GMM) consist of 13 Volumes. Volume four (4) of the GMM contain the general maintenance policy and procedures required by FAR 121. Volume 11 & 13 includes the weight and balance and ground handling procedures, respectively. The remaining volumes speak to the specific subject areas relative to the maintenance departments as required by FAR Part 121.

INSPECTION DATA: The ValuJet Airlines Inc., manual system was evaluated for maintenance policy on parts and material as required by FAR Section. 121.369. Each volume was reviewed for policy and procedures, including the revision status for both company issued manuals and technical publications.

ValuJet Airlines, Inc. General Maintenance Manual (GMM) was reviewed to determine compliance with company procedures.

FINDING 2.03.1: There are several forms in the CAS document that do not have forms numbers and are not listed in the GMM Chapter #7.

FINDING 2.03.2: CAS document speaks to a job title Supervisor of Line Maintenance) that is not included in the GMM block diagram.

FINDING 2.03.3. GMM Chapter 7-25, Rev. 41,5-24-95 Equipment Transfer Record VJ-M021
GMM Chapter 5-12, Rev. 41,5-24-85 Equipment Transfer Record VJ-M021, procedures are not being followed.

FINDING 2.03.4: The General Maintenance Manual (GMM) was found with three (3) separate chapters describing the procedures for parts and material handling, receiving and tagging. Each chapter contradicts each other. This is contrary to FAR 121.135(a)(1).

FINDING 2.03.5: The GMM Chapter 12, page 8, "Receiving Inspection" (Paragraph A) states, "The Director Quality Assurance or his delegate shall perform spot checks to monitor the proper performance of this function. The duties of the receiving inspector may be delegated to trained and qualified stores personnel." This is contrary to FAR 121.369 (b)(2).

a. Chapter 12 above, contradicts this same "Receiving inspection" section found in Chapter 8, pg. 2, "Receiving Inspection Procedures". Chapter 8, is found to be in compliance with FAR 121.369 (b) (2), but not Chapter 12.
b. Chapter 3, page 5, section 5 states that the "Quality Assurance Director will provide trained receiving personnel and that he must hold a valid A&P rating". This statement also contradicts Chapter twelve (12) above.

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FINDING 2.03.6: General Maintenance Manual Chpt 6-14, Rev 14, para 4.b.3 Note: Replacement of components with quick disconnect pitot or static lines do not require a leak check. This procedure is not in compliance with FAR Part 43, Appendix E. The GMM does not address checking the positive lock indication.

FINDING 2.03.7: General Maintenance Manual Chpt 10-2, Orig. para l-B, states "qualified senior mechanic" or "supervisor" and "maintenance trainer", as also found in 10-5, para 3-A-2, 10-7, para 5-D. These positions are not listed in the "duties and responsibilities" index chapter 3.

FINDING 2.03.8: General Maintenance Manual (GMM) Chpt 10-3, Rev 52, Para 2-B-2 has no established guideline for RII training.

FINDING 2.03.9: CAS Document does not speak to Engine Trend Monitoring as part of Data Collection". Also the CAS report does not include the "trend data" to show how the fleet engines are operating.

FINDING 2.03.10: The CAS Document shows no sign of FAA acceptance (Stamp) or (Signature)

FINDING 2.03.11: The CAS program is mentioned in two (2) different documents, the GMM(General Maintenance Manual) Chapter 4 and a separate standalone CAS document

FINDING 2.03.12: GMM Chapter 4 states that the Director of Quality Control will administer the CAS program, but the CAS document states that the MRB members will administer the program.

FINDING 2.03.13: CAS Document speaks to a "Reliability Program" in several sections. ValuJet is not authorized to have a reliability program.

FINDING 2.03.14: Interview with a "Reliability Specialist" revealed that the CAS program is contracted out to a vendor. The CAS program does not address or describe the vendor arrangements. It is not known if the vendor is listed in ValuJet's vendor list.

FINDING 2.03.15: ValuJet CAS Document does not speak to the "Audit Function" of the CAS program..

FINDING 2.03.16 The ValuJet CAS program does not address "Emergency Responding".

FINDING 2.03.17: CAS Document Chapter-7, page 2, para B (1) and (2) speak to a revision being "Approved". The CAS program only need to be "accepted; a reliability program needs "approval".

FINDING 2.03.18: Engine shop manuals and general information is current. Parts were checked, found some lines with no caps, "some valves with no protective caps. There is no controlling document or procedure for the proper storage of dehydrating agent, Desiccant Type 90013200 or an equivalent. Also, the dehydrating agent is not properly stored.

FINDING 2.03.19: The Fuel Manual was reviewed due to the high number of fuel quantity/fuel flow indication problems. Chapter 6-8, Rev 3, 5-1-94, figure 6 states that "Stick Reading for ValuJet Aircraft are in pounds of fuel". This is not true, as some are in pounds and others are in kilos. The manual does not address airport certification, aircraft handling, water in fuel, or fuel devices. This is contrary to FAR 121.135(a)(l), 121.363 and 121.378.

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FINDING 2.03.20: The General Maintenance Manual was found with the following discrepancies:
Director Quality Assurance, Duties and Responsibilities must "ensure all work on aircraft, parts or equipment is performed in accordance with ValuJet standards". This statement is contrary to FAR, Par. 43.13(c).
b. The Store Department Manager is responsible for disposition of parts and materials, but the GMM is vague in identifying the individual who should be performing the receiving and inspecting of parts.
c. Chapter 4 has an incorrect reference on page 53, section 3,b. It should reference Chapter 5, not Chapter 7.

FINDING 2.03.21: A reference in the GMM Chapter 4 is made to Operations Specifications Section D83; however, section (c) for borrowing parts was omitted.

FINDING 2.03.22: GMM Chapter 4, page 62, section 1.a has an erroneous reference to Chapter 7; it should read Chapter 5.

FINDING 2.03.23: Winter Operation Manual page G-2, Rev-6/De-Icing& Anti-Icing Manual 1-4, Rev-1.

1. Type II Fluids: both manuals state type II can be used for both deicing and anti-icing. Type II fluids are anti-icing only.

2. Holdover time: the last part of this statement regarding fluid effectiveness must reference a time.

2. De-Icing & Anti-icing Manual Page 2-1, Rev 1,1-12-95
A. -4 Training at least once a year, must be annually.
.. Winter Operations Manual Pg 1-5, Rev-6, Para 4-b
All de-icing must be done in accordance with ValuJet's Program, not any other program

FINDING 2.03.24: A review was done to the latest revision to the ValuJet DC-9-32 Series Maintenance Check Manual, Report ME-DLA-300. The copy was assigned to the Maintenance Planning Department and the revision number was number 2, February, 1994. Quality Assurance Department copy had a revision of number 7, and missing the revision date on the records of revision log. The DC-9 Maintenance Program Specification under Quality Assurance Department has a revision number 7.

FINDING 2.03.25: Concerning Limits for the DC-9 Tires the General Maintenance Manual chapter 5 page 5-5, 5-24-95 Rev 41, para D-(2)" Cut Beyond Limits", should be "Cut Limits". Refer to allowable cuts in DC-9 M / M 32-05 page 5-5,5-24-95 Rev. 41. Para F-(2) No statements or data can be found in the Maintenance Manual 32-05, Fig. 203 only addresses the cut gap and depth.

FINDING 2.03.26: GMM Chapter 4, page 54 states that "Repairs are done in accordance with FAA Regulations." This is not correct; repairs are done in accordance with manufacturer's manuals.

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2.05 RECORDS SYSTEMS

DESCRIPTION - As required by Federal Aviation Regulations (FAR) 121.380, 121.380a and 121.369, ValuJet maintains a Maintenance Records Systems. This system procedure is contained in their General Maintenance Manual and supported by the ValuJet Computer System.

INSPECTION DATA: Aircraft Flight Logs, Aircraft History Records for particular ATA chapter, Overhaul Records for Escape Chutes, Continuing Analyses and Surveillance Data, Collection Records, and other random records as necessary.

FINDING 2.05.1: ValuJet could not produce the Engine Condition Monitoring (ECM) reports for the previous 12 month period as specified in the GMM page 4-15.

FINDING 2.05.2: The July CAS Report mentions a landing gear problem with N931VV and found that MD-80 bumpers were installed on this aircraft. Dee Howard repair station may have installed wrong bumpers. Several hours were spent trying to locate the maintenance record entry for removing and replacing the bumpers. No records could be found. This is contrary to FAR 121.369(c), 121.379 and 43.9(a) and (b).

10/31/95

2.06 MAINTENANCE FACILITIES

DESCRIPTION - The ValuJet Airlines, Inc. Line Station at Hartsfield Atlanta International Airport, Atlanta, GA is designated as the main maintenance center. The line station contains ramp spaces for aircraft maintenance and a storage facility to store materials. The line station maintains adequately trained and properly certified personnel to perform limited maintenance fictions. Materials, tools and manuals are maintained at this line station to adequately perform routine and non-routine maintenance through B checks. The C "checks" and structural inspections are performed by outside contract entities.

INSPECTION DATA: ValuJet Airlines, Inc. General Maintenance Manual (GMM) was reviewed to determine compliance with company procedures and visual inspections were conducted at the stores department.

FINDING 2.06.1: The following parts were found without the equipment transfer record (ETR) form VJ-M021, which were in the "shipping discrepancy" Bin:
a. A Harness Restraint was also missing the manufacturer's data plate.
b. Two (2) Harness restraints, P/N 110795-01M.

FINDING 2.06.2**:** P.B.E., S/N E94549022, was found in the unserviceable shelf, but the equipment transfer record (ETR) form VJ-M021, was missing the required information in section "C" and "D" per General Maintenance Manual.

FINDING 2.06.3: An inspection was performed at the stores facilities and found eight (8) Hydraulic Pump Clamps, P/N 374105, on a serviceable shelf with just one (1) Equipment Transfer Records (ETR) form VJ-M021. The ETR had an inventory purchase (IP) number 1216, but no material certification attached to it. IP1216 was checked at purchasing department and it was noted that five (5) clamps were ordered. The receiving invoice for the parts were not available at the time of the request On September 25, 1995 a fax was received at ValuJet's purchasing department from Robert E. Hoose, Inc., noting invoice number 279645, dated 7/28/95 and a material certification for only five (5) clamps, P/N 374105.

FINDING 2.06.4: The following parts were missing the required information on block "Shelf Life Expires" on the equipment transfer records (ETR):
a. P/N 522-2703-011, ATC transponder, S/N 7205.
b. P/N 4061-400-905, modes transponder, S/N 9007023, this unit was noted with "N/A" on the block identified "Shelf Life Expires".

FINDING 2.06.5: A review of the Quarantine Program for parts was conducted at the stores department. Specifically, a log sheet was noted next to the Quarantine Shelf, this log sheet is not found in the GMM. Using the log sheet for traceability of parts returned to stock and randomly checking actual parts, two (2) were found with missing required documents. These parts were to have the previous six (6) flight log pages attached to the serviceable tag returning it to stock. One example is P/N 714810 Fuel Pressure & Dump Valve The General Maintenance Manual identifies these units as Shelf Life Limited, and proper filling the block on the ETR.

FINDING 2.06.6: Two parts were found with missing information on the equipment Transfer Record (ETR) as noted below
1 - P/N 13621-2-24, S/N 33-2, Evacuation Slide, was missing the inspector's stamp or signature on the block identified as "Certificate Service By".

2- P/N 591407, S/N 48026 AU, L/H wings tip, missing signature on block identified as “Expedite for Repair Mech”.

FINDING 2.06.7: P/N JG908A11, EPR indicator, S/N 09, had two identification tags attached to it. One is ValuJet’s form VJ-M021, Equipment Transfer Record (ETR) #19741 which indicates that the part was Robbed from A/C N905, dated 6-10-95. The other tag is form #QC-236 Rev. 2/95 and stamped inspected by“AC112” dated 6-20-95, inscription on tag shows “not compatible for -9 engine”. A block identified as “Discrepancy noted” has a circled “yes”. This unit is of questionable serviceability.

FINDING 2.06.8: Part #383342-l-1, starter, S/N2 1443 was missing a serviceable tag from vendor as new unit. The papers attached to the part was a material certification from Aviation Sales Company stating that the part was obtained from AlliedSignal Aerospace as new. No certification from AlliedSignal was found at this time.

FINDING 2.06.9: During the stores inspection, it was noted that an internal procedure for scrapping parts was developed. This internal procedure is not in the General Maintenance Manual. Furthermore, this procedure included a scrap log with no control number.

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2.07 CONTRACTUAL ARRANGEMENTS:

DESCRIPTION: ValuJet Airlines utilizes various vendors to perform maintenance inspection and repair on their powerplant, appliances and parts. ValuJet Airlines performs line, A& B checks with company personnel. ValuJet Airlines maintains contractual agreements with their major vendors as well as the leased aircraft in their fleet.

INSPECTION DATA: Reviewed General Maintenance Manual (GMM) forms and procedures, aircraft listing and training department & records.

FINDING 2.07.1: N904VJ C-Check-2 S/N 47377, 66,526: 40 hours, 79,144 cycle Reviewed work package and cards. NB-1 Eng. Removed for High time. no tag on this Engine (Using Douglas O.A.M.P. and Dent Mapping Program.

10/31/95

2.14 CONTINUING ANALYSIS AND SURVEILLANCE PROGRAM

DESCRIPTION - As required by Federal Aviation Regulations (FAR) 121.373, ValuJet maintains a continuing analysis and surveillance program to monitor the effectiveness and performance of the day to day operation of the airlines.

The system contains a data collection function, an analysis function, an audit function, a corrective action function and a follow up function. The system is maintained at the Atlanta, GA main base. Much of the data is entered and stored in a computer program designed by ValuJet and an outside contractor. All data collection is done by ValuJet employees, but computations and reports are generated by an outside contractor. A CAS Meeting is held monthly, usually the last Tuesday of each month.

INSPECTION DATA: ValuJet Airlines, Inc. CAS Document, General Maintenance Manual (GMM), June and July CAS reports, Records/Inspection, Engine Trend Monitoring Reports, Employee Interviews and Attendance of the September CAS meeting.

FINDING 2.14.1: ValueJet's Continuing Analysis and Surveillance Program (CAS) does not appear to be FAA approved and other findings concerning the CAS program were noted during the inspection. ValuJet was able to demonstrate how trends were detected, action taken, and how follow-up actions were conducted ValuJet demonstrated at their CAS monthly meeting that a joint effort is used in solving matters that have reached alert levels. The specific findings concerning the CAS manual are listed in sections 2.03 and 2.05.

10/31/95
2.18 AIRCRAFT RAMP INSPECTION

DESCRIPTION - ValuJet operates 34 DC-9 aircraft, several of which remain overnight (RON) at the Atlanta Airport in Atlanta, GA. These aircraft receive line type maintenance during this RON stay and are prepared for early morning departures into the ValuJet route structure. Approximately one hour before departure time crewmembers arrive and begin their appropriate duties.

INSPECTION DATA: Ramp inspections were conducted at the Hartsfield International Atlanta Airport. The inspections were conducted using guidelines as authorized in the Inspector's Handbook and NASIP Guidelines.

FINDING 2.18.1: On aircraft N933VV DC 9-32, there was no placard installed on the left fuel quantity guage in the wing refueling panel as required by ValuJet's MEL procedures. The cockpit left main fuel tank quantity guage had been deferred per the MEL and identified as MEL control 4313. When reviewing the flight release, this showed that the left fuel flow indicator was the inoperative component.

FINDING 2.18.2: Aircraft N907VJ - The L-1 Passenger Door "main cabin door caution light" actuator located on the door was wrapped with speed tape so as to cause the switch actuator to actuate and turn off the "main cabin door caution light." Maintenance removed the speed tape and the system worked normally and the aircraft was released for service. The Director of Maintenance was notified and witnessed this matter. This speed tape is not an approved repair. This finding has been combined with finding 2.18.4.

FINDING 2.18.3: Aircraft N914VV was at the gate and maintenance was changing the Captain's windscreen. The windscreen was removed and the weather was drizzling. In the event of heavier rain, the inside of the cockpit and instrument panel would have gotten wet. This aircraft was not in an adequate facility for the level of maintenance that was being conducted. This is contrary to FAR 121.105 and 121.367(b).

FINDING 2.18.4: Aircraft 915VV, the main passenger door (L-1) had a piece of speed tape wrapped around the switch actuator bumper on the door itself, so as to keep the "main cabin door caution light" extinguished. Maintenance could not show any approval for this repair. Maintenance removed the speed tape and the caution light stayed on. Maintenance deferred the system per the MEL. ValuJet GMM page 12-5 lists RII items and para d-6 states that "door rigging" is a (RII) required inspection item. Could not find any maintenance records showing work being done on this door and a RII inspection being done. Director of Maintenance (DOM) has possession of the speed tape from both N915VV and N907VV. These procedures are contrary to FAR 43.13, 121.363, 121.369(c), 121.709(b)(2)(i) and 121.628(a)(5).

SUMMARY OF FINDINGS

VALUJET AIRLINES INC
VJ6A
NASIP INSPECTION
SEPTEMBER 18- SEPTEMBER 29, 1995

121
SO-ATL-11

Finding No.	Category
1.02.1	C
1.02.2	C
1.03.1	A
1.03.2	A
1.03.3	A
1.04.1	A
1.05.1	A
1.05.2	A
1.05.3	C
1.05.4	A
1.05.5	A
1.05.6	C
1.07.1	A
1.07.2	B
1.07.3	C
2.03.1	B
2.03.2	C
2.03.3	B
2.03.4	A
2.03.5	A
2.03.6	A
2.03.7	C
2.03.8	C
2.03.9	C
2.03.10	C
2.03.11	C
2.03.12	C
2.03.13	C
2.03.14	C
2.03.15	C
2.03.16	C
2.03.17	C
2.03.18	B
2.03.19	A
2.03.20	A
2.03.21	C

2.03.22	C
2.03.23	C
2. 03.24	C
2.03.25	C
2.03.26	C
2.05.1	B
2.05.2	A
2.06.1	B
2.06.2	B
2.06.3	B
2.06.4	B
2.06.5	B
2.06.6	B
2.06.7	B
2.06.8	B
2.06.9	B
2.07.1	B
2.14.1	C
2.18.1	B
2.18.2	B
2.18.3	A
2.18.4	A

	TOTALS	
CATEGORY A	**CATEGORY** B	CATEGORY C
17	17	24

TOTAL FINDINGS - 58

VALUJET
VJ6A465W
ALANTA, GA.
2/14/96

Report prepared by
AFS-300

This report summary addresses ValuJet Airline's accident/ incidents, enforcement history, NASIP Inspections, and the FAA's surveillance activity. Airworthiness concerns following two (2) recent accidents and a DOT Office of Inspector General (OIG) audit of the air carrier are the catalyst of this analysis.

ValuJet was originally certified as a domestic air carrier (121) on October 21,1993. Their certificate number is VJ6A465W. ValuJet will be addressed as VJ6A throughout the remainder of this report.

Their principal base of operations is Atlanta, Ga. Additionally, they operate two (2) maintenance facilities at the Hartsfield Airport, Atlanta, Ga. and Dulles Airport, Va.

General Information:

VJ6A has an adequate management staff that consists of

CEO
General Manager
Vice President of Maintenance
Director of Maintenance
Chief Pilot
Director of Operations
Chief Inspector
Director of Aircraft Programs
Director of Technical Services
Director of Safety

The VP of Maintenance, Director of Technical Services, Director of Aircraft Programs, Chief Inspector, and Director of Safety are recent additions to the management staff.

VJ6A principal inspectors consider all individuals well qualified for their positions.

VJ6A'S Certificate is managed by the ATL-FSDO, College Park Ga. The Principal FAA Inspectors are:

PMI	David J. Harper
POI	Robert E. Bruce
PAI	David L. Frantz

VJ6A employs approx. 142 captains, 17 check airman, 4 designated inspectors, 170 pilots, 450 flight attendants, 156 A&P mechanics, 137 ground personnel, and numerous other staff and service personnel.

The primary training location for pilots, flight attendants, and mechanics is Atlanta, Ga.

VJ6A operates 34 DC-9-30 series aircraft and uses contract maintenance facilities for **scheduled and unscheduled maintenance** away from their main base in Atlanta and the sub-base at Dulles.

Contract Maintenance Organizations:

1. AMR Combs	Windsor Lock Ct.
2. Signature Flight Services	Boston, Ms.
3. Lane Aviation	Columbus, Oh.
4. AMR and NWAA	Dallas, Tx.
5. Jet Center	Fort Lauderdale, Fl.
6. USAIR	Oakland, Ca.
7. David Yocum	Kansas City, Mo.
8. North West	Orlando, Fl.
9. Signature Flight Support	Chicago, IL.
10. North West	Memphis, Tn.
11. Continental	New Orleans, La.
12. Continental	West Palm Beach, Fl.
13. Rick Aviation	Newport news, Va.
14. Northwest	Philadelphia, Pa.
15. Jet South	Fort Myers Fl.
16. AMR	Savannah, Ga.
17. Northwest	Tampa, Fl.

The company phone number is (404) 907-2580.

ACCIDENT/INCIDENT:

Accident History:

1. July 5, 1994 aircraft encountered moderate chop at cruise. One (1) cabin crew member suffered multiple leg fractures no fatalities. The NTSB investigated and determined probable cause as severe turbulence over flight area.

2. June 8, 1995 aircraft experienced a uncontained turbine failure during takeoff roll at Atlanta's Hartsfield Airport, Ga. Five (5) passengers and one (1) cabin crew member were injured no fatalities. The NTSB is investigating, with no probable cause reported.

3. January 7 1996 during an attempted landing at Nashville, Tn. the aircraft sustained damage to the nose landing gear. The aircraft departed the runway, circled and landed with no nose landing gear. NTSB is investigating, with no probable cause reported. No fatalities or injuries reported.

Incident History:

VJ6A had a total of nine (9) incidents since 1994 with the last one occurring in December 1995.

VIOLATION HISTORY:

VJ6A has a total of 46 violations since 1993 with 20 violation remaining open. Approx. Six (6) of the violations were maintenance related. The FAR's violated are; 43.9, 43.13, 121.363, 121.367, and 121.369. No accidents were related to any of these violations.

All maintenance related violation were closed with administrative action (letter of correction). In an analysis of the enforcement action it was noted that a violation of FAR 121.363 occurred two (2) times in less than one (1) year and both closed with letters of correction.

FAA Order 2150.3A specifically states that the letter of corrections sole purpose is to correct conditions which are in violation of the FARs. With the second violation of FAR 121.363 occurring within one (1) of the first violation it appears that the corrective action was not adequate.

NASIP:

A NASIP was performed at VJ6A in September 1995. A total 58 findings were noted. The category are:

1. 17 Category A
2. 17 Category B
3. 24 Category C

43 of the 58 findings were maintenance related. While the inspection was completed five months ago, 43 findings have not been closed.

The significant maintenance related NASIP findings are:

Manuals and Procedures:

1. Eleven findings were noted with the document that outlines the continued analysis and surveillance program (CAS). The significant findings include:

- Problems with CAS forms numbering system
- CAS does not address engine trend monitoring
- Maintenance Manual conflicts with CAS document
- CAS program not accepted by the FAA

- CAS does not outline audit function
- CAS does not address emergency response
- CAS reference a reliability program, however, VJ6A has none

2. Fifteen findings were noted with the General Maintenance Manual (GMM) and related documents. The significant findings include:

- GMM conflicts with FAR requirements in several areas
- Fuel Manual not adequate, several important items omitted
- GMM has conflicting chapters
- GMM does not establish guidelines for RII training
- Winter Ops. Manual reference incorrect information on de-icing fluids
- Maintenance Check Manual not current in Maint. Planning Dept.

Records Systems:

3. Two findings were noted with the records system they are:

- No engine condition monitoring records
- CAS reported a maintenance problem, however, no records were found correcting problem

Maintenance Facilities:

4. Nine findings were noted in the area of Maintenance Facilities. The significant findings include:

- Parts found in bins without records
- Parts not identified IAW GMM
- A system not outlined in the GMM used to track returned parts to stock
- Part scrapping procedure not addressed in GMM

Ramps and Spots:

5. Four findings were noted in the area of ramps and spots. The significant findings include:

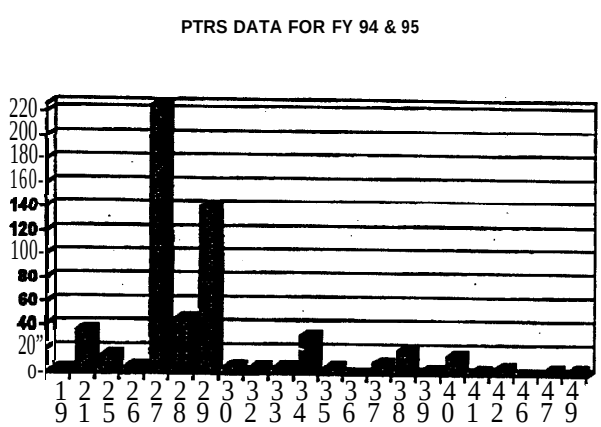
- MEL procedure not followed
- Performing maintenance without adequate facilities
- Performing maintenance with unapproved procedures

FAA SURVEILLANCE HISTORY

The following is an analysis of two (2) years of VJ6A's surveillance activities. The data was obtained from the National PTRS. 22 air carrier specific inspection items were analyzed. They are identified by the surveillance codes as they appear in the PTRS Manual.

A reference table is provided below the histogram that identifies the PTRS Code with the actual inspection function. Example; Number 27 on the chart is a ramp inspection that was accomplished 226 times in two (2) years.

The histogram clearly shows that the most accomplished inspection is the ramp inspection PTRS Code 3627 and the least accomplished is the structural inspection PTRS Code 3646.



Reference:

19. = Main Base
21. = Line Station
25. = Air Operators Special Inspection
26. = Manuals and Procedures
27. = Ramps
28. =Spot
29. = En Route
30. = En Route Cabin
32. = Shop/Facility
33. = Training Records
34. = Aircraft Records
35. = Continuing Analysis

3619 = 003
3621 = 036
3625 = 015
3626 = 006
3627 = 226
3628 = 046
3629 = 141
3630 = 006
3632 = 005
3633 = 006
3634 = 031
3635 = 005

36. = Reliability Program	3636 = 002
37. = Inspection Program	3637 = 009
38. = Fuel Facility	3638 = 020
39. = Approved Weight & Balance	3639 = 003
40. = Contract Maintenance Facility	3640 - 015
41. = Maintenance Support Facility	3641 = 002
42. = Technical Manuals	3642 = 005
46. = Structural Inspection	3646 = 000
47. = Structural Spot	3647 = 003
49. = Airworthiness Directives	3649=003

A total of 588 inspection items were recorded by the certificate management office and geographic inspectors during the work program years of FY 94 and 95.

Of the 588 inspections 359 were satisfactory eight (8) were not accomplished, eight (8) were canceled "X-out", 207 recorded some discrepancy, and **six (6) resulted in enforcement action.**

36 percent of all inspection accomplished in two (2) years recorded some findings.

It was noted that surveillance code 3636 **reliability program inspection was** recorded two (2) times with a total of 10 inspector hours charged to an air carrier that does not have a reliability program.

When comparing the NASIP findings with surveillance activities, we clearly see that areas receiving the least attention during the inspection year make up the majority of the maintenance related NASIP findings.

In addition to the PTRS information a report was run on the Safety Performance Analysis System (SPAS) for VJ6A. The report analyzed the following areas:

Records and Procedures
Airworthiness Surveillance
Aircraft Records

The report covered approx. three years of data. In all areas analyzed VJ6A was at the advisory and or alert threshold in the majority of the months studied.

Additionally, an independent regional aviation safety specialist analyzed VJ6A inspection and surveillance data with virtually the same results and conclusions as this report. This additional sources further validates our hypothesis.

CONCLUSIONS:

This report addressed VJ6A's accident/incident enforcement history, NASIP Inspection, and the FAA's surveillance activity. The data reviewed, clearly show some weakness in the FAA's surveillance.

The PTRS data analysis revealed that some critical surveillance activities did not receive much attention They are as follows:

1. Manuals and Procedures PTRS Code 3626 six (6) inspection

2. Shop and Facilities PTRS Code 3632 five (5) inspection

3. Structural Inspection PTRS Code 3646 zero (0) inspections

Although some may argue that six (6) inspections of manuals and procedures is sufficient in two (2) years, you need only look to the recent NASIP Inspection findings to see why more inspections should have been done. 35 of the inspection findings were in the manuals and procedures and shop and facilities area. Additionally, the SPAS data for procedures indicate that increased surveillance is warranted. 20 times between December 1993 and January 1996 VJ6A was at the advisory and or alert threshold.

The PTRS data also indicated that no structural inspections were accomplished on VJ6A's aircraft in two (2) years. With a supplemental inspection document (SID) required by AD 87-14-07 to **ensure continued structural integrity of an aging fleet of DC-9 aircraft,** AFS 300 believes this critical inspection was severely overlooked.

The findings closet date for the September 1995 NASIP inspection is February 28,1996

RECOMMENDATIONS:

Based on VJ6A's history, The NASIP Inspection, NTSB and OIG investigations, and Surveillance AFS-300 can recommend the following actions:

1. Consideration should be given to an immediate FAR-121 re-certification of this airline. This recommendation is based on such known safety related issues as the absence of adequate policies and procedures for the maintenance personnel to follow. Additionally, the absence of engine trend monitoring data, and the possibility of a continuous airworthiness maintenance program that maybe inadequate because it uses reliability based procedures without a reliability program.

2. The overall surveillance of the air carrier should be increased in FY96. Special attention should be directed toward manuals and procedures, structural inspections, the

adequacy of the maintenance program, and shops and facilities. Additionally, the PMI should consider accomplishing two (2) main base inspections every year.

3. The cIose out dead line for the NASIP inspection is February 28, 1996. Every effort should be made to meet this dead line with positive corrective action.

4. When a violation of the FARs are detected the inspector should consider past enforcement history before administrative corrective action is offered. If an air carrier violates the same regulation in a short period of time, escalating the enforcement action may be appropriate.

This report was compiled from information obtained from the national database and VJ6A's NASIP Inspection Report. A physical inspection of the maintenance manual was not conducted by AFS-330

APPENDIX J—ATTACHMENT 1 OF CONSENT ORDER

UNITED STATES DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
ATLANTA, GEORGIA

In the Matter of: ValuJet Airlines, Inc.

FAA Enforcement Investigative Reports

96SO110070 96SO110076 96SO110089 96SO110097 96SO110099 96SO110102
96SO110109 96SO110111 96SO110115 96SO110116 96SO110117 96SO110118
96SO110119 96SO110120 96SO110121 96SO110122 96SO110123 96SO110124
96SO110125 96SO110126 96SO110127 96SO110129 96SO110134 96SO110135

CONSENT ORDER

Considering the Enforcement Investigative Reports enumerated above, the Federal Aviation Administration (FAA) has concluded that ValuJet Airlines, Inc., ("ValuJet") under its authority to operate as an air carrier under Part 121 of the Federal Aviation Regulations (FAR) (14 C.F.R. 121), conducted airworthiness and aircraft maintenance related activities, and flight operations, contrary to and in violation of the FAR's, as specified in Attachment 1.

The FAA acknowledges ValuJet's cooperative attitude and its commitment to return to airline operations at the highest level of safety. In consideration of the foregoing, the FAA and ValuJet have reached an agreement on this matter under which both are willing to accept the issuance of this Consent Order to avoid potential litigation and expedite the resumption of ValuJet's operations.

The FAA acknowledges that ValuJet's execution of, and payment in accordance with, this Consent Order does not constitute or imply an admission by ValuJet of the facts, circumstances, and regulatory violations averred in Attachment 1 of this Consent Order.

This Consent Order is issued under the authority contained in 49 U.S.C. Sections 46105, 46301 and 44709, and 14 C.F.R. 13.13.

ValuJet agrees that it will pay to the FAA $2,000,000 (two million dollars) as remedial, not punitive, payment representing and reflecting the costs incurred by the FAA to investigate, review, establish, reinspect, and ultimately enforce this consent order. ValuJet agrees that this consent order only addresses reimbursement to the FAA and does not constitute a penalty for any possible violations of federal regulations, and does not constitute a penalty of any kind for purpose of criminal violations, including any violations of federal criminal law.

ValuJet agrees that it shall not raise any claim or defense based on, or because of, this consent order or any payments made pursuant to this consent order, including, but not limited to, double jeopardy, excessive fines, collateral estoppel, and equitable estoppel, in any civil action brought by any government agency other than the FAA, and in any criminal action brought by any government agency.

ValuJet does not, by agreeing to the entry of this consent order, waive its right to contest on the merits any and all allegations of criminal violations or conduct.

The FAA agrees that, except for violations of regulations concerning hazardous materials and civil aviation security, it will not pursue any civil penalty for any violation of the regulations known by FAA as of the date and time of the execution of this agreement.

ACCORDINGLY, it is hereby Ordered as follows:

1. In accordance with its responsibility to promote and regulate the safety of air transportation and the public interest, the FAA issues this Consent Order. In accordance herewith, ValuJet will cease all revenue service under 14 CFR Part 121 on or before 11:59 p.m. EST on June 17, 1996. ValuJet further agrees to deposit its Air Carrier Operating Certificate to the Atlanta Flight Standards District Office (FSDO) on or before 11:59 p.m. EST on June 19, 1996. The FSDO will maintain possession of the certificate until such time as the FAA determines that ValuJet is qualified and capable of exercising the privileges of the holder of an Air Carrier Operating Certificate. The FAA agrees to accommodate ValuJet, in accordance with regulations and FAA directives, to reposition aircraft, establish pilot qualifications, and maintain pilot currency.

2. ValuJet agrees to pay $2,000,000 (two million dollars) to the Federal Aviation Administration by check or money order and addressed or delivered to the FAA Southern Region, Office of Assistant Chief Counsel as follows:

   a) $500,000 (five hundred thousand dollars) paid at the time of the execution of this agreement.

   b) The balance of $1,500,000 (one million five hundred thousand dollars) paid within ten days of the date operations are resumed, or within 60 days of the date of execution of this agreement, whichever comes first.

ATTACHMENT 1

1. In March 1996, ValuJet failed to document the specifics of the corrosion tasks performed in its Corrosion Control and Prevention Program on at least two aircraft.

2. On or about May 25, 1996, a ValuJet mechanic released for return to service N915VV, DC-9-32, after inspecting the nosewheel compartment, when the cover for the external power connection in that compartment was missing.

3. On May 6, 1996, ValuJet personnel inappropriately referred to an MEL provision concerning Aux Fuel Tank Quantity Gauges to defer maintenance on the Aux Tank Fuel Pumps, for which circuit breakers had popped in operation.

4. On or about March 22, 1996, ValuJet Flight #274 from Atlanta, Georgia, to Columbus, Ohio, experienced an in-flight loss of cabin pressurization resulting in a emergency descent. ValuJet failed to report the malfunction of the pressurization system and the resulting emergency action on a Mechanical Reliability Report as required by ValuJet Standard Practice No. 8170.

5. ValuJet failed to inspect Contract Fueling Agency equipment, storage facilities, and records at Boston for a period of approximately eight months prior to March 27, 1996, and at Savannah for a period of approximately six months prior to May 9, 1996. ValuJet's Standard Practice 8908 requires that periodic checks of the Contract Fueling Agency's equipment and storage facilities be performed at least monthly and reported to the Chief Inspector.

6. On March 27, 1996, ValuJet personnel failed to properly follow troubleshooting procedures specified in the maintenance manual concerning engine driven generators.

7. On or about May 17, 1996, ValuJet N919VV was ferried from DFW to ATL for service on the main cabin door's gust lock. The aircraft was subsequently returned to service without conclusive documentation that this non-deferrable discrepancy had been corrected.

8. On or about May 11, 1996, an inspection of the training and qualifications records revealed that a Pilot in Command Line Check entry was not signed and dated by the ValuJet Reviewing Official and that the Check Airman failed to sign a Flight Safety Proficiency Check. The same inspection revealed that a Second in Command Line Check entry on the Pilot Training Records Checklist was not signed and dated by the ValuJet Reviewing Official and that a Flight Safety Training Record contained entries for only four simulator sessions, not the required six or more.

9. On or about June 8, 1995, the nose landing gear on ValuJet N930VV failed to retract after takeoff from Boston-Logan Airport and failed to properly extend prior to the unscheduled landing back at Boston-Logan Airport. ValuJet maintenance personnel found

the aircraft safe for a ferry flight to Dulles Airport, provided the aircraft be ferried with the landing gear in the down position as required in ValuJet's Standard Practice (8165.4(a)(3) and (4)). During the ferry flight, the flight crew cycled the landing gear up and down several times. ValuJet maintenance personnel at Dulles Airport subsequently "noted" that the gear was functioning normally, and returned the aircraft to revenue service with no further action.

10. On or about July 23, 1995, a discrepancy was entered in ValuJet N930VV's permanent maintenance record that the main cabin door would not overcenter lock with the handle. ValuJet maintenance personnel cleared the discrepancy by adjusting the locking mechanism, but failed to insure that the repair received a Required Inspection and certification by an authorized person as required under ValuJet Standard Practice 8100.4 (f).

11. On March 16, 1996, an entry was made in the aircraft logbook for N905VJ, a DC-9-32, indicating that the #1 engine cowl had a hole in it. ValuJet improperly deferred the discrepancy and assigned the item to a non-routine work card. ValuJet's Standard Practice Manual, Section 8218.2, prohibits deferral of items which affect airworthiness. A hole in the engine cowl affects airworthiness in that it degrades the operation of the engine fire protection system. ValuJet operated N905VJ on eight (8) flights when the aircraft was in unairworthy condition by reason of the hole in the engine cowl.

12. On June 3, 1996, an entry was made in the flight log of N942VV, a DC-9-32, indicating that a hydraulic accumulator pressure gauge had hydraulic fluid inside the face of the gauge. ValuJet improperly deferred the discrepancy and issued the above item deferral number DSO4585, to be complied with on the next "C" check. ValuJet's Standard Practice Manual, Section 8218.2, prohibits deferral of items which affect airworthiness. Hydraulic fluid inside the face of the hydraulic accumulator pressure gauge affects airworthiness in that overall performance could be degraded and continued operation could cause a loss of hydraulic system pressure. ValuJet operated N942VV on seven (7) flights when it was not in airworthy condition by reason of the improper deferral of the hydraulic accumulator pressure gauge.

13. On or about July 30, 1995, the flight log indicated that aircraft N919VV, a DC-9 traveling from IAD to RDU, was struck by two birds on the two right outboard leading edge slats. Maintenance inspected the aircraft as required by chapter 5 of the Aircraft Maintenance Manual, but did not record the results of their inspection in their log book or file a Special Inspection Compliance Record to Quality Assurance as required by ValuJet Standard Practice 8115.

14. Between June 5, 1995 and March 14, 1996, the weather radar system on N930VV was written up in the Aircraft Maintenance Record as inoperative by flight crews thirty-one times without effective repair.

15. On or about October 28, 1995, the flight log indicated that aircraft N919VV, traveling from IAD to RDU, was struck by lightning on the nose cone. A mechanic signed off on the nose cone without completing all of the required inspection and maintenance practices as

required by chapter 5 of the Aircraft Maintenance Manual or filing a Special Inspection Compliance Record to Quality Assurance as required by ValuJet Standard Practice 8115.

16. On or about August 27, 1995, the flight log indicated that the center windshield of aircraft N919VV became delaminated in the lower right corner. On or about August 29, 1995, the windshield panel was replaced after at least 7 passenger-carrying revenue flights were conducted in the interim.

17. On or about July 30, 1995, the flight log indicated that aircraft N919VV was struck by lightning on the aileron. A temporary repair was made, however, as of May 29, 1996, the aircraft was used to conduct at least 9 passenger-carrying revenue flights although no permanent repair had been accomplished and no form VJ-M036 had been completed.

18. On or about June 5, 1996, the life limits of 4 Turbine Disks in the Pratt & Whitney JT8D-9A engine installed in N919VV, which are required to be overhauled on a specified time basis, were being tracked by ValuJet's Records Master File with incorrect life limits.

19. On or about June 5, 1996, the life limits of 3 Turbine Disks and a Compressor Disk in the Pratt & Whitney JT8D-9A engine installed in N930VV, which are required to be overhauled on a specified time basis, were being tracked by ValuJet's Records Master File with incorrect life limits.

20. During an inspection conducted of ValuJet at Dulles Airport (IAD) on or about June 1, 1996, ValuJet was unable to produce records of filter changes of service carts utilized at IAD for hydraulic and engine oil. ValuJet's Standard Practice No. 8225 requires that all ValuJet equipment used for servicing hydraulic reservoir and CSD fluids have their filters changed every 60 days to prevent contaminants from entering aircraft fluid systems and that such filter replacement be recorded.

21. Between May 22 and June 1, 1996, ValuJet operated at least seven aircraft on approximately 79 revenue flights when they were out of compliance with the lavatory flush motor AD. Additional inspection revealed that at least 9 other aircraft were not in compliance with the AD.

22. ValuJet failed to comply with AD-95-12-25, which requires an inspection to prevent chafing of a hole in the FIREX supply pipe of the number one engine. ValuJet operated aircraft N127NK on 24 flights between May 22 and June 1, 1996, when it was out of compliance with the AD.

23. On or about February 27, 1996, ValuJet repaired a fuel leak on civil aircraft N920VV by tightening the screws which secure the wing fuel tank structural access panels and deferring the discrepancy. The manufacturer's maintenance manual requires that a torque wrench be used for such repair and that each screw be tightened to a specific torque value. ValuJet performed the maintenance with a conventional ratchet and failed to use a torque

wrench. ValuJet also improperly described the leak in the maintenance log resulting in the wrong part being worked on when the deferred item was repaired.

24. FAA Inspectors observed that the left gear flap follow-up cables were mis-routed (the cables were crossed), contrary to ValuJet's DC-9 maintenance manual, section 9-2750-1-9801, on at least three aircraft.

25. FAA Inspectors determined that ValuJet returned to service at least six Valujet aircraft when the flap bus cable either showed obvious signs of improper tension or had tension below the allowable limit. In addition, ValuJet assigned a mechanic to conduct the inspection of a flap bus cable on N913VV when that mechanic was not qualified to do so.

26. An FAA Inspector observed a mechanic performing an "A" check on N917VV and noted that the tailcone slide was not rigged properly. Upon inquiry by the FAA Inspector, the mechanic stated that he did not know how it was rigged and that this was his first aviation job. FAA Inspectors determined that at least three ValuJet aircraft did not have tailcones rigged properly.

27. On or about May 21, 1996, a ValuJet mechanic released for return to service N803VV, a DC-9-80, after performing maintenance on the cockpit lighting system without satisfactorily having performed that work at an earlier date or under the direct supervision of someone who had appropriate previous experience.

28. On or about May 22, 1996, a ValuJet mechanic released for return to service N5342L, a DC-9-32, after inspecting the pilot and copilot instrument panel secondary latch system, when the mechanic did not know what the secondary latches were.

29. On or about May 22, 1996, a ValuJet mechanic released for return to service N5342L, a DC-9-32, after inspecting the E&E compartment, without detecting that five out of twelve screws were missing from an overhead panel in that compartment.

30. On or about May 22, 1996, a ValuJet mechanic used a dial pressure gauge to determine the pressure of the tires on N919VV, a DC-9-32, without determining the calibration status of the gauge.

31. On or about May 23, 1996, a ValuJet mechanic released for return to service N529MD, a DC-9-32, after inspection of the flight control system when there was an improper composite repair of the right hand flap.

32. On or about May 23, 1996, a ValuJet mechanic released for return to service N919VV, a DC-9-32, after inspection of the flight control system when there was an improper composite repair of the right hand flap.

33. On or about May 25, 1996, a ValuJet mechanic released for return to service N913VV, DC-9-32, after inspecting the nosewheel compartment, when the cover for the external power connection in that compartment was missing.

34. On ValuJet aircraft N922VV an FAA Inspector observed that a lavatory fire extinguisher was not properly installed in that one of the discharge nozzles was not routed to the trash container. As of June 6, 1996, ValuJet personnel were unable to provide documentation for installation of this type of fire extinguishers, which is properly installed on a Boeing 727/737 aircraft.

Considering the above, the FAA alleges that ValuJet violated the following sections of the Federal Aviation Regulations:

1. 121.105 in that ValuJet failed to ensure that competent personnel and adequate facilities and equipment are available at such points along the air carrier's route as are necessary for the proper servicing, maintenance, and preventative maintenance of airplanes and auxiliary equipment.

2. 121.135(a) in that ValuJet failed to include in a required manual instructions and information necessary to allow the personnel concerned to perform their duties and responsibilities with a high degree of safety.

3. 121.3(a) by engaging in scheduled interstate air transportation within the 48 contiguous United States or the District of Columbia in violation of appropriate operations specifications.

4. 121.367(a) in that ValuJet's inspection program failed to insure that maintenance is performed in accordance with the certificate holder's manual.

5. 121.375 in that ValuJet performed maintenance and failed to have a training program to ensure that each person who determines the adequacy of work done is fully informed about procedures and techniques and new equipment in use and is competent to perform his duties.

6. 121.380 (a)(2) by failing to keep records documenting performance of the CPCP.

7. 121.380(a)(2)(iii) by failing to keep accurate records of the time since last overhaul of all items installed on the aircraft which are required to be overhauled on a specified time basis.

8. 121.628(a)(5) in that ValuJet aircraft contrary to the applicable conditions and limitations contained in the ValuJet MEL.

9. 121.683 (a)(1) by failing to keep complete pilot training and qualification records.

10. 121.703(a)(16) in that ValuJet failed to report the occurrence or detection of the failure, malfunction or defect concerning aircraft components or systems that result in taking emergency actions during flight.

11. 39.3 by operating a product to which an airworthiness directive applies without complying with that directive.

12. 43.13 (a) by performing maintenance on an aircraft, engine, or appliance and failing to use the methods, techniques, and practices acceptable to the Administrator.

13. 43.13(b) by maintaining or altering an aircraft, engine, or appliance and not doing the work in such a manner and use materials of such a quality that the condition of the aircraft, airframe, aircraft engine, or appliance worked on will be at least equal to its original or properly altered condition.

14. 91.7 and 121.153(a)(2) by operating aircraft not in an airworthy condition.

APPENDIX K—EXCERPTS FROM TITLE 49 CFR PART 175

code of federal regulations

Transportation

49

PARTS 100 TO 177

Revised as of October 1, 1995

CONTAINING
A CODIFICATION OF DOCUMENTS
OF GENERAL APPLICABILITY
AND FUTURE EFFECT

AS OF OCTOBER 1, 1995

With Ancillaries

Published by
the Office of the Federal Register
National Archives and Records
Administration

as a Special Edition of
the Federal Register

T43 See entry for T43 in the IM Tank Configuration Table in paragraph (c)(7)(i) of this section.

T44 DOT Specification IM 101 portable tanks shall be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads must be the greater of 7.62 mm (0.300 inch) or the thickness required for a tank with a design pressure at least equal to 1.5 times the vapor pressure of the lading at 46 °C (115 °F).

T45 DOT Specification IM 101 portable tanks shall be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads must be the greater of 6.35 mm (0.250 inch) or the thickness required for a tank with a design pressure at least equal to 1.3 times the vapor pressure of the lading at 46 °C (115 °F).

T46 IM portable tanks in sodium metal service are not required to be hydrostatically retested.

(8) *"W" codes.* These provisions apply only to transportation by water:

Code/Special Provisions

W41 When offered for transportation by water, this material must be packaged in bales and be securely and tightly bound with rope, wire or similar means.

[Amdt. 172–123, 55 FR 52582, Dec. 21, 1990, as amended at 56 FR 66250, Dec. 20, 1991; 57 FR 45458, Oct. 1, 1992; 57 FR 47513, Oct. 16, 1992; Amdt. 172–127, 57 FR 52938, Nov. 5, 1992; 172–123, 57 FR 59310, Dec. 15, 1992; Amdt. 172–133, 58 FR 50235, Sept. 24, 1993; Amdt. 172–130, 58 FR 51531, Oct. 1, 1993; Amdt. 172–134, 59 FR 28493, June 2, 1994; Amdt. 172–127, 59 FR 49133, Sept. 26, 1994; Amdt. 172–136, 59 FR 38064, July 26, 1994; Amdt. 172–137, 59 FR 48549, Sept. 21, 1994; Amdt. 172–139, 59 FR 67485, Dec. 29, 1994; Amdt. 172–140, 60 FR 26805, May 18, 1995; Amdt. 172–146, 60 FR 48767, Sept. 20, 1995; Amdt. 172–145, 60 FR 49110, Sept. 21, 1995; Amdt.172–144, 60 FR 49072, Sept. 21, 1995]

EFFECTIVE DATE NOTE: At 60 FR 49072, Sept. 21, 1995, §172.102, paragraph (c)(3) was amended by removing Special Provisions "B41", "B43" and "B63", and by revising Special Provisions "B64" and "B79" effective July 1, 1996. For the convenience of the user the superseded text is set forth below.

* * * * *

§ 172.102 Special provisions.

(c) * * *

(3) * * *

B64 Each single unit tank car tank built after December 31, 1990 must be equipped with a tank head puncture resistance system that conforms to §179.105–5 of this subchapter.

* * * * *

B79 Tank car tanks must have head puncture resistance and thermal protection in accordance with §§179.105–4 and 179.105–5 of this subchapter for tanks built before April 1, 1989.

* * * * *

Subpart C—Shipping Papers

§ 172.200 Applicability.

(a) *Description of hazardous materials required.* Except as otherwise provided in this subpart, each person who offers a hazardous material for transportation shall describe the hazardous material on the shipping paper in the manner required by this subpart.

(b) This subpart does not apply to any material, other than a hazardous substance, hazardous waste or marine pollutant, that is—

(1) Identified by the letter "A" in Column 1 of the §172.101 Table, except when the material is offered or intended for transportation by air; or

(2) Identified by the letter "W" in Column 1 of the §172.101 Table, except when the material is offered or intended for transportation by water; or

(3) An ORM–D, except when the material is offered or intended for transportation by air.

[Amdt. 172–29A, 41 FR 40677, Sept. 20, 1976, as amended by Amdt. 172–58, 45 FR 34697, May 22, 1980; Amdt. 172–74, 47 FR 43065, Sept. 30, 1982; Amdt. 172–112, 53 FR 17160, May 13, 1988; Amdt. 172–127, 57 FR 52938, Nov. 5, 1992]

§ 172.201 General entries.

(a) *Contents.* When a description of hazardous material is required to be included on a shipping paper, that description must conform to the following requirements:

(1) When a hazardous material and a material not subject to the requirements of this subchapter are described on the same shipping paper, the hazardous material description entries required by §172.202 and those additional

entries that may be required by § 172.203:

(i) Must be entered first, or

(ii) Must be entered in a color that clearly contrasts with any description on the shipping paper of a material not subject to the requirements of this subchapter, except that a description on a reproduction of a shipping paper may be highlighted, rather than printed, in a contrasting color (the provisions of this paragraph apply only to the basic description required by § 172.202(a) (1) and (2), and (3)), or

(iii) Must be identified by the entry of an "X" placed before the proper shipping name in a column captioned "HM." (The "X" may be replaced by "RQ," if appropriate.)

(2) The required shipping description on a shipping paper and all copies thereof used for transportation purposes, must be legible and printed (manually or mechanically) in English.

(3) Unless it is specifically authorized or required in this subchapter, the required shipping description may not contain any code or abbreviation.

(4) A shipping paper may contain additional information concerning the material provided the information is not inconsistent with the required description. Unless otherwise permitted or required by this subpart, additional information must be placed after the basic description required by § 172.202(a).

(b) *Name of shipper.* A shipping paper for a shipment by water must contain the name of the shipper.

(c) *Continuation page.* A shipping paper may consist of more than one page, if each page is consecutively numbered and the first page bears a notation specifying the total number of pages included in the shipping paper. For example, "Page 1 of 4 pages."

(d) *Emergency response telephone number.* A shipping paper must contain an emergency response telephone number, as prescribed in subpart G of part 172 of this subchapter.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976, as amended by Amdt. 172-29B, 41 FR 57067, Dec. 30, 1976; Amdt. 172-58, 45 FR 34697, May 22, 1980; Amdt. 172-58, 45 FR 74664, Nov. 10, 1980; Amdt. 172-90, 49 FR 10510, Mar. 20, 1984; Amdt. 172-116, 54 FR 27144, June 27, 1989; Amdt. 172-123, 55 FR 52589, Dec. 21, 1990]

§ 172.202 Description of hazardous material on shipping papers.

(a) The shipping description of a hazardous material on the shipping paper must include:

(1) The proper shipping name prescribed for the material in Column 2 of the § 172.101 Table;

(2) The hazard class or division prescribed for the material as shown in Column 3 of the § 172.101 Table (class names or subsidiary hazard class or division number may be entered following the numerical hazard class, or following the basic description). The hazard class need not be included for the entry "Combustible liquid, n.o.s.";

(3) The identification number prescribed for the material as shown in Column 4 of the § 172.101 Table;

(4) The packing group, in Roman numerals, prescribed for the material in Column 5 of the § 172.101 Table, if any. The packing group may be preceded by the letters "PG" (e.g., "PG II"); and

(5) Except for empty packagings (see § 173.29 of this subchapter), cylinders for Class 2 (compressed gases) materials, and bulk packagings, the total quantity (by net or gross mass, capacity, or as otherwise appropriate), including the unit of measurement, of the hazardous material covered by the description (e.g., "800 lbs", "55 gal.", "3629 kg", or "208 L"). For cylinders for Class 2 (compressed gases) materials and bulk packagings, some indication of total quantity must be shown (e.g., "10 cylinders" or "1 cargo tank").

(b) Except as provided in this subpart, the basic description specified in paragraphs (a) (1), (2), (3) and (4) of this section must be shown in sequence with no additional information interspersed. For example: "Gasoline, 3, UN 1203, PG II".

(c) The total quantity of the material covered by one description must appear before or after, or both before and after, the description required and authorized by this subpart. The type of packaging and destination marks may be entered in any appropriate manner before or after the basic description. Abbreviations may be used to express units of measurement and types of packagings.

(d) Technical and chemical group names may be entered in parentheses

between the proper shipping name and hazard class or following the basic description. An appropriate modifier, such as "contains" or "containing," and/or the percentage of the technical constituent may also be used. For example: "Flammable liquids, n.o.s. (contains Xylene and Benzene), 3, UN 1993, II".

(e) Except for those materials in the UN Recommendations, the ICAO Technical Instructions, or the IMDG Code, a material that is not a hazardous material according to this subchapter may not be offered for transportation or transported when its description on a shipping paper includes a hazard class or an identification number specified in § 172.101.

[Amdt. 172-101, 45 FR 74665, Nov. 10, 1980, as amended by Amdt. 172-103, 51 FR 5970, Feb. 18, 1986; Amdt. 172-123, 55 FR 52589, Dec. 21, 1990; 56 FR 66252, Dec. 20, 1991; Amdt. 172-127, 57 FR 52938, Nov. 5, 1992; Amdt. 172-130, 58 FR 51531, Oct. 1, 1993]

§ 172.203 Additional description requirements.

(a) *Exemptions.* Each shipping paper issued in connection with a shipment made under an exemption must bear the notation "DOT-E" followed by the exemption number assigned and so located that the notation is clearly associated with the description to which the exemption applies.

(b) *Limited quantities.* The description for a material offered for transportation as "limited quantity," as authorized by this subchapter, must include the words "Limited Quantity" or "Ltd Qty" following the basic description.

(c) *Hazardous substances.* (1) Except for radioactive materials described in accordance with paragraph (d) of this section, if the proper shipping name for a material that is a hazardous substance does not identify the hazardous substance by name, one of the following descriptions shall be entered, in parentheses, in association with the basic description:

(i) The name of the hazardous substance as shown in the Appendix A to § 172.101; or

(ii) For waste streams, the waste stream number; or

(iii) For wastes which exhibit an EPA characteristic of ignitability, corrosivity, reactivity, or Toxicity, the letters "EPA" followed by the word "ignitability", or "corrosivity", or "reactivity", or "Toxicity", as appropriate or the corresponding "D" number, as appropriate.

(2) The letters "RQ" shall be entered on the shipping paper either before or after, the basic description required by § 172.202 for each hazardous substance (see definition in § 171.8 of this subchapter). For example: "RQ, Allyl alcohol, 6.1, UN 1098, I"; or "Environmentally hazardous substance, solid, n.o.s., 9, UN 3077, III, RQ (Adipic acid)".

(d) *Radioactive material.* The description for a shipment of a Class 7 (radioactive) material must include the following additional entries as appropriate:

(1) The name of each radionuclide in the Class 7 (radioactive) material that is listed in § 173.435 of this subchapter. For mixtures of radionuclides, the radionuclides that must be shown must be determined in accordance with § 173.433(f) of this subchapter.

(2) The name of each radionuclide in the radioactive material that is listed in § 173.435 of this subchapter. Abbreviations, e.g., "^{99}Mo" are authorized.

(3) A description of the physical and chemical form of the material, if the material is not in special form (generic chemical description is acceptable for chemical form).

(4) The activity contained in each package of the shipment in terms of the appropriate SI units (e.g. Becquerel, Terabecquerel, etc.) or in terms of the appropriate SI units followed by the customary units (e.g. Curies, millicuries, etc.). Alternatively, for domestic transportation, the activity in a package of Class 7 (radioactive) materials may be described solely in terms of curies until April 1, 1997. Abbreviations are authorized. Except for plutonium-238, plutonium-239, and plutonium-241, the weight in grams or kilograms of fissile radionuclides may be inserted instead of activity units. For plutonium-238, plutonium-239, and plutonium-241 the weight in grams or kilograms of fissile radionuclides may be inserted in addition to the activity units. For the shipment of a package

containing a highway route controlled quantity of Class 7 (radioactive) materials (see §173.403 of this subchapter) the words "Highway route controlled quantity" must be entered in association with the basic description.

(5) The category of label applied to each package in the shipment. For example: "RADIOACTIVE WHITE–I."

(6) The transport index assigned to each package in the shipment bearing RADIOACTIVE YELLOW–II or RADIOACTIVE YELLOW–III labels.

(7) For a shipment of fissile Class 7 (radioactive) materials:

(i) The words "Fissile Excepted" if the package is excepted pursuant to §173.453 of this subchapter;

(ii) For a fissile material, controlled shipment, the additional notation: "Warning—Fissile material, controlled shipment. Do not load more than * * * packages per vehicle." (Asterisks to be replaced by appropriate number.) "In loading and storage areas, keep at least 6 meters (20 feet) from other packages bearing radioactive labels"; and

(iii) If a fissile material, controlled shipment is to be transported by water, the supplementary notation must also include the following statement: "For shipment by water, only one fissile material, controlled shipment is permitted in each hold."

(8) For a package approved by the U.S. Department of Energy (DOE) or U.S. Nuclear Regulatory Commission (USNRC), a notation of the package identification marking as prescribed in the applicable DOE or USNRC approval. (See §173.471 of the subchapter.)

(9) For an export shipment or a shipment in a foreign made package, a notation of the package identification marking as prescribed in the applicable International Atomic Energy Agency (IAEA) Certificate of Competent Authority which has been issued for the package. (See §173.473 of the subchapter.)

(10) For a shipment required by this subchapter to be consigned as exclusive use:

(i) An indication that the shipment is consigned as exclusive use; or

(ii) If all the descriptions on the shipping paper are consigned as exclusive use, then the statement "Exclusive Use Shipment" may be entered only once on the shipping paper in a clearly visible location.

(11) For a shipment of low specific activity material or surface contaminated objects, the appropriate group notation of LSA–I, LSA–II, LSA–III, SCO–I, or SCO–II.

(e) *Empty packagings.* (1) The description on the shipping paper for a packaging containing the residue of a hazardous material may include the words "RESIDUE: Last Contained * * *" in association with the basic description of the hazardous material last contained in the packaging.

(2) For a tank car containing the residue (as defined in §171.8) of a hazardous material, the requirements of §174.25(c) and paragraph (e)(3) of this section apply.

(3) If a packaging, including a tank car, contains a residue that is a hazardous substance, the description on the shipping papers must be prefaced with the phrase "RESIDUE: Last Contained * * *" and the letters "RQ" must be entered on the shipping paper either before or after the basic description.

(f) *Transportation by air.* When a package containing a hazardous material is offered for transportation by air and this subchapter prohibits its transportation aboard passenger-carrying aircraft, the words "Cargo aircraft only" must be entered after the basic description.

(g) *Transportation by rail.* (1) The shipping paper for a rail car containing a hazardous material must contain the notation "Placarded" followed by the name of the placard required for the rail car.

(2) The shipping paper for each Class DOT–113 tank car containing a flammable gas must contain an appropriate notation, such as "DOT–113A," and the statement "Do Not Hump or Cut Off Car While in Motion."

(3) When shipments of elevated temperature materials are transported under the exception permitted in §173.247(h)(3) of this subchapter, the shipping paper must contain an appropriate notation, such as "Maximum Operating Speed 15 mph."

(h) *Transportation by highway.* Following the basic description for a hazardous material in a Specification MC

330 or MC 331 cargo tank, there must be entered for—

(1) *Anhydrous ammonia.* (i) The words "0.2 PERCENT WATER" to indicate the suitability for shipping anhydrous ammonia in a cargo tank made of quenched and tempered steel as authorized by §173.315(a), Note 14 of this subchapter, or

(ii) The words "NOT FOR Q and T TANKS" when the anhydrous ammonia does not contain 0.2 percent or more water by weight.

(2) *Liquefied petroleum gas.* (i) The word "NONCORROSIVE" or "NONCOR" to indicate the suitability for shipping "Noncorrosive" liquefied petroleum gas in a cargo tank made of quenched and tempered steel as authorized by §173.315(a), Note 15 of this subchapter, or

(ii) The words "NOT FOR Q and T TANKS" for grades of liquefied petroleum gas other than "Noncorrosive".

(i) *Transportation by water.* Each shipment by water must have the following additional shipping paper entries:

(1) Identification of the type of packagings such as barrels, drums, cylinders, and boxes.

(2) The number of each type of package including those in a freight container or on a pallet.

(3) The gross mass of each type of package or the individual gross mass of each package.

(j) *Dangerous when wet material.* The words "Dangerous when wet" shall be entered on the shipping paper in association with the basic description for a material which meets the definition of a dangerous when wet material in §173.124(c) of this subchapter.

(k) *Technical names for "n.o.s." and other generic descriptions.* Unless otherwise excepted, if a material is described on a shipping paper by one of the proper shipping names listed in paragraph (k)(3) of this section, the technical name of the hazardous material must be entered in parentheses in association with the basic description. For example "Corrosive liquid, n.o.s., (Caprylyl chloride), 8, UN 1760, II", or "Corrosive liquid, n.o.s., 8, UN 1760, II (contains Caprylyl chloride)". The word "contains" may be used in association with the technical name, if appropriate. For organic peroxides which may qualify for more than one generic listing depending on concentration, the technical name must include the actual concentration being shipped or the concentration range for the appropriate generic listing. For example, "Organic peroxide type B, solid, 5.2, UN 3102 (dibenzoyl peroxide, 52–100%)" or "Organic peroxide type E, solid, 5.2, UN 3108 (dibenzoyl peroxide, paste, <52%)".

(l) In addition to the n.o.s. descriptions listed herein, the requirements of this section apply to all shipping descriptions for poisonous materials which are subject to the requirements of paragraph (m) of this section, and for which the proper shipping name does not specifically identify the poisonous constituent by technical name. For example, "Motor fuel antiknock mixtures (Tetraethyl lead), 6.1 , UN 1649, I", or "Motor fuel antiknock mixtures, 6.1, UN 1649, I (Tetraethyl lead)".

(2) If a hazardous material is a mixture or solution of two or more hazardous materials, the technical names of at least two components most predominately contributing to the hazards of the mixture or solution must be entered on the shipping paper as required by paragraph (k) of this section. For example, "Flammable liquid, corrosive, n.o.s., 3, UN 2924, II (contains Methanol, Potassium hydroxide)".

(3) Proper shipping names for which the provisions of this paragraph apply are as follows:

Alcoholates solution, n.o.s., *in alcohol*
Alcohols, toxic, n.o.s.
Aldehydes, toxic, n.o.s.
Alkali metal alcoholates, self-heating, corrosive, n.o.s.
Alkaline earth metal alcoholates, n.o.s.
Amines, flammable, corrosive, n.o.s. *or* Polyamines, flammable, corrosive, n.o.s.
Amines, liquid, corrosive, flammable, n.o.s. *or* Polyamines, liquid, corrosive, flammable, n.o.s.
Amines, liquid, corrosive, n.o.s. *or* Polyamines, liquid, corrosive, n.o.s.
Amines, solid, corrosive, n.o.s. *or* Polyamines, solid, corrosive, n.o.s.
Articles, explosive, n.o.s.
Caustic alkali liquids, n.o.s.
Charges, propelling
Chloroformates, toxic, corrosive, n.o.s.
Combustible liquid, n.o.s.
Components, explosive train, n.o.s.
Compounds, cleaning liquid, *corrosive, flammable, toxic*
Compounds, tree *or* weed killing, liquid, *flammable, corrosive, toxic*

Compressed *or* Liquefied gases, flammable, n.o.s.
Compressed *or* Liquefied gases, n.o.s.
Compressed *or* Liquefied gases, oxidizing, n.o.s.
Compressed *or* Liquefied gases, toxic, flammable, n.o.s.
Compressed *or* Liquefied gases, toxic, n.o.s.
Contrivances, water-activated
Corrosive, liquid, acidic, inorganic *or* organic, n.o.s.
Corrosive, liquid, basic, inorganic *or* organic, n.o.s.
Corrosive liquids, flammable, n.o.s.
Corrosive liquids, n.o.s.
Corrosive liquids, oxidizing, n.o.s.
Corrosive liquids, toxic, n.o.s.
Corrosive liquids, water-reactive, n.o.s.
Corrosive, solid, acidic, inorganic *or* organic, n.o.s.
Corrosive, solid, basic, inorganic *or* organic, n.o.s.
Corrosive solids, flammable, n.o.s.
Corrosive solids, n.o.s.
Corrosive solids, oxidizing, n.o.s.
Corrosive solids, self-heating, n.o.s.
Corrosive solids, toxic, n.o.s.
Corrosive solids, water-reactive, n.o.s.
Disinfectants, liquid, corrosive, n.o.s.
Disinfectants, liquid, toxic, n.o.s.
Disinfectants, solids, toxic, n.o.s.
Dispersant gas, n.o.s.
Dyes, liquid, corrosive, n.o.s. *or* Dye intermediates, liquid, corrosive, n.o.s.
Dyes, liquid, toxic, n.o.s. *or* Dye intermediates, liquid, toxic, n.o.s.
Dyes, solid, corrosive, n.o.s. *or* Dye intermediates, solid, corrosive, n.o.s.
Dyes, solid, toxic, n.o.s. *or* Dye intermediates, solid, toxic, n.o.s.
Environmentally hazardous substances, liquid *or* solid, n.o.s.
Flammable gases, solid, corrosive, n.o.s.
Flammable liquids, corrosive, n.o.s.
Flammable liquids, n.o.s.
Flammable liquids, toxic, corrosive, n.o.s.
Flammable liquids, toxic, n.o.s.
Flammable solids, corrosive, organic *or* inorganic, n.o.s.
Flammable solids, organic, molten, n.o.s.
Flammable solids, organic *or* inorganic, n.o.s.
Flammable solids, toxic, organic *or* inorganic, n.o.s.
Halogenated irritating liquids, n.o.s.
Hazardous waste, liquid *or* solid, n.o.s.
Hydrocarbons, liquid, n.o.s.
Infectious substances, affecting animals
Infectious substances, affecting humans
Insecticide gases, n.o.s.
Insecticide gases, toxic, n.o.s.
Isocyanates, flammable, toxic, n.o.s. *or* Isocyanates solutions, flammable, toxic, n.o.s.
Isocyanates, toxic, flammable, n.o.s. *or* Isocyanates solutions, toxic, flammable, n.o.s.
Medicines, liquid, flammable, toxic, n.o.s.
Medicines, liquid, toxic, n.o.s.
Medicine, solid, toxic, n.o.s.
Metal powder, self-heating, n.o.s.
Metal salts of organic compounds, flammable, n.o.s.
Metallic substance, water-reactive, n.o.s.
Metallic substance, water-reactive, self-heating, n.o.s.
Nitriles, flammable, toxic, n.o.s.
Nitriles, toxic, flammable, n.o.s.
Nitriles, toxic, n.o.s.
Organic peroxide type B, liquid
Organic peroxide type B, liquid, temperature controlled
Organic peroxide type B, solid
Organic peroxide type B, solid, temperature controlled
Organic peroxide type C, liquid
Organic peroxide type C, liquid, temperature controlled
Organic peroxide type C, solid
Organic peroxide type C, solid, temperature controlled
Organic peroxide type D, liquid
Organic peroxide type D, liquid, temperature controlled
Organic peroxide type D, solid
Organic peroxide type D, solid, temperature controlled
Organic peroxide type E, liquid
Organic peroxide type E, liquid, temperature controlled
Organic peroxide type E, solid
Organic peroxide type E, solid, temperature controlled
Organic peroxide type F, liquid
Organic peroxide type F, liquid, temperature controlled
Organic peroxide type F, solid
Organic peroxide type F, solid, temperature controlled
Organometallic compound, toxic, n.o.s.
Organometallic compound dispersion, water-reactive, flammable, n.o.s.
Organometallic compound solution, water-reactive, flammable, n.o.s.
Other regulated substances, liquid, n.o.s.
Other regulated substances, solid, n.o.s.
Oxidizing liquid, corrosive, n.o.s.
Oxidizing liquid, n.o.s.
Oxidizing liquid, toxic, n.o.s.
Oxidizing solid, corrosive, n.o.s.
Oxidizing solid, flammable, n.o.s.
Oxidizing solid, n.o.s.
Oxidizing solid, self-heating, n.o.s.
Oxidizing solid, toxic, n.o.s.
Oxidizing solid, water-reactive, n.o.s.
Pesticides, liquid, flammable, toxic, n.o.s.
Pesticides, liquid, toxic, flammable, n.o.s.
Pesticides, liquid, toxic, n.o.s.
Pesticides, solid, toxic, n.o.s.
Propellant, liquid
Propellant, solid
Pyrophoric liquids, organic *or* inorganic, n.o.s.

Pyrophoric metals, n.o.s. *or* Pyrophoric alloys, n.o.s.
Pyrophoric organometallic compound, n.o.s.
Pyrophoric solids, organic *or* inorganic, n.o.s.
Refrigerant gases, n.o.s.
Samples, explosive (*other than initiating explosives*)
Self-heating liquid, corrosive, inorganic, n.o.s.
Self-heating liquid, corrosive, organic, n.o.s.
Self-heating liquid, inorganic, n.o.s.
Self-heating liquid, organic, n.o.s.
Self-heating liquid, toxic, inorganic, n.o.s.
Self-heating liquid, toxic, organic, n.o.s.
Self-heating solid, corrosive, inorganic, n.o.s.
Self-heating solid, corrosive, organic, n.o.s.
Self-heating solid, organic or inorganic, n.o.s.
Self-heating solid, oxidizing, n.o.s.
Self-heating solid, toxic, organic or inorganic, n.o.s.
Self-reactive liquid type B
Self-reactive liquid type B, temperature controlled
Self-reactive liquid type C
Self-reactive liquid type C, temperature controlled
Self-reactive liquid type D
Self-reactive liquid type D, temperature controlled
Self-reactive liquid type E
Self-reactive liquid type E, temperature controlled
Self-reactive liquid type F
Self-reactive liquid type F, temperature controlled
Self-reactive solid type B
Self-reactive solid type B, temperature controlled
Self-reactive solid type C
Self-reactive solid type C, temperature controlled
Self-reactive solid type D
Self-reactive solid type D, temperature controlled
Self-reactive solid type E
Self-reactive solid type E, temperature controlled
Self-reactive solid type F
Self-reactive solid type F, temperature controlled
Solids containing corrosive liquid, n.o.s.
Solids containing flammable liquid, n.o.s.
Solids containing toxic liquid, n.o.s.
Substances, explosive, n.o.s.
Substances, explosive, very insensitive (substances, EVI), n.o.s.
Tear gas substances, liquid *or* solid, n.o.s.
Toxic liquids, corrosive, organic *or* inorganic, n.o.s.
Toxic liquids, flammable, organic *or* inorganic, n.o.s.
Toxic liquids, organic *or* inorganic, n.o.s.
Toxic liquids, oxidizing, n.o.s.
Toxic liquids, water-reactive, n.o.s.
Toxic solids, corrosive, organic *or* inorganic, n.o.s.
Toxic solids, flammable, organic *or* inorganic, n.o.s.
Toxic solids, organic *or* inorganic, n.o.s.
Toxic solids, oxidizing, n.o.s.
Toxic solids, self-heating, n.o.s.
Toxic solids, water-reactive, n.o.s.
Water-reactive, liquid, corrosive, n.o.s.
Water-reactive, liquid, n.o.s.
Water-reactive, liquid, toxic, n.o.s.
Water-reactive, solid, corrosive, n.o.s.
Water-reactive, solid, flammable, n.o.s.
Water-reactive, solid, n.o.s.
Water-reactive, solid, oxidizing, n.o.s.
Water-reactive, solid, self-heating, n.o.s.
Water-reactive, solid, toxic, n.o.s.

(4) The provisions of this paragraph do not apply—

(i) To a material that is a hazardous waste and described using the proper shipping name "Hazardous waste, liquid *or* solid, n.o.s.", classed as a miscellaneous Class 9, provided the EPA hazardous waste number is included on the shipping paper in association with the basic description, or provided the material is described in accordance with the provisions of § 172.203(c) of this part.

(ii) To a material for which the hazard class is to be determined by testing under the criteria in § 172.101(c)(11).

(iii) If the n.o.s. description for the material (other than a mixture of hazardous materials of different classes meeting the definitions of more than one hazard class) contains the name of the chemical element or group which is primarily responsible for the material being included in the hazard class indicated.

(iv) If the n.o.s. description for the material (which is a mixture of hazardous materials of different classes meeting the definition of more than one hazard class) contains the name of the chemical element or group responsible for the material meeting the definition of one of these classes. In such cases, only the technical name of the component that is not appropriately identified in the n.o.s. description shall be entered in parentheses.

(l) *Marine pollutants.* (1) If the proper shipping name for a material which is a marine pollutant does not identify by name the component which makes the material a marine pollutant, the name of that component must appear in parentheses in association with the basic

description. Where two or more components which make a material a marine pollutant are present, the names of at least two of the components most predominantly contributing to the marine pollutant designation must appear in parentheses in association with the basic description.

(2) The words "Marine Pollutant" shall be entered in association with the basic description for a material which is a marine pollutant.

(3) Except for transportation by vessel, marine pollutants subject to the provisions of 49 CFR 130.11 are excepted from the requirements of paragraph (l) of this section if a phrase indicating the material is an oil is placed in association with the basic description.

(m) *Poisonous materials.* Notwithstanding the hazard class to which a material is assigned—

(1) If a liquid or solid material in a package meets the definition of a Division 6.1, Packing Group I or II, according to this subchapter, and the fact that it is a poison is not disclosed in the shipping name or class entry, the word "Poison or Toxic" shall be entered on the shipping paper in association with the shipping description.

(2) If the technical name of the compound or principal constituent that causes a material to meet the definition of Division 6.1, Packing Group I or II (as defined in §173.132(a) of this subchapter), or Division 2.3 (as defined in §173.115(c) of this subchapter), is not included in the proper shipping name for the material, the technical name shall be entered on the shipping paper in the manner prescribed in paragraph (k) of this section.

(3) For materials which are poisonous by inhalation (see §171.8 of this subchapter), the words "Poison-Inhalation Hazard" and the words "Zone A", "Zone B", "Zone C", or "Zone D", for gases or "Zone A" or "Zone B" for liquids, as appropriate, shall be entered on the shipping paper immediately following the shipping description. The word "Poison" need not be repeated if it otherwise appears in the shipping description.

(n) *Elevated temperature materials.* Except for molten sulfur or molten aluminum, if a liquid material in a package meets the definition of an elevated temperature material in §171.8 of this subchapter, and the fact that it is an elevated temperature material is not disclosed in the shipping name, the word "HOT" must immediately precede the proper shipping name of the material on the shipping paper.

(o) *Organic peroxides and self-reactive materials.* The description on a shipping paper for a Division 4.1 (self-reactive) material or a Division 5.2 (organic peroxide) material must include the following additional information, as appropriate:

(1) If notification or competent authority approval is required, the shipping paper must contain a statement of approval of the classification and conditions of transport.

(2) For Division 4.1 (self-reactive) and Division 5.2 (organic peroxide) materials that require temperature control during transport, the control and emergency temperature must be included on the shipping paper.

(3) The word "SAMPLE" must be included in association with the basic description when a sample of a Division 4.1 (self-reactive) material (see §173.224(c)(4) of this subchapter) or Division 5.2 (organic peroxide) material (see §173.225(c)(4) of this subchapter) is offered for transportation or transported.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §172.203, see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

EFFECTIVE DATE NOTE: At 60 FR 50304, Sept. 28, 1995, §172.203 was amended by revising paragraphs (d)(1), (d)(4), and (d)(7), and adding paragraphs (d)(10) and (d)(11), effective April 1, 1996. For the convenience of the user the superseded text is set forth below.

§172.203 Additional description requirements.

* * * * *

(d) * * *

(1) The words "RADIOACTIVE MATERIAL" unless these words are contained in the proper shipping name.

* * * * *

(4) The activity contained in each package of the shipment in terms of curies, millicuries, or microcuries. Abbreviations

are authorized. For the shipment of a package containing a highway route controlled quantity of radioactive materials (see §173.403(l) of this subchapter), the words "Highway route controlled quantity" must be entered in association with the basic description.

* * * * *

(7) For a shipment of fissile radioactive materials:

(i) The words "Fissile Exempt," if the package is exempt pursuant to §173.453 of this subchapter, or

(ii) If not exempt, the fissile class of each package in the shipment, pursuant to §173.455 of this subchapter; and

(iii) For a Fissile Class III shipment, the additional notation: "Warning—Fissile Class III Shipment. Do not Load More Than * * * Packages per Vehicle." (Asterisks to be replaced by appropriate number.) "In loading and Storage Areas, Keep at Least 20 Feet (6 Meters) from Other Packages Bearing Radioactive Labels."

(iv) If a Fissile Class III shipment is to be transported by water, the supplementary notation must also include the following statement: "For shipment by water, only one Fissile Class III shipment is permitted in each hold."

* * * * *

§ 172.204 Shipper's certification.

(a) *General.* Except as provided in paragraphs (b) and (c) of this section, each person who offers a hazardous material for transportation shall certify that the material is offered for transportation in accordance with this subchapter by printing (manually or mechanically) on the shipping paper containing the required shipping description the certification contained in paragraph (a)(1) of this section or the certification (declaration) containing the language contained in paragraph (a)(2) of this section.

(1) "This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

NOTE: In line one of the certification the words "herein-named" may be substituted for the words "above-named".

(2) "I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations."

(b) *Exceptions.* (1) Except for a hazardous waste, no certification is required for a hazardous materials offered for transportation by motor vehicle and transported:

(i) In a cargo tank supplied by the carrier, or

(ii) By the shipper as a private carrier except for a hazardous material that is to be reshipped or transferred from one carrier to another.

(2) No certification is required for the return of an empty tank car which previously contained a hazardous material and which has not been cleaned or purged.

(c) *Transportation by air*—(1) *General.* Certification containing the following language may be used in place of the certification required by paragraph (a) of this section:

I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and in proper condition for carriage by air according to applicable national governmental regulations.

(2) *Certificate in duplicate.* Each person who offers a hazardous material to an aircraft operator for transportation by air shall provide two copies of the certification required in this section. (See §175.30 of this subchapter.)

(3) *Passenger and cargo aircraft.* Each person who offers for transportation by air a hazardous material authorized for air transportation shall add to the certification required in this section the following statement:

This shipment is within the limitations prescribed for passenger aircraft/cargo aircraft only (delete nonapplicable).

(4) *Radioactive material.* Each person who offers any radioactive material for transportation aboard a passenger-carrying aircraft shall sign (mechanically or manually) a printed certificate stating that the shipment contains radioactive material intended for use in, or

incident to, research, or medical diagnosis or treatment.

(d) *Signature.* The certifications required by paragraph (a) or (c) of this section:

(1) Must be legibly signed by a principal, officer, partner, or employee of the shipper or his agent; and

(2) May be legibly signed manually, by typewriter, or by other mechanical means.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 172.204, see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 172.205 Hazardous waste manifest.

(a) No person may offer, transport, transfer, or deliver a hazardous waste (waste) unless an EPA Form 8700-22 and 8700-22A (when necessary) hazardous waste manifest (manifest) is prepared in accordance with 40 CFR 262.20 and is signed, carried, and given as required of that person by this section.

(b) The shipper (generator) shall prepare the manifest in accordance with 40 CFR part 262.

(c) The original copy of the manifest must be dated by, and bear the handwritten signature of, the person representing:

(1) The shipper (generator) of the waste at the time it is offered for transportation, and

(2) The initial carrier accepting the waste for transportation.

(d) A copy of the manifest must be dated by, and bear the handwritten signature of the person representing:

(1) Each subsequent carrier accepting the waste for transportation, at the time of acceptance, and

(2) The designated facility receiving the waste, upon receipt.

(e) A copy of the manifest bearing all required dates and signatures must be:

(1) Given to a person representing each carrier accepting the waste for transportation,

(2) Carried during transportation in the same manner as required by this subchapter for shipping papers,

(3) Given to a person representing the designated facility receiving the waste,

(4) Returned to the shipper (generator) by the carrier that transported the waste from the United States to a foreign destination with a notation of the date of departure from the United States, and

(5) Retained by the shipper (generator) and by the initial and each subsequent carrier for three years from the date the waste was accepted by the initial carrier. Each retained copy must bear all required signatures and dates up to and including those entered by the next person who received the waste.

(f) The requirements of paragraphs (d) and (e) of this section do not apply to a rail carrier when waste is delivered to a designated facility by railroad if:

(1) All of the information required to be entered on the manifest (except generator and carrier identification numbers and the generator's certification) is entered on the shipping paper carried in accordance with § 174.26(c) of this subchapter;

(2) The delivering rail carrier obtains and retains a receipt for the waste that is dated by and bears the handwritten signature of the person representing the designated facility; and

(3) A copy of the shipping paper is retained for three years by each railroad transporting the waste.

(g) The person delivering a hazardous waste to an initial rail carrier shall send a copy of the manifest, dated and signed by a representative of the rail carrier, to the person representing the designated facility.

(h) A hazardous waste manifest required by 40 CFR part 262, containing all of the information required by this subpart, may be used as the shipping paper required by this subpart.

[Amdt. 172-58, 45 FR 34698, May 22, 1980, as amended by Amdt. 172-90, 49 FR 10510, Mar. 20, 1984; 49 FR 11184, Mar. 26, 1984]

Subpart D—Marking

§ 172.300 Applicability.

(a) Each person who offers a hazardous material for transportation shall mark each package, freight container, and transport vehicle containing the hazardous material in the manner required by this subpart.

(b) When assigned the function by this subpart, each carrier that transports a hazardous material shall mark

each package, freight container, and transport vehicle containing the hazardous material in the manner required by this subpart.

[Amdt. 172-101, 45 FR 74666, Nov. 10, 1980]

§ 172.301 General marking requirements for non-bulk packagings.

(a) *Proper shipping name and identification number.* (1) Except as otherwise provided by this subchapter, each person who offers for transportation a hazardous material in a non-bulk packaging shall mark the package with the proper shipping name and identification number (preceded by "UN" or "NA", as appropriate) for the material as shown in the § 172.101 table.

(2) The proper shipping name for a hazardous waste (as defined in § 171.8 of this subchapter) is not required to include the word "waste" if the package bears the EPA marking prescribed by 40 CFR 262.32.

(b) *Technical names.* In addition to the marking required by paragraph (a) of this section, each non-bulk packaging containing hazardous materials subject to the provisions of § 172.203(k) of this part shall be marked with the technical name in parentheses in association with the proper shipping name in accordance with the requirements and exceptions specified for display of technical descriptions on shipping papers in § 172.203(k) of this part.

(c) *Exemption packagings.* The outside of each package authorized by an exemption shall be plainly and durably marked "DOT-E" followed by the exemption number assigned.

(d) *Consignee's or consignor's name and address.* Each person who offers for transportation a hazardous material in a non-bulk package shall mark that package with the name and address of the consignor or consignee except when the package is—

(1) Transported by highway only and will not be transferred from one motor carrier to another; or

(2) Part of a carload lot, truckload lot or freight container load, and the entire contents of the rail car, truck or freight container are shipped from one consignor to one consignee.

(e) *Previously marked packagings.* A package which has been previously marked as required for the material it contains and on which the marking remains legible, need not be remarked. (For empty packagings, see § 173.29 of this subchapter.)

(f) *Marking exceptions.* (1) Identification numbers are not required on packages which contain only limited quantities, as defined in § 171.8 of this subchapter, or ORM-D materials.

(2) The marking of technical names on non-bulk packagings filled for shipment prior to December 31, 1990 is not required until December 31, 1991.

[Amdt. 172-123, 55 FR 52590, Dec. 21, 1990]

§ 172.302 General marking requirements for bulk packagings.

(a) *Identification numbers.* Except as otherwise provided in this subpart, no person may offer for transportation or transport a hazardous material in a bulk packaging unless the packaging is marked as required by § 172.332 with the identification number specified for the material in the § 172.101 Table—

(1) On each side and each end, if the packaging has a capacity of 3,785 L (1,000 gallons) or more;

(2) On two opposing sides, if the packaging has a capacity of less than 3,785 L (1,000 gallons); or

(3) For cylinders permanently installed on a tube trailer motor vehicle, on each side and each end of the motor vehicle.

(b) *Size of markings.* Except as otherwise provided, markings required by this subpart on bulk packagings must have a width of at least 6.0 mm (0.24 inch) and a height of at least—

(1) 100 mm (3.9 inches) for rail cars;

(2) 25 mm (one inch) for portable tanks with capacities of less than 3,785 L (1,000 gallons); and

(3) 50 mm (2.0 inches) for cargo tanks and other bulk packages.

(c) *Exemption packagings.* The outside of each bulk package used under the terms of an exemption shall be plainly and durably marked "DOT-E" followed by the exemption number assigned.

(d) Each bulk packaging marked with a proper shipping name, common name or identification number as required by this subpart must remain marked when it is emptied unless it is—

(1) Sufficiently cleaned of residue and purged of vapors to remove any potential hazard; or

(2) Refilled, with a material requiring different markings or no markings, to such an extent that any residue remaining in the packaging is no longer hazardous.

(e) Additional requirements for marking portable tanks, cargo tanks, tank cars, multi-unit tank car tanks, and other bulk packagings are prescribed in §§172.326, 172.328, 172.330, and 172.331, respectively, of this subpart.

(f) A bulk packaging marked prior to October 1, 1991, in conformance to the regulations of this subchapter in effect on September 30, 1991, need not be remarked if the key words of the proper shipping name are identical to those currently specified in the §172.101 Table. For example, a tank car marked "ANHYDROUS AMMONIA" need not be remarked "ANHYDROUS AMMONIA, LIQUEFIED".

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended at 56 FR 66254, Dec. 20, 1991]

§ 172.303 Prohibited marking.

(a) No person may offer for transportation or transport a package which is marked with the proper shipping name or identification number of a hazardous material unless the package contains the identified hazardous material or its residue.

(b) This section does not apply to—

(1) Transportation of a package in a transport vehicle or freight container if the package is not visible during transportation and is loaded by the shipper and unloaded by the shipper or consignee.

(2) Markings on a package which are securely covered in transportation.

(3) The marking of a shipping name on a package when the name describes a material not regulated under this subchapter.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended at 56 FR 66254, Dec. 20, 1991]

§ 172.304 Marking requirements.

(a) The marking required in this subpart—(1) Must be durable, in English and printed on or affixed to the surface of a package or on a label, tag, or sign.

(2) Must be displayed on a background of sharply contrasting color;

(3) Must be unobscured by labels or attachments; and

(4) Must be located away from any other marking (such as advertising) that could substantially reduce its effectiveness.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-29B, 41 FR 57067, Dec. 30, 1976]

§ 172.306 [Reserved]

§ 172.308 Authorized abbreviations.

(a) Abbreviations may not be used in a proper shipping name marking except as authorized in this section.

(b) The abbreviation "ORM" may be used in place of the words "Other Regulated Material."

(c) Abbreviations which appear as authorized descriptions in Column 2 of the §172.101 Table (e.g., "TNT" and "PCB") are authorized.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended by Amdt. 172-145, 60 FR 49110, Sept. 21, 1995]

§ 172.310 Class 7 (radioactive) materials.

In addition to any other markings required by this subpart, each package containing Class 7 (radioactive) materials must be marked as follows:

(a) Each package with a gross mass greater than 50 kilograms (110 pounds) must have the its gross mass marked on the outside of the package.

(b) Packaging must be marked on the outside of the package, in letters at least 13 mm (0.5 inch) high, with the words "TYPE A" or "TYPE B" as appropriate. A packaging which does not conform to Type A or Type B requirements may not be so marked.

(c) Each Type B, Type B(U) or Type B(M) packaging must be marked on the outside of the package with a radiation symbol that conforms to the requirements of Appendix B to Part 172.

(d) Each package destined for export shipment must also be marked "USA" in conjunction with the specification marking, or other package certificate identification. (See §§173.471, 173.472, and 173.473 of this subchapter).

[Amdt 172-143, 60 FR 50304, Sept. 28, 1995]

EFFECTIVE DATE NOTE: At 60 FR 50304, Sept. 28, 1995, §172.310 was revised, effective April 1, 1996. For the convenience of the user the superseded text is set forth below.

§ 172.310 Radioactive materials.

(a) In addition to any other markings required by this subpart, each package containing radioactive materials must be marked as follows:

(1) Each package of radioactive materials in excess of 110 pounds (50 kilograms) must have its gross weight plainly and durably marked on the outside of the package.

(2) Each package of radioactive materials which conforms to the requirements for Type A or Type B packaging (§ 173.403 of this subchapter) must be plainly and durably marked on the outside of the package in letters at least ½-inch (13 mm.) high, with the words "TYPE A" or "TYPE B" as appropriate. A packaging which is not in compliance with these requirements may not be so marked.

(3) Each package of radioactive material destined for export shipment must also be marked "USA" in conjunction with the specification marking, or other package certificate identification. (See §§ 173.471 173.472, and 173.473 of this subchapter.)

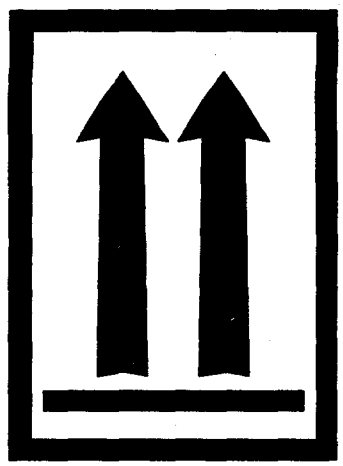
[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-78, 48 FR 10226, Mar. 10, 1983]

§ 172.312 Liquid hazardous materials in non-bulk packagings.

(a) Except as provided in this section, each non-bulk combination package having inner packagings containing liquid hazardous materials must be:

(1) Packed with closures upward, and

(2) Legibly marked, with package orientation markings that conform pictorially to ISO Standard 780-1985, on two opposite vertical sides of the package with the arrows pointing in the correct upright direction. Depicting a rectangular border around the arrows is optional.



Package orientation

(b) Arrows for purposes other than indicating proper package orientation may not be displayed on a package containing a liquid hazardous material.

(c) The requirements of paragraph (a) of this section do not apply to—

(1) A non-bulk package with inner packagings which are cylinders.

(2) Except when offered or intended for transportation by aircraft, packages containing flammable liquids in inner packagings of one liter or less prepared in accordance with § 173.150 (b) or (c) of this subchapter.

(3) When offered or intended for transportation by aircraft, packages containing flammable liquids in inner packagings of 120 ml (4 fluid oz.) or less prepared in accordance with § 173.150 (b) or (c) of this subchapter when packed with sufficient absorption material between the inner and outer packagings to completely absorb the liquid contents.

(4) Liquids contained in manufactured articles (e.g., alcohol or mercury in thermometers) which are leak-tight in all orientations.

numbers, when required, must be displayed on ~~either~~ orange panels (see §172.332(b)) or on a plain white square-on-point display configuration having the same outside dimensions as a placard. In addition, for materials in hazard classes for which placards are specified and identification number displays are required, but for which identification numbers may not be displayed on the placards authorized for the material (see §172.334(a)), identification numbers must be displayed on orange panels or on the plain white square-on-point display configuration in association with the required placards. An identification number displayed on a white square-on-point display configuration is not considered to be a placard.

(1) The 100 mm (3.9 inch) by 215 mm (8.5 inches) area containing the identification number shall be located as prescribed by §172.332 (c)(1) and (c)(2) and may be outlined with a solid or dotted line border.

(2) [Reserved]

(c) Identification numbers are not required:

(1) On the ends of a portable tank, cargo tank or tank car having more than one compartment if hazardous materials having different identification numbers are being transported therein. In such a circumstance, the identification numbers on the sides of the tank shall be displayed in the same sequence as the compartments containing the materials they identify.

(2) On a cargo tank containing only gasoline, if the cargo tank is marked "Gasoline" on each side and rear in letters no less than 50 mm (2 inches) high, or is placarded in accordance with §172.542(c).

(3) On a cargo tank containing only fuel oil, if the cargo tank is marked "Fuel Oil" on each side and rear in letters no less than 50 mm (2 inches) high, or is placarded in accordance with §172.544(c).

(4) For each of the different liquid petroleum distillate fuels, including gasoline and gasohol in a compartmented cargo tank or tank car, if the identification number is displayed for the distillate fuel having the lowest flash point.

(5) For each of the different liquid petroleum distillate fuels, including gasoline and gasohol transported in a cargo tank, if the identification number is displayed for the liquid petroleum distillate fuel having the lowest flash point.

(6) On nurse tanks meeting the provisions of §173.315(m) of this subchapter.

[Amdt. 172-101, 45 FR 74667, Nov. 10, 1980, as amended by Amdt. 172-74, 47 FR 40365, Sept. 30, 1982; Amdt. 172-109, 52 FR 13038, Apr. 20, 1987; Amdt. 172-110, 52 FR 29528, Aug. 10, 1987; Amdt. 172-123, 55 FR 52593, Dec. 21, 1990; 56 FR 66255, Dec. 20, 1991]

§172.338 Replacement of identification numbers.

If more than one of the identification number markings on placards, orange panels, or white square-on-point display configurations that are required to be displayed are lost, damaged or destroyed during transportation, the carrier shall replace all the missing or damaged identification numbers as soon as practicable. However, in such a case, the numbers may be entered by hand on the appropriate placard, orange panel or white square-on-point display configuration providing the correct identification numbers are entered legibly using an indelible marking material. When entered by hand, the identification numbers must be located in the white display area specified in §172.332. This section does not preclude required compliance with the placarding requirements of subpart F of this subchapter.

[Amdt. 172-110, 52 FR 29528, Aug. 10, 1987]

Subpart E—Labeling

§172.400 General labeling requirements.

(a) Except as specified in §172.400a, each person who offers for transportation or transports a hazardous material in any of the following packages or containment devices, shall label the package or containment device with labels specified for the material in the §172.101 Table and in this subpart:

(1) A non-bulk package;

(2) A bulk packaging, other than a cargo tank, portable tank, or tank car, with a volumetric capacity of less than 18 m^3 (640 cubic feet), unless placarded

in accordance with subpart F of this part;

(3) A portable tank of less than 3785 L (1000 gallons) capacity, unless placarded in accordance with subpart F of this part;

(4) A DOT Specification 106 or 110 multi-unit tank car tank, unless placarded in accordance with subpart F of this part; and

(5) An overpack, freight container or unit load device, of less than 18 m^3 (640 cubic feet), which contains a package for which labels are required, unless placarded or marked in accordance with § 172.512 of this part.

(b) Labeling is required for a hazardous material which meets one or more hazard class definitions, in accordance with Column 6 of the § 172.101 Table and the following table:

Hazard class or division	Label name	Label design or section reference (§)
1.1	EXPLOSIVE 1.1	172.411
1.2	EXPLOSIVE 1.2	172.411
1.3	EXPLOSIVE 1.3	172.411
1.4	EXPLOSIVE 1.4	172.411
1.5	EXPLOSIVE 1.5	172.411
1.6	EXPLOSIVE 1.6	172.411
2.1	FLAMMABLE GAS	172.417
2.2	NON-FLAMMABLE GAS.	172.415
2.3	POISON GAS	172.416
3 (flammable liquid)	FLAMMABLE LIQUID	172.419
Combustible liquid	(none)	
4.1	FLAMMABLE SOLID	172.420
4.2	SPONTANEOUSLY COMBUSTIBLE.	172.422
4.3	DANGEROUS WHEN WET.	172.423
5.1	OXIDIZER	172.426
5.2	ORGANIC PEROXIDE.	172.427
6.1 (Packing Groups I and II).	POISON.	172.430
6.1 (Packing Group III).	KEEP AWAY FROM FOOD.	172.431
6.2	INFECTIOUS SUBSTANCE [1].	172.432
7 (see § 172.403)	RADIOACTIVE WHITE-I.	172.436
7	RADIOACTIVE YELLOW-II.	172.438
7	RADIOACTIVE YELLOW-III.	172.440
7 (empty packages, see § 173.427).	EMPTY	172.450
8	CORROSIVE	172.442
9	CLASS 9	172.446

[1] The ETIOLOGIC AGENT label specified in regulations of the Department of Health and Human Services at 42 CFR 72.3 may apply to packages of infectious substances.

[Amdt. 172-123, 55 FR 52593, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991]

§ 172.400a Exceptions from labeling.

(a) Notwithstanding the provisions of § 172.400, a label is not required on—

(1) A cylinder, or a Dewar flask conforming to § 173.320 of this subchapter containing a Division 2.1 or Division 2.2 gas that is—

(i) Not poisonous;

(ii) Carried by a private or contract motor carrier;

(iii) Not overpacked; and

(iv) Durably and legibly marked in accordance with CGA Pamphlet C-7, appendix A.

(2) A package or unit of military explosives (including ammunition) shipped by or on behalf of the DOD when in—

(i) Freight containerload, carload or truckload shipments, if loaded and unloaded by the shipper or DOD; or

(ii) Unitized or palletized break-bulk shipments by cargo vessel under charter to DOD if at least one required label is displayed on each unitized or palletized load.

(3) A package containing a hazardous material other than ammunition that is—

(i) Loaded and unloaded under the supervision of DOD personnel, and

(ii) Escorted by DOD personnel in a separate vehicle.

(4) A compressed gas cylinder permanently mounted in or on a transport vehicle.

(5) A freight container, aircraft unit load device or portable tank, which—

(i) Is placarded in accordance with subpart F of this part, or

(ii) Conforms to paragraph (a)(3) or (b)(3) of § 172.512.

(6) An overpack or unit load device in or on which labels representative of each hazardous material in the overpack or unit load device are visible.

(7) A package of low specific activity radioactive material, when transported under § 173.425(b) of this subchapter.

(b) Certain exceptions to labeling requirements are provided for small quantities and limited quantities in applicable sections in part 173 of this subchapter.

(c) Notwithstanding the provisions of § 172.402(a), a subsidiary hazard label is not required on a package containing a Class 8 (corrosive) material which has a

subsidiary hazard of Division 6.1 (poisonous) if the toxicity of the material is based solely on the corrosive destruction of tissue rather than systemic poisoning.

(d) For Division 6.1 Packing Group III materials, a POISON label may be used in place of a KEEP AWAY FROM FOOD label.

[Amdt. 172-123, 55 FR 52594, Dec. 21, 1990, as amended by Amdt. 172-132, 58 FR 50501, Sept. 27, 1993; 172-130, 58 FR 51531, Oct. 1, 1993; Amdt. 172-139, 59 FR 67490, Dec. 29, 1994; Amdt. 172-145, 60 FR 49110, Sept. 21, 1995]

§ 172.401 Prohibited labeling.

(a) Except as otherwise provided in this section, no person may offer for transportation and no carrier may transport a package bearing a label specified in this subpart unless:

(1) The package contains a material that is a hazardous material, and

(2) The label represents a hazard of the hazardous material in the package.

(b) No person may offer for transportation and no carrier may transport a package bearing any marking or label which by its color, design, or shape could be confused with or conflict with a label prescribed by this part.

(c) The restrictions in paragraphs (a) and (b) of this section, do not apply to packages labeled in conformance with:

(1) Any United Nations recommendation, including the class number (see §172.407), in the document entitled "*Transport of Dangerous Goods.*";

(2) The International Maritime Organization (IMO) requirements, including the class number (see §172.407), in the document entitled "International Maritime Dangerous Goods Code";

(3) The ICAO Technical Instructions; or

(4) The TDG Regulations.

(d) The provisions of paragraph (a) of this section do not apply to a packaging bearing a label if that packaging is:

(1) Unused or cleaned and purged of all residue;

(2) Transported in a transport vehicle or freight container in such a manner that the packaging is not visible during transportation; and

(3) Loaded by the shipper and unloaded by the shipper or consignee.

[Amdt. 172-9, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-75, 47 FR 44471, Oct. 7, 1982; Amdt. 172-77, 47 FR 54822, Dec. 6, 1982; Amdt. 172-94, 49 FR 38134, Sept. 27, 1984; Amdt. 172-100, 50 FR 41521, Oct. 11, 1985; Amdt. 172-123, 55 FR 52594, Dec. 21, 1990; Amdt. 172-132, 58 FR 50501, Sept. 27, 1993]

§ 172.402 Additional labeling requirements.

(a) *Subsidiary hazard labels.* Each package containing a hazardous material—

(1) Shall be labeled with primary and subsidiary hazard labels as specified in Column 6 of the §172.101 Table (unless excepted in paragraph (a)(2) of this section); and

(2)For other than Class 1 or Class 2 materials (for subsidiary labeling requirements for Class 1 or Class 2 materials see paragraph (e) or paragraphs (f) and (g), respectively, of this section), if not already labeled under paragraph (a)(1) of this section, shall be labeled with subsidiary hazard labels in accordance with the following table:

SUBSIDIARY HAZARD LABELS

Subsidiary hazard level (packing group)	Subsidiary Hazard (Class or Division)						
	3	4.1	4.2	4.3	5.1	6.1	8
I	X	***	***	X	X	X	X
II	X	X	X	X	X	X	X
III	*	X	X	X	X	X	X

X—Required for all modes.
*—Required for all modes, except for a material with a flash point at or above 38° C (100°F) transported by rail or highway.
**—Reserved
***—Impossible as subsidiary hazard.

(b) *Display of hazard class on labels.* The appropriate hazard class or, for Division 5.1 or 5.2 the division number, shall be displayed in the lower corner of a primary hazard label and may not be displayed on a subsidiary label.

(c) *Cargo Aircraft Only label.* Each person who offers for transportation or transports by aircraft a package containing a hazardous material which is authorized on cargo aircraft only shall label the package with a CARGO AIRCRAFT ONLY label specified in §172.448 of this subpart.

(d) *Radioactive Materials.* Each package containing a radioactive material that also meets the definition of one or more additional hazards, except Class

9, shall be labeled as a radioactive material as required by §172.403 of this subpart and for each additional hazard.

(e) *Class 1 (explosive) Materials.* In addition to the label specified in Column 6 of the §172.101 Table, each package of Class 1 material that also meets the definition for:

(1) Division 6.1, Packing Groups I or II, shall be labeled POISON; or

(2) Class 7, shall be labeled in accordance with §172.403 of this subpart.

(f) *Division 2.2 materials.* In addition to the label specified in Column 6 of the §172.101 Table, each package of Division 2.2 material that also meets the definition for an oxidizing gas (see §171.8 of this subchapter) must be labeled OXIDIZER.

(g) *Division 2.3 materials.* In addition to the label specified in Column 6 of the §172.101 Table, each package of Division 2.3 material that also meets the definition for:

(1) Division 2.1, must be labeled Flammable Gas;

(2) Division 5.1, must be labeled Oxidizer; and

(3) Class 8, must be labeled Corrosive.

[Amdt. 172–123, 55 FR 52594, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; Amdt. 172–139, 59 FR 67490, Dec. 29, 1994; Amdt. 172–140, 60 FR 26805, May 18, 1995]

§ 172.403 Class 7 (radioactive) material.

(a) Unless excepted from labeling by §§173.421 through 173.425 of this subchapter, each package of radioactive material must be labeled as provided in this section.

(b) The proper label to affix to a package of Class 7 (radioactive) material is based on the radiation level at the surface of the package and the transport index. The proper category of label must be determined in accordance with paragraph (c) of this section. The label to be applied must be the highest category required for any of the two determining conditions for the package. RADIOACTIVE WHITE–I is the lowest category and RADIOACTIVE YELLOW–III is the highest. For example, a package with a transport index of 0.8 and a maximum surface radiation level of 0.6 millisievert (60 millirems) per hour must bear a RADIOACTIVE YELLOW–III label.

(c) Category of label to be applied to Class 7 (radioactive) materials packages:

Transport index	Maximum radiation level at any point on the external surface	Label category[1]
0[2]	Less than or equal to 0.005 mSv/h (0.5 mrem/h).	WHITE–I.
More than 0 but not more than 1	Greater than 0.005 mSv/h (0.5 mrem/h) but less than or equal to 0.5 mSv/h (50 mrem).	YELLOW–II.
More than 1 but not more than 10	Greater than 0.05 mSv/h (50 mrem) but less than or equal to 2 mSv/h (200 mrem/h).	YELLOW–III.
More than 10	Greater than 2 mSv/h (200 mrem/h) but less than or equal to 10 mSv/h (1,000 mrem/h).	YELLOW–III (Must be shipped under exclusive use provisions; see 173.441(b) of this subchapter).

[1] Any package containing a "highway route controlled quantity" (§173.403 of this subchapter) must be labelled as RADIOACTIVE YELLOW–III.

[2] If the measured TI is not greater than 0.05, the value may be considered to be zero.

(d) *EMPTY* label. See §173.428(d) of this subchapter for EMPTY labeling requirements.

(e) [Reserved]

(f) Each package required by this section to be labeled with a RADIOACTIVE label must have two of these labels, affixed to opposite sides of the package. (See §172.406(e)(3) for freight container label requirements).

(g) The following applicable items of information must be entered in the blank spaces on the RADIOACTIVE label by legible printing (manual or mechanical), using a durable weather resistant means of marking:

(1) *Contents.* The name of the radionuclides as taken from the listing of radionuclides in §173.435 of this subchapter (symbols which conform to es-

(b) The telephone number required by paragraph (a) of this section must be the number of the person offering the hazardous material for transportation or the number of an agency or organization capable of, and accepting responsibility for, providing the detailed information concerning the hazardous material. A person offering a hazardous material for transportation who lists the telephone number of an agency or organization shall ensure that agency or organization has received current information on the material, as required by paragraph (a)(2) of this section before it is offered for transportation.

[Amdt. 172-116, 54 FR 27145, June 27, 1989, as amended at 55 FR 33713, Aug. 17, 1990; Amdt. 172-127, 59 FR 49133, Sept. 26, 1994]

Subpart H—Training

SOURCE: Amdt. 172-126, 57 FR 20952, May 15, 1992, unless otherwise noted.

§ 172.700 Purpose and scope.

(a) *Purpose.* This subpart prescribes requirements for training hazmat employees.

(b) *Scope.* Training as used in this subpart means a systematic program that ensures a hazmat employee has familiarity with the general provisions of this subchapter, is able to recognize and identify hazardous materials, has knowledge of specific requirements of this subchapter applicable to functions performed by the employee, and has knowledge of emergency response information, self-protection measures and accident prevention methods and procedures (see § 172.704).

(c) *Modal-specific training requirements.* Additional training requirements for the individual modes of transportation are prescribed in parts 174, 175, 176, and 177 of this subchapter.

§ 172.701 Federal-State relationship.

This subpart and the parts referenced in § 172.700(c) prescribe minimum training requirements for the transportation of hazardous materials. For motor vehicle drivers, however, a State may impose more stringent training requirements only if those requirements—

(a) Do not conflict with the training requirements in this subpart and in part 177 of this subchapter; and

(b) Apply only to drivers domiciled in that State.

§ 172.702 Applicability and responsibility for training and testing.

(a) A hazmat employer shall ensure that each of its hazmat employees is trained in accordance with the requirements prescribed in this subpart.

(b) A hazmat employee who performs any function subject to the requirements of this subchapter may not perform that function unless trained in accordance with the requirements prescribed in this subpart. It is the duty of each hazmat employer to comply with the applicable requirements of this subchapter and to thoroughly instruct each hazmat employee in relation thereto.

(c) Training may be provided by the hazmat employer or other public or private sources.

(d) A hazmat employer shall ensure that each of its hazmat employees is tested by appropriate means on the training subjects covered in §172.704.

[Amdt. 172-126, 57 FR 20952, May 15, 1992; 57 FR 22182, May 27, 1992]

§ 172.704 Training requirements.

(a) Hazmat employee training shall include the following:

(1) *General awareness/familiarization training.* Each hazmat employee shall be provided general awareness/familiarization training designed to provide familiarity with the requirements of this subchapter, and to enable the employee to recognize and identify hazardous materials consistent with the hazard communication standards of this subchapter.

(2) *Function-specific training.* (i) Each hazmat employee shall be provided function-specific training concerning requirements of this subchapter, or exemptions issued under subchapter A of this chapter, which are specifically applicable to the functions the employee performs.

(ii) As an alternative to function-specific training on the requirements of this subchapter, training relating to the requirements of the ICAO Technical Instructions and the IMDG Code

for transportation in accordance with the requirements of this subchapter.

(2) Transportation is performed by highway only.

(3) A package is not offered for transportation less than 24 hours after it is finally closed for transportation, and each package is inspected for leakage and is found to be free from leaks immediately prior to being offered for transportation.

(4) Each package is loaded by the shipper and unloaded by the consignee, unless the motor carrier is a private or contract carrier.

(5) The packaging may be used only once under this paragraph and may not be used again for shipment of hazardous materials except in accordance with § 173.28.

(d) *Technical names for n.o.s. descriptions.* The requirements for the inclusion of technical names for n.o.s. descriptions on shipping papers and package markings, §§ 172.203 and 172.301 of this subchapter, respectively, do not apply to packagings prepared in accordance with paragraph (b) of this section, except as follows:

(1) Packages containing materials meeting the definition of a hazardous substance must be described as required in § 172.203(c) of this subchapter and marked as required in § 172.324 of this subchapter; and

(2) Packages containing hazardous materials subject to the provisions of § 172.203(m) of this subchapter must be described in accordance with § 172.203(m) of this subchapter.

[Amdt. 173-224, 55 FR 52609, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-231, 57 FR 52939, Nov. 5, 1992; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994]

Subpart B—Preparation of Hazardous Materials for Transportation

§ 173.21 Forbidden materials and packages.

Unless otherwise provided in this subchapter, the offering for transportation or transportation of the following is forbidden:

(a) Materials that are designated "Forbidden" in Column 3 of the § 172.101 Table.

(b) Forbidden explosives as defined in § 173.54 of this part.

(c) Electrical devices which are likely to create sparks or generate a dangerous quantity of heat, unless packaged in a manner which precludes such an occurrence.

(d) For carriage by aircraft, any package which has a magnetic field of more than 0.00525 gauss measured at 4.5 m (15 feet) from any surface of the package.

(e) A material in the same packaging, freight container, or overpack with another material, the mixing of which is likely to cause a dangerous evolution of heat, or flammable or poisonous gases or vapors, or to produce corrosive materials.

(f) A package containing a material which is likely to decompose with a self-accelerated decomposition temperature (SADT) of 50°C (122°F) or less, or polymerize at a temperature of 54°C (130°F) or less with an evolution of a dangerous quantity of heat or gas when decomposing or polymerizing, unless the material is stabilized or inhibited in a manner to preclude such evolution. The SADT may be determined by any of the test methods described in part II of the UN Recommendations on the Transport of Dangerous Goods, Tests and Criteria, Second Edition (1990).

(1) A package meeting the criteria of paragraph (f) of this section may be required to be shipped under controlled temperature conditions. The control temperature and emergency temperature for a package shall be as specified in the table in this paragraph based upon the SADT of the material. The control temperature is the temperature above which a package of the material may not be offered for transportation or transported. The emergency temperature is the temperature at which, due to imminent danger, emergency measures must be initiated.

SECTION 173.21 TABLE: METHOD OF DETERMINING CONTROL AND EMERGENCY TEMPERATURE.

SADT [1]	Control temperatures	Emergency temperature
SADT ≤ 20 °C (68 °F).	20 °C (36 °F) below SADT.	10 °C (18 °F) below SADT.

(2) Except as otherwise provided in this subchapter, a closure (including gaskets or other closure components, if any) used on a specification packaging must conform to all applicable requirements of the specification.

(g) Venting. Venting of packagings, to reduce internal pressure which may develop by the evolution of gas from the contents, is permitted only when—

(1) Transportation by aircraft is not involved;

(2) Except as otherwise provided in this subchapter, the evolved gases are not poisonous, likely to create a flammable mixture with air or be an asphyxiant under normal conditions of transportation;

(3) The packaging is designed so as to preclude an unintentional release of hazardous materials from the receptacle; and

(4) For shipments in bulk packagings, venting is authorized for the specific hazardous material by a special provision in the §172.101 Table or by the applicable bulk packaging specification in part 178 of this subchapter.

(h) Outage and filling limits—(1) *General.* When filling packagings and receptacles for liquids, sufficient ullage (outage) must be left to ensure that neither leakage nor permanent distortion of the packaging or receptacle will occur as a result of an expansion of the liquid caused by temperatures likely to be encountered during transportation. Requirements for outage and filling limits for non-bulk and bulk packagings are specified in §§173.24a(d) and 173.24b(a), respectively.

(2) *Compressed gases and cryogenic liquids.* Filling limits for compressed gases and cryogenic liquids are specified in §§173.301 through 173.306 for cylinders and §§173.314 through 173.319 for bulk packagings.

(i) Air transportation. Packages offered or intended for transportation by aircraft must conform to the general requirements for transportation by aircraft in §173.27, except as provided in §171.11 of this subchapter.

[Amdt. 173-224, 55 FR 52610, Dec. 21, 1990, as amended by Amdt. 173-227, 56 FR 49989, Oct. 2, 1991; 56 FR 66265, Dec. 20, 1991; Amdt. 173-238, 59 FR 38064, July 26, 1994; Amdt. 173-241, 59 FR 67491, Dec. 29, 1994; Amdt. 173-242, 60 FR 26805, May 18, 1995]

§173.24a Additional general requirements for non-bulk packagings and packages.

(a) Packaging design. Except as provided in §172.312 of this subchapter:

(1) *Inner packaging closures.* A combination packaging containing liquid hazardous materials must be packed so that closures on inner packagings are upright.

(2) *Friction.* The nature and thickness of the outer packaging must be such that friction during transportation is not likely to generate an amount of heat sufficient to alter dangerously the chemical stability of the contents.

(3) *Securing and cushioning.* Inner packagings of combination packagings must be so packed, secured and cushioned to prevent their breakage or leakage and to control their movement within the outer packaging under conditions normally incident to transportation. Cushioning material must not be capable of reacting dangerously with the contents of the inner packagings.

(4) *Metallic devices.* Nails, staples and other metallic devices shall not protrude into the interior of the outer packaging in such a manner as to be likely to damage inner packagings or receptacles.

(5) *Vibration.* Each non-bulk package must be capable of withstanding, without rupture or leakage, the vibration test procedure specified in §178.608 of this subchapter.

(b) Non-bulk packaging filling limits. (1) A single or composite non-bulk packaging may be filled with a liquid hazardous material only when the specific gravity of the material does not exceed that marked on the packaging, or a specific gravity of 1.2 if not marked, except as follows:

(i) A Packing Group I packaging may be used for a Packing Group II material with a specific gravity not exceeding the greater of 1.8, or 1.5 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material;

(ii) A Packing Group I packaging may be used for a Packing Group III material with a specific gravity not exceeding the greater of 2.7, or 2.25 times the specific gravity marked on the

175.705 Inspection of aircraft for contamination by Class 7 (radioactive) materials.
175.706 Radiation protection program.

AUTHORITY: 49 U.S.C. 5101–5127; 49 CFR 1.53.

SOURCE: Amdt. 175–1, 41 FR 16106, Apr. 15, 1976, unless otherwise noted.

EDITORIAL NOTE: Nomenclature changes to part 175 appear at 50 FR 45731, Nov. 1, 1985.

Subpart A—General Information and Regulations

§ 175.1 Purpose and scope.

This part prescribes requirements, in addition to those contained in parts 171, 172 and 173 of this subchapter, applicable to aircraft operators transporting hazardous materials aboard (including attached to or suspended from) aircraft.

[Amdt. 175–15, 45 FR 35332, May 27, 1980]

§ 175.3 Unacceptable hazardous materials shipments.

Hazardous materials that are not prepared for shipment in accordance with this subchapter may not be accepted for transportation or transported aboard an aircraft.

[Amdt. 175–25, 47 FR 54822, Dec. 6, 1982]

§ 175.5 Applicability.

(a) This part applies to the acceptance for transportation, loading and transportation of hazardous materials in any aircraft in the United States and in aircraft of United States registry anywhere in air commerce. This part does not apply to:

(1) Aircraft owned and operated by a government when not engaged in carrying persons or property for commercial purposes;

(2) Aircraft which are not owned by a government nor engaged in carrying persons or property for commercial purposes but which are under the exclusive direction and control of a government for a period of not less than 90 days as specified in a written contract or lease. An aircraft is under the exclusive direction and control of a government when the government exercises responsibility for:

(i) Approving crew members and determining that they are qualified to operate the aircraft;

(ii) Determining the airworthiness and directing maintenance of the aircraft; and

(iii) Dispatching the aircraft, including the times of departure, airports to be used, and type and amount of cargo to be carried;

(3) Aircraft of United States registry under lease to and operated by foreign nationals outside the United States if:

(i) Hazardous materials forbidden aboard aircraft by § 172.101 of this subchapter are not carried on the aircraft; and

(ii) Other hazardous materials are carried in accordance with the regulations of the State (nation) of the aircraft operator.

[Amdt. 175–15, 45 FR 35332, May 27, 1980]

§ 175.10 Exceptions.

(a) This subchapter does not apply to:

(1) Aviation fuel and oil in tanks that are in compliance with the installation provisions of 14 CFR, chapter 1.

(2) Hazardous materials required aboard an aircraft in accordance with the applicable airworthiness requirements and operating regulations. Unless otherwise approved by the Associate Administrator for Hazardous Materials Safety, items of replacement for such hazardous materials must be transported in accordance with this subchapter except that—

(i) In place of the required packagings, packagings specially designed for the transport of aircraft spares and supplies may be used, provided such packagings provide at least an equivalent level of protection to those that would be required by this subchapter;

(ii) Aircraft batteries are not subject to quantity limitations such as those provided in § 172.101 or § 175.75(a) of this subchapter; and,

(iii) A tire assembly with a serviceable tire is not subject to the provisions of this subchapter provided the tire is not inflated to a gauge pressure exceeding the maximum rated pressure for that tire.

(3) Hazardous materials loaded and carried in hoppers or tanks of aircraft certificated for use in aerial seeding, dusting, spraying, fertilizing, crop improvement, or pest control, to be dispensed during such an operation.

(4) Non-radioactive medicinal and toilet articles (including aerosols) carried by a crew member or passenger in checked or carry-on baggage. Also aerosols in Division 2.2, with no subsidiary risk, for sporting or home use, when carried in checked baggage only, when:

(i) The total capacity of all the containers used by a crewmember or passenger does not exceed 2 kg (70 net weight ounces) or 2 liters (68 fluid ounces);

(ii) The capacity of each container other than an aerosol container does not exceed 470 ml (16 fluid ounces) or 0.5 kg (1.1 pound) of material.

(5) Small-arms ammunition for personal use carried by a crewmember or passenger in his baggage (excluding carry-on baggage) if securely packed in fiber, wood or metal boxes, or other packagings specifically designed to carry small amounts of ammunition. This paragraph does not apply to persons traveling under the provisions of 14 CFR 108.11 (a) and (b).

(6) [Reserved]

(7) Oxygen, or any hazardous material used for the generation of oxygen, for medical use by a passenger, which is furnished by the aircraft operator in accordance with 14 CFR 121.574 or 135.91. For purposes of this paragraph, an aircraft operator that is not a certificate holder under 14 CFR part 121 or part 135, may apply this exception in conformance with 14 CFR 121.574 or 135.91 in the same manner as required for a certificate holder.

(8) Human beings and animals with an implanted medical device, such as a heart pacemaker, that contains Class 7 (radioactive) materials or with radiopharmaceuticals that have been injected or ingested.

(9) Smoke grenades, flares, or similar devices carried only for use during a sport parachute jumping activity.

(10) Personal smoking materials intended for use by any individual when carried on his person except lighters with flammable liquid reservoirs and containers containing lighter fluid for use in refilling lighters.

(11) Smoke grenades, flares, and pyrotechnic devices affixed to aircraft carrying no person other than a required flight crewmember during any flight conducted at and as a part of a scheduled air show or exhibition of aeronautical skill. The affixed installation accommodating the smoke grenades, flares, or pyrotechnic devices on the aircraft must be approved by the FAA for its intended use.

(12) Hazardous materials which are loaded and carried on or in cargo aircraft only, and which are to be dispensed or expended during flight for weather control, enviromental restoration or protection, forest preservation and protection, flood control, avalanche control purposes, or routine quality control testing of special fireworks manufactured for the Department of Defense, when the following requirements are met:

(i) Operations may not be conducted over densely populated areas, in a congested airway, or near any airport where air carrier passenger operations are conducted.

(ii) Each operator shall prepare and keep current a manual containing operational guidelines and handling procedures, for the use and guidance of flight, maintenance, and ground personnel concerned in the dispensing or expending of hazardous materials. The manual must be approved by the FAA Civil Aviation Security Office responsible for the operator's overall aviation security program or the FAA Civil Aviation Security Office in the region where the operator is located. The manual must be approved by the FAA Civil Aviation Security Field Office responsible for reviewing the operator's hazardous materials program or the FAA Civil Aviation Security Field Office in the region where the operator is located. Each operation must be conducted in accordance with the manual.

(iii) No person other than a required flight crewmember, FAA inspector, or person necessary for handling or dispensing the hazardous material may be carried on the aircraft.

(iv) The operator of the aircraft must have advance permission from the owner of any airport to be used for the dispensing or expending operation.

(v) When dynamite and blasting caps are carried for avalanche control flights, the explosives must be handled by, and at all times be under the control of, a qualified blaster. When re-

(20) A wheelchair or other battery-powered mobility aid equipped with a spillable battery, when carried as checked baggage, provided that—

(i) Visual inspection including, where necessary, removal of the battery, reveals no obvious defects (however, removal of the battery from the housing should be performed by qualified airline personnel only);

(ii) The battery is disconnected and terminals are insulated to prevent short circuits;

(iii) The pilot-in-command is advised, either orally or in writing, prior to departure, as to the location of the battery aboard the aircraft; and

(iv) The wheelchair or mobility aid is loaded, stowed, secured and unloaded in an upright position or the battery is removed, the wheelchair or mobility aid is carried as checked baggage without further restriction, and the removed battery is carried in a strong, rigid packaging under the following conditions:

(A) The packaging must be leak-tight and impervious to battery fluid. An inner liner may be used to satisfy this requirement if there is absorbent material placed inside of the liner and the liner has a leakproof closure;

(B) The battery must be protected against short circuits, secured upright in the packaging, and be packaged with enough compatible absorbent material to completely absorb liquid contents in the event of rupture of the battery; and

(C) The packaging must be labeled with a CORROSIVE label, marked to indicate proper orientation, and marked with the words "Battery, wet, with wheelchair."

(21) Hair curlers containing hydrocarbon gas, no more than one per passenger or crew member, provided that the safety cover is securely fitted over the heating element. Gas refills for such curlers are not permitted in checked or carry-on baggage.

(22) A mercurial barometer carried as carry-on-baggage only, by a representative of a government weather bureau or similar official agency, provided that individual advises the operator of the presence of the barometer in his baggage. The barometer must be packaged in a strong outer packaging having sealed inner liner or bag of strong, leak proof and puncture-resistant material impervious to mercury, which will prevent the escape of mercury from the package irrespective of its position. The pilot-in-command must be informed of the presence of any such barometer by the operator of the aircraft.

(23) With the approval of the operator of the aircraft and as carry-on baggage, electrically powered heat-producing articles (e.g., battery-operated equipment, such as underwater torches and soldering equipment), which, if accidentally activated, will generate extreme heat and can cause fire. The heat-producing component, or the energy source, must be removed so as to prevent unintentional functioning during transport.

(24) With the approval of the operator and as checked baggage, a small chemical oxygen generator for personal use, one per person, that meets the following requirements:

(i) The generator, without its packaging, must be capable of withstanding a 1.8 m (5.9 feet) drop test onto a rigid, non-resilient, flat and horizontal surface, in the position most likely to cause damage, without loss of its contents and without actuation;

(ii) The generator must be equipped with an actuating device with at least two positive means of preventing unintentional actuation;

(iii) The generator must be well insulated and, when it is actuated at a temperature of 20 °C (68 °F), the temperature of any external surface of the generator must not exceed 100 °C (212 °F);

(iv) The generator must be in the manufacturer's original packaging and this must include a sealed outer wrapping or clear evidence that the generator has not been tampered with; and

(v) The generator packaging must be marked to indicate that the package meets the requirements of this paragraph (e.g., conforms with 49 CFR 175.10(a)(24)).

(25) With approval of the aircraft operator, one small carbon dioxide cylinder fitted into a self-inflating lifejacket, plus one spare cartridge, may be carried by a passenger or crew member in checked or carry-on baggage.

(26) A small medical or clinical mercury thermometer for personal use,

when carried in protective cases by passengers or crew members.

[Amdt. 175–1, 41 FR 16106, Apr. 15, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §175.10, see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 175.20 Compliance and training.

(a) Unless this subchapter specifically provides that another person shall perform a particular duty, each operator shall comply with all applicable requirements in parts 106, 171, 172, and 175 of this chapter and shall ensure each of its hazmat employees receive training in relation thereto. (See also 14 CFR 121.135, 121.401, 121.433a, 135.323, 135.327 and 135.333.)

(b) A carrier may not transport a hazardous material by aircraft unless each of its hazmat employees involved in that transportation is trained as required by subpart H of part 172 of this subchapter.

[Amdt. 175–48, 57 FR 20953, May 15, 1992]

§ 175.25 Notification at air passenger facilities of hazardous materials restrictions.

(a) Each aircraft operator who engages in for-hire transportation of passengers shall display notices of the requirements applicable to the carriage of hazardous materials aboard aircraft, and the penalties for failure to comply with those requirements. Each notice must be legible, and be prominently displayed so that it can be seen by passengers in locations where the aircraft operator issues tickets, checks baggage, and maintains aircraft boarding areas.

(1) Each notice must contain the following information:

Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person.

A violation can result in penalties of up to $25,000 and 5 years imprisonment. (49 U.S.C. 1809)

Hazardous materials include explosives, compressed gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials.

Examples: Paints, lighter fluid, fireworks, tear gases, oxygen bottles, and radio-pharmaceuticals.

There are special exceptions for small quantities (up to 75 ounces total) of medicinal and toilet articles carried in your luggage and certain smoking materials carried on your person.

For further information contact your airline representative.

(2) The information contained in paragraph (a)(1) of this section must be printed:

(i) In legible Engish;

(ii) In lettering of at least 1 cm (0.4 inch) in height for the first three paragraphs and 6.0 mm (0.2 inch) in height for the last three paragraphs; and

(iii) On a background of contrasting color.

(3) Size and color of the notice are optional. Additional information, if not inconsistent with required information, may be included.

[Amdt. 175–12, 45 FR 13091, Feb. 28, 1980, as amended by 175–23, 47 FR 43066, Sept. 30, 1982; Amdt. 175–47, 55 FR 52685, Dec. 21, 1990; Amdt. 175–50, 58 FR 50505, Sept. 27, 1993]

§ 175.26 Notification at cargo facilities of hazardous materials requirements.

(a) After September 30, 1994, each person who engages in the acceptance or transport of cargo for transportation by aircraft shall display notices, at each facility where cargo is accepted, to persons offering such cargo of the requirements applicable to the carriage of hazardous materials aboard aircraft, and the penalties for failure to comply with those requirements. Each notice must be legible, and be prominently displayed so that it can be seen. At a minimum, each notice must communicate the following information:

(1) Cargo containing hazardous materials (dangerous goods) for transportation by aircraft must be offered in accordance with the Federal Hazardous Materials Regulations (49 CFR parts 171–180).

(2) A violation can result in civil penalties of up to $25,000 and criminal penalties of up to $500,000 and 5 years imprisonment.

(3) Hazardous materials (dangerous goods) include explosives, compressed gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials.

(b) The information contained in paragraph (a) of this section must be printed:

(1) Legibly in English, and, where cargo is accepted outside of the United States, in the language of the host country; and

(2) On a background of contrasting color.

(c) Size and color of the notice are optional. Additional information, examples, or illustrations, if not inconsistent with required information, may be included.

(d) Exceptions: Display of a notice required by paragraph (a) of this section is not required at:

(1) An unattended location (e.g., a drop box) provided a general notice advising customers of a prohibition on shipments of hazardous materials through that location is prominently displayed; or

(2) A customer's facility where hazardous materials packages are accepted by a carrier.

[Amdt. 175-50, 58 FR 50505, Sept. 27, 1993]

§ 175.30 Accepting and inspecting shipments.

(a) No person may accept a hazardous material for transportation aboard an aircraft unless the hazardous material is:

(1) Authorized, and is within the quantity limitations specified for carriage aboard aircraft according to §172.101 of this subchapter or as otherwise specifically provided by this subchapter.

(2) Described and certified on a shipping paper prepared in duplicate in accordance with subpart C of part 172 or as authorized by §171.11 of this subchapter. The originating aircraft operator must retain one copy of each shipping paper for 90 days;

(3) Labeled and marked in accordance with subparts D and E of part 172 or as authorized in §171.11 of this subchapter, and placarded (when required) in accordance with subpart F of part 172 of this subchapter; and,

(4) Labeled with a "CARGO AIRCRAFT ONLY" label (see §172.448 of this subchapter) if the material as presented is not permitted aboard passenger-carrying aircraft.

(b) Except as provided in paragraph (d) of this section, no person may carry a hazardous material in a package, outside container, or overpack aboard an aircraft unless the package, outside container, or overpack is inspected by the operator of the aircraft immediately before placing it:

(1) Aboard the aircraft; or,

(2) In a unit load device or on a pallet prior to loading aboard the aircraft.

(c) A hazardous material may only be carried aboard an aircraft if, based on the inspection prescribed in paragraph (b) of this section, the operator determines that the package, outside container, or overpack containing the hazardous material:

(1) Has no holes, leakage or other indication that its integrity has been compromised; and

(2) For Class 7 (radioactive) materials, does not have a broken seal, except that packages contained in overpacks need not be inspected for seal integrity.

(d) The requirements of paragraphs (b) and (c) of this section do not apply to:

(1) An ORM-D material packed in a freight container and offered for transportation by one consignor;

(2) Dry ice (carbon dioxide, solid); or

(e) An overpack containing packages of hazardous materials may be accepted only if the operator has taken all reasonable steps to establish that:

(1) The overpack does not contain a package bearing the "CARGO AIRCRAFT ONLY" label unless—

(i) The overpack affords clear visibility of and easy access to the package; or

(ii) The package contains a material which may be carried inaccessibly under the provisions of §175.85(c)(1); or

(iii) Not more than one package is overpacked.

(2) The proper shipping names, identification numbers, labels and special handling instructions appearing on the inside packages are clearly visible or reproduced on the outside of the overpack, and

(3) Has determined that a statement to the effect that the inside packages comply with the prescribed specifications appears on the outside of the

overpack, when specification packagings are prescribed.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-12, 45 FR 13091, Feb. 28, 1980; Amdt. 175-17, 45 FR 68654, Oct. 11, 1980; Amdt. 175-25, 47 FR 54822, Dec. 6, 1982; Amdt. 175-34, 50 FR 48420, Nov. 25, 1985; Amdt. 175-37, 51 FR 5974, Feb. 18, 1986; Amdt. 175-39, 51 FR 44791, Dec. 12, 1986; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§ 175.31 Reports of discrepancies.

(a) Each person who discovers a discrepancy, as defined in paragraph (b) of this section, relative to the shipment of a hazardous material following its acceptance for transportation aboard an aircraft shall, as soon as practicable, notify the nearest FAA Civil Aviation Security Office by telephone and shall provide the following information:

(1) Name and telephone number of the person reporting the discrepancy.

(2) Name of the aircraft operator.

(3) Specific location of the shipment concerned.

(4) Name of the shipper.

(5) Nature of discrepancy.

(b) Discrepancies which must be reported under paragraph (a) of this section are those involving hazardous materials which are improperly described, certified, labeled, marked, or packaged, in a manner not ascertainable when accepted under the provisions of §175.30(a) of this subchapter, including:

(1) Package which are found to contain hazardous materials:

(i) Other than as described or certified on shipping papers;

(ii) In quantities exceeding authorized limits;

(iii) In inside containers which are not authorized or have improper closures;

(iv) In inside containers not oriented as shown by package markings;

(v) With insufficient or improper absorption materials, when required; or

(2) Packages or baggage which are found to contain hazardous materials subsequent to their being offered and accepted as other than hazardous materials.

[Amdt. 175-15, 45 FR 35332, May 27, 1980, as amended by Amdt. 175-41, 52 FR 36672, Sept. 30, 1987]

§ 175.33 Notification of pilot-in-command.

(a) Except as provided in §175.10, when a hazardous material subject to the provisions of this subchapter is carried in an aircraft, the operator of the aircraft shall provide the pilot-in-command at least the following information in writing as early as practicable prior to departure:

(1) The proper shipping name, hazard class and identification number of the material as specified in §172.101 of this subchapter or the ICAO Technical Instructions. In the case of Class 1 material, the compatibility group letter also must be shown. If a hazardous material is described by the proper shipping name, hazard class, and identification number appearing in:

(i) Section 172.101 of this subchapter, any additional description requirements provided in §§172.202 and 172.203 of this subchapter must also be shown in the notification.

(ii) The ICAO Technical Instructions, any additional information required to be shown on shipping papers by §171.11 of this subchapter must also be shown in the notification.

(2) The total number of packages;

(3) The net quantity or gross weight, as applicable, for each package except those containing Class 7 (radioactive) materials and those for which there is no limit imposed on the maximum net quantity per package;

(4) The location of the packages aboard the aircraft;

(5) Confirmation that no damaged or leaking packages have been loaded on the aircraft;

(6) For Class 7 (radioactive) materials, the number of packages, overpacks or freight containers their category, transport index (if applicable), and their location aboard the aircraft;

(7) Confirmation that the package must be carried on cargo aircraft only if its transportation aboard passenger-carrying aircraft is forbidden; and

(8) An indication, when applicable, that a hazardous material is being carried under terms of an exemption.

(b) A copy of the written notification to pilot-in-command shall be readily available to the pilot-in-command during flight. Emergency response infor-

been unintentional release of hazardous materials from a package. Each operator making a report under this section shall send that report to the Research and Special Programs Administration, Information Systems Manager, Department of Transportation, Washington, DC 20590-0001, with a separate copy to the FAA facility indicated in paragraph (a) of this section.

(d) [Reserved]

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-23, 47 FR 43066, Sept. 30, 1982; Amdt. 175-40, 52 FR 8592, Mar. 19, 1987; Amdt. 175-43, 54 FR 25813, June 19, 1989; Amdt. 175-46, 55 FR 39961, Oct. 1, 1990; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990; Amdt. 175-54, 60 FR 49111, Sept. 21, 1995]

Subpart B—Loading, Unloading and Handling

§ 175.75 Quantity limitations aboard aircraft.

(a) Except as provided in § 175.85(c)(3), no person may carry on an aircraft:

(1) A hazardous material except as permitted by this subchapter:

(2) More than 25 kg (55 pounds) net weight of hazardous material (and in addition thereto, 75 kg (165 pounds) net weight of Division 2.2 (non-flammable compressed gas) materials permitted to be carried aboard passenger-carrying aircraft:

(i) In an inaccessible cargo compartment,

(ii) In any freight container within an accessible cargo compartment, or

(iii) In any accessible cargo compartment in a cargo aircraft only in a manner that makes it inaccessible unless in a freight container;

(3) Packages containing Class 7 (radioactive) materials when their combined transport index number (determined by adding together the transport index numbers shown on the labels of the individual packages and/or overpacks):

(i) In passenger carrying aircraft, exceeds 50.0 or, for any single package, exceeds 3.0, or

(ii) In cargo aircraft only, exceeds 200.00 (for fissile Class 7 (radioactive) materials, see § 175.702(b)(2)(iv)) or, for any single package, exceeds 10.0.

(b) No limitation applies to the number of packages of Class 9 (miscellaneous hazardous) materials, or ORM-D materials aboard an aircraft.

[Amdt. 175-1A, 41 FR 40686, Sept. 20, 1976, as amended by Amdt. 175-13, 45 FR 20101, Mar. 27, 1980; Amdt. 175-25, 47 FR 54823, Dec. 6, 1982; Amdt. 175-29, 48 FR 50461, Nov. 1, 1983; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§ 175.78 Stowage compatibility of cargo.

(a) For stowage on an aircraft, in a cargo facility, or at any other area at an airport designated for the stowage of hazardous materials, packages containing hazardous materials which might react dangerously with one another may not be placed next to each other or in a position that would allow a dangerous interaction in the event of leakage. As a minimum, the segregation prescribed in the following Table must be maintained.