National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December 17, 2007
In reply refer to: A-07-97 through -103

Honorable Robert A. Sturgell
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 7, 2006, about 2359 eastern standard time,[1] United Parcel Service Company (UPS) flight 1307, a McDonnell Douglas DC-8-71F,[2] N748UP, landed at its destination airport, Philadelphia International Airport (PHL), Philadelphia, Pennsylvania, after a cargo smoke indication in the cockpit. The captain, first officer, and flight engineer evacuated the airplane after landing. The flight crewmembers sustained minor injuries, and the airplane and most of the cargo were destroyed by fire after landing. The scheduled cargo flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 on an instrument flight rules flight plan. Night visual conditions prevailed at the time of the accident.[3]

The National Transportation Safety Board determined that the probable cause of this accident was an in-flight cargo fire that initiated from an unknown source, which was most likely located within cargo container 12, 13, or 14. Contributing to the loss of the aircraft were the inadequate certification test requirements for smoke and fire detection systems and the lack of an on board fire suppression system.

Flight Crew Performance

The accident flight was uneventful until just after the descent to PHL began, about 2335, at which time, the first officer detected an odor and asked the captain and flight engineer if they smelled anything.

After the first officer's query, the flight crew began to actively analyze the situation and take action, including looking for visible evidence of smoke or fire in the area behind the cockpit. The flight crew also proactively began troubleshooting to determine the source of the odor. The captain stated during postaccident interviews that he evaluated diversion alternatives at this time but decided to continue to PHL. Neither the UPS DC-8 Aircraft Operating Manual

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

[2] McDonnell Douglas is now owned by the Boeing Commercial Airplane Group.

[3] For more information, see *In-Flight Cargo Fire, United Parcel Service Company Flight 1307, McDonnell Douglas DC-8-71F, N748UP, Philadelphia, Pennsylvania, February 7, 2007*, Aircraft Accident Report NTSB/AAR-07/07 (Washington, DC: NTSB, 2007).

(AOM) nor the DC-8 Airplane Flight Manual states what procedures should be accomplished in the event that only an odor is present.

The Cargo Smoke warning light in the main cargo compartment illuminated about 20 minutes after the first officer first mentioned the presence of an odor. One minute 15 seconds later, the Lower Cargo Fire warning light illuminated and indicated that smoke was in the lower aft middle cargo compartment. After the first warning light illuminated, the flight crew began to execute the Lower and/or Main Cargo Compartment Smoke or Fire checklist, and the first officer turned the airplane toward the airport. Cockpit voice recorder (CVR) evidence indicates that, during this portion of the flight, the first officer maintained control of the airplane and the captain oversaw the crew actions and worked with the flight engineer to handle troubleshooting, communication, and emergency efforts.

Use and Adequacy of Smoke, Fire, or Fumes Checklists

During the review of the flight crew's actions and decision-making, investigators found that company guidance and checklists regarding smoke, fire, or fumes in the absence of a cockpit warning were not adequate because neither UPS nor Boeing provides specific flight crew procedures for responding to such a situation. Instead, the UPS DC-8 AOM provided four checklists that could have been applied to such a situation, three of which were predicated on visible evidence of smoke or fire or an alert activation in the cockpit. The Fumes Evacuation checklist applied specifically to fumes, but the AOM did not provide guidance on when to use the checklist. During the period in which the crew attempted to determine the origin of the odor, no smoke or fire warning lights illuminated in the cockpit, no visible evidence of smoke or fire existed, the CVR recorded no comments by the flight crew about burning eyes or headaches, and no evidence of abnormalities other than odor existed.

Because of a lack of guidance, the crew began to execute the Fumes Evacuation checklist, increasing both air conditioning packs to maximum flow, which would have increased the airflow through the cabin. This would have evacuated the smoke more quickly, diluting the air and inhibiting the flight crew's ability to identify the source of the odor and the smoke detectors' ability to detect the smoke. Further, additional oxygen would have been provided to the smoldering fire. Although these would be appropriate steps to take in a situation involving fumes that might, for example, cause irritation or otherwise prevent the flight crew's ability to operate the airplane, they are not appropriate in a situation in which a fire is suspected. Therefore, the Safety Board concludes that the increased airflow that resulted from the Fumes Evacuation checklist actions diluted the smoke and inhibited its detection by either the smoke detection system or flight crewmembers and provided the fire with additional oxygen.

Although the FAA provides guidance to crewmembers on issues related to in-flight fires in Advisory Circular (AC) 120-80, the AC does not provide guidance to flight crews on how to respond to evidence of smoke, fire, and fumes in the absence of a cockpit alert. In 2004, an international initiative was undertaken to improve guidance and checklist procedures in this area. The initiative developed a smoke, fire, and fumes checklist template to standardize and optimize responses to such events. Recognizing that time is critical in responding to any event, the proposed smoke, fire, and fumes checklist guidelines emphasize that flight crews should balance efforts to diagnose and resolve any fire hazard with efforts to evaluate the possibility of

diverting; that a crew should have a simple, rapid, integrated checklist for responding to such a situation; and that the operator's Smoke or Fumes Evacuation checklist should be performed only after the fire has been extinguished or at such time as smoke or fumes become the greatest threat. The guidelines further state that smoke removal may change the airflow and worsen the situation by fanning or masking an ignition source.

Boeing is currently updating the flight and operations manuals for most of its product line to provide revised smoke, fire, and fumes checklists based on the template of the industry initiative. However, Boeing does not currently plan to revise the manuals of older airplanes like the DC-8, which will require individual operators of this airplane to work with the manufacturer and the FAA to develop such revisions for their own operations. Therefore, the need for FAA guidance remains especially important for older airplanes, including the accident airplane model.

If UPS procedures had contained guidance similar to that in the 2004 smoke, fire, and fumes industry checklist, the flight crew would have had a simplified, appropriate procedure to address the problem. Therefore, the Safety Board concludes that the aviation industry initiative on smoke, fire, and fumes provides specific guidance on when and how flight crews should respond to evidence of a fire in the absence of a cockpit smoke and/or fire warning. The Safety Board believes that the FAA should provide clear guidance to operators of passenger and cargo aircraft operating under 14 CFR Parts 121, 135, and 91K on flight crew procedures for responding to evidence of a fire in the absence of a cockpit alert based on the guidance developed by the 2004 smoke, fire, and fumes industry initiative.

Smoke or Fire Detection System Certification Tests

Because the first smoke detector system activation did not occur until at least 20 minutes after the fire had initiated, the system did not perform in accordance with the performance standards established by the FAA (smoke detector system activation within 5 minutes of fire initiation). The Safety Board's investigation revealed that the smoke detection system certification tests for the DC-8 were not conducted with cargo loaded on the airplane, nor were they required to be, and, therefore, the tests did not account for the effects of a loaded cargo area on smoke detection. The investigation also revealed that current smoke and fire detection system certification tests do not adequately test for "all approved operating configurations and conditions," as required by 14 CFR 25.858. Although the accident airplane was certificated under *Civil Aviation Regulations* 4b, not Part 25, the Board is concerned that current certification methods do not ensure that smoke and fire detection systems are operating in compliance with FAA regulations for smoke detection timeliness.

AC 25-9A contains guidelines on how to conduct certification tests in compliance with FAA regulations and states that the tests should demonstrate that the system can detect a smoldering fire. However, although the AC proposes various acceptable smoke generators and materials to be used in the tests, it does not indicate whether the tests should be conducted with cargo loaded in the cargo compartment or whether cargo containers should be used. Information provided by FAA and Boeing personnel indicates that smoke and fire detection system certification tests are typically conducted with a smoke-generating device in the open area of the compartment, which is more representative of a passenger airplane configuration than a cargo configuration with containers. They indicated that the tests were conducted without cargo

containers because using an empty compartment results in greater smoke dilution, requiring the smoke detectors to be sensitive to a small amount of smoke.

With cargo containers loaded in the cargo compartment, air exiting the air conditioning vents in the ceiling is primarily directed outward and downward toward the floor. The cargo containers also create a barrier that the smoke must traverse before it enters the open space of the cargo compartment where it can be detected by the smoke detection system. Neither of the effects of cargo containers—the ventilation changes and the smoke barrier—are accounted for during the certification tests; therefore, the tests do not ensure compliance with the performance criteria contained in 14 CFR 25.858, which requires that all approved operating configurations and conditions be tested.

The Safety Board concludes that the current certification test standards and guidance for smoke and fire detection systems on board many aircraft are not adequate because they do not account for the effects of cargo and cargo containers on airflow around the detection sensors and on the containment of smoke from a fire inside a container. The Board is concerned that a fire producing a small amount of smoke within a sealed cargo container may not be promptly detected by existing smoke detection systems. Therefore, the Safety Board believes that the FAA should ensure that the performance requirements for smoke and fire detection systems account for the effects of cargo and cargo containers on airflow around the detection sensors and on the containment of smoke from a fire inside a container and should establish standardized methods of demonstrating compliance with those requirements.

Smoke Detection and Fire Suppression Systems on Cargo Airplanes

The accident airplane was not required to be equipped with a fire suppression system, and, as a result, the fire, which began as a smoldering fire in one of the cargo containers, was able to develop into a substantial fire that burned through the container and ceiling liner while the airplane was airborne. The Safety Board has had longstanding concerns about the lack of fire suppression systems in cargo compartments and has issued several safety recommendations in the last 20 years to address this issue.

For example, as a result of the investigation into the May 11, 1996, accident involving ValuJet flight 592, the Safety Board issued Safety Recommendation A-97-56, which asked the FAA to expedite final rulemaking to require smoke detection and fire suppression systems for all class D cargo compartments.[4] On February 12, 1998, the FAA issued a final rule that required the installation of fire suppression equipment in cargo compartments on board passenger aircraft; however, the requirement for a fire suppression system did not apply to cargo airplanes.

In addition, as a result of its investigation of the September 5, 1996, fire involving Federal Express Corporation (FedEx) flight 1406, the Safety Board issued Safety Recommendation A-98-78, which asked the FAA to require on-board fire extinguishing systems

[4] National Transportation Safety Board, *In-Flight Fire and Impact with Terrain, ValuJet Airlines, Inc., Flight 592, DC9-32, N904VJ, Everglades Near Miami, Florida, May 11, 1996*, Aircraft Accident Report NTSB/AAR-97/06 (Washington, DC: NTSB, 1997).

if they were deemed feasible.[5] In response, the FAA indicated that current procedures regarding ventilation and depressurization were sufficient means to control a fire until the flight could land and that an on-board suppression system would add "considerable" weight to the airplane and reduce the amount of cargo that could be carried on board.

At the UPS flight 1307 public hearing, the FAA indicated that it was considering a notice of proposed rulemaking (NPRM) for the development of a new compartment classification, class F, which would require fire detection and suppression systems in which any means of chemical extinguishment and crew access could be used. Class E compartments would continue to be used in all cargo operations. The FAA acknowledged at the hearing that recent technologies have made fire suppression systems on board cargo airplanes more feasible to operators and that it expects to receive input on new ideas and technologies for fire suppression systems on cargo airplanes as a result of the NPRM. FedEx stated at the public hearing that it has already developed an on-board cargo compartment fire extinguishing system, which testing showed completely extinguished a fire before it breached the container.

The Safety Board commends the actions taken by FedEx to voluntarily develop a fire suppression system for its airplanes. The Safety Board concludes that the threat from cargo fires could be mitigated by the installation of fire suppression systems. Therefore, the Safety Board believes that the FAA should require that fire suppression systems be installed in the cargo compartments of all cargo airplanes operating under 14 CFR Part 121.

Emergency Response Issues

Although the flight crew safely evacuated the airplane and the emergency response was timely, several emergency response-related safety issues were identified during the investigation, including ARFF equipment training, cargo aircraft familiarization training, and cargo airplane emergency exit requirements.

High-Reach Extendable Turret With Skin-Penetrating Nozzle Training for Aircraft Rescue and Firefighting

PHL ARFF personnel used a high-reach extendable turret with skin-penetrating nozzle (HRET/SPN) during the UPS emergency response in an attempt to pierce the fuselage and fight the interior fire. The ARFF personnel who used the HRET/SPN during the emergency response stated, during postaccident interviews, that they experienced problems penetrating the fuselage with the device and had to reposition the tip of the nozzle a few times before successfully piercing the airplane's fuselage. The emergency response to this accident has not been the only response during which ARFF personnel experienced problems using an HRET/SPN. For example, during the response to the February 2005 runway overrun at Teterboro Airport (TEB), Teterboro, New Jersey,[6] the HRET/SPN operators experienced problems similar to those

[5] National Transportation Safety Board, *In-Flight Fire/Emergency Landing, Newburgh, New York, Federal Express Flight 1406, Douglas DC-10-10, N68055, September 5, 1996,* Aircraft Accident Report NTSB/AAR-98/03 (Washington, DC: NTSB, 1998).

[6] National Transportation Safety Board, *Runway Overrun and Collision, Platinum Jet Management, LLC, Bombardier Challenger CL-600-1A11, N370V, Teterboro, New Jersey, February 2, 2005*, Aircraft Accident Report NTSB/AAR-06/04 (Washington, DC: NTSB, 2006).

experienced by the UPS responders. Specifically, the piercing tip folded back and had to be reset during piercing attempts.

In 2005, the FAA conducted research that determined that the HRET/SPN outperformed the standard roof-mounted turret and handline, including the ability to better control and contain the spread of interior fires and reduce high cabin temperatures. FAA and International Fire Service Training Association training materials state that the successful use of the device depended on the skill level of the operator and required continual training in operations, tactics, and strategies. Although ACs 150/5210-17A and 150/5220-10C state that ARFF personnel should be trained to identify the proper procedures for the use of each hose, nozzle, and adapter used locally and should be provided guidance on equipment training, neither of the ACs specifically address training on the use of the HRET/SPN.

Since PHL ARFF obtained its HRET/SPN in 1991, it has used two different devices to train its ARFF personnel on how to penetrate a fuselage: a small general aviation airplane, which PHL no longer uses, and a Specialized Aircraft Fire Training mockup. The HRET/SPN-equipped vehicle at TEB was operated by two police officers who had been cross-trained in ARFF. Both officers stated that they had training on an HRET/SPN-equipped vehicle. One of the officers stated that he thought that the training had helped him during the accident response but that he also believed that "you have to practice every day."

Despite having received some training on the HRET/SPN, ARFF personnel at both PHL and TEB encountered problems using the device. Further, because of aviation's excellent safety record, most ARFF personnel may not have any actual experience fighting an interior fire. The Safety Board notes that the PHL and TEB ARFF personnel who used the HRET/SPN during the emergency responses had never used the device during an actual emergency response up to that time.

The Safety Board concludes that some ARFF personnel are not adequately trained on the use of the HRET/SPN, reducing the effectiveness of the device in fighting interior aircraft fires. Therefore, the Safety Board believes that the FAA should provide guidance to ARFF personnel on the best training methods to obtain and maintain proficiency with the HRET/SPN.

Aircraft Rescue and Firefighting Cargo Familiarization Training

Although PHL's airport emergency plan (AEP) required ARFF personnel to respond to all accidents at the airport, PHL ARFF did not typically conduct aircraft familiarization training on cargo aircraft before the accident, and ARFF personnel were not familiar with the accident airplane. During the emergency response, PHL ARFF personnel had problems opening the main cargo door, most likely because they did not understand its manual operation. Specifically, one of the responders broke the exterior cargo door handle when he tried to force it open and rendered it inoperable. As a result, PHL ARFF personnel were unable to off-load cargo containers, which affected their ability to locate, access, and suppress the fire. Similar problems were noted in the Safety Board's report on the September 5, 1996, Newburgh, New York, accident, which

indicated that ARFF personnel were also not familiar with the operation of the main cargo door and initially were unable to open it.[7]

In accordance with 14 CFR 139.139(i), ARFF personnel are required to receive initial and recurrent training in 12 subject areas. AC 150/5210-17A, "Programs for Training of Aircraft Rescue and Firefighting Personnel," provides guidance on how to meet the regulations and specifies what should be included in the training program for aircraft familiarization. The AC recommends that ARFF personnel be trained to "identify the types of aircraft operating at the airport . . . [and] locate normal entry doors [and] emergency exit openings." Although neither the regulations nor the AC excludes cargo airplanes from aircraft familiarization training for ARFF personnel, evidence from the UPS and Newburgh accident investigations indicates that some airports do not provide such training and that such training is needed to facilitate emergency response efforts.

The Safety Board concludes that PHL ARFF personnel were not familiar with the accident airplane's main cargo door, which adversely affected their ability to access the airplane's interior to fight the fire. Even though PHL has substantial cargo operations and an AEP that requires the airport to respond to all on-site accidents, PHL ARFF personnel indicated that they did not schedule familiarization training on cargo aircraft. Although the Board is encouraged that PHL ARFF has initiated cargo familiarization training since the accident, it is concerned that cargo aircraft familiarization training may not be emphasized at other airports. Therefore, the Safety Board believes that the FAA should require airport inspectors to ensure that Part 139 airports with cargo operations include cargo aircraft in their ARFF aircraft familiarization training programs.

Cargo Airplane Emergency Exit Requirements

The accident airplane's two side cockpit windows had been designated as the airplane's emergency exits. The left forward (L1) door, which was used as the primary means of entry and exit for the airplane, was also identified as an emergency exit in the UPS DC-8 AOM and on the airplane's emergency briefing card.

Although cargo aircraft do not carry passengers, Federal regulations allow cargo operators to carry additional personnel.[8] The accident airplane was configured to carry up to 7 occupants, and the Safety Board has learned that some cargo operators' wide-body airplanes can be configured to carry up to 27 occupants.[9] While the two cockpit windows provide a means for the flight crew to evacuate the airplane, a floor level emergency exit with an evacuation slide

[7] National Transportation Safety Board, *In-Flight Fire/Emergency Landing, Newburgh, New York, Federal Express Flight 1406, Douglas DC-10-10, N68055, September 5, 1996,* Aircraft Accident Report NTSB/AAR-98/03 (Washington, DC: NTSB, 1998).

[8] Title 14 CFR 121.583 allows cargo operators to carry additional personnel, including, but not limited to, additional crewmembers, company or government personnel, and other individuals necessary for the safety of flight or monitoring the cargo.

[9] An FAA CertAlert dated January 21, 2004, regarding an accident involving an MD-10 cargo airplane noted that ARFF personnel responding to the scene were surprised to see seven people exit the airplane. The alert stated that as many as 27 personnel could be on board the operator's MD-10 airplanes at any time.

would provide a more efficient and expedient way for all occupants to exit a cargo airplane in the event of an emergency.

In addition, ARFF personnel may also need to enter an airplane to rescue occupants, fight a fire, or search for the notice to captain. A floor level exit provides ARFF personnel with the most efficient means to enter an airplane wearing protective gear or breathing apparatus that could prevent their entry through a cockpit window. Further, as seen in the UPS and the Newburgh, New York, cargo accidents, ARFF personnel may need to access the area inside the L1 door to manually operate the main cargo door. If the L1 door were a designated emergency exit, it would be required to have instructional placards. Although ARFF personnel did not open the L1 door during this emergency response, instructional placards would benefit ARFF personnel as well as other first responders (such as mutual aid, ramp personnel, and airport operations).

The FAA acknowledged that, although a forward floor level emergency exit is not required on cargo airplanes, operators often designate the L1 door as an alternate emergency exit. Further, as evidenced by the UPS and FedEx accidents, even if the cockpit window exits are accessible, the floor level exit is often the preferred emergency exit for use by occupants to egress the airplane under emergency conditions. The Safety Board is concerned that the L1 door is not required to be designated as an “emergency exit” despite evidence that floor level exits are often used by cargo airplane occupants in the event of an emergency and provide a faster and more efficient means for the flight crew and other occupants to exit the airplane.

At the time of the DC-8’s certification, Federal regulations required emergency exits and their means of opening to be marked on the outside of the airplane to assist ARFF personnel. Although the cockpit windows had exterior placards providing instructions on their operation, they were not visually identifiable as emergency exits because they had no contrasting colored band around them nor were they required to be by Federal regulations. Further, the L1 door did not have either exterior instructional placards or a visual indication that it was an emergency exit. The Safety Board is concerned that cargo airplane emergency exits are not required to have visual markings indicating them as emergency exits even though such markings are required on passenger airplanes and would provide ARFF with a rapid method of identifying such exits.

Therefore, the Safety Board concludes that a floor level emergency exit, including one equipped (when appropriate) with an evacuation slide, would enable more efficient emergency egress for airplane occupants than cockpit window exits and that the associated, instructional placarding of such an exit would assist emergency responders with locating and operating the exit door and accessing the interior of the airplane. Therefore, the Safety Board recommends that the FAA require cargo operators to designate at least one floor level door as a required emergency exit and equip the door with an evacuation slide, when appropriate. Further, the Safety Board recommends that the FAA require all emergency exits on cargo aircraft that are operable from the outside to have a 2-inch contrasting colored band outlining the exit.

Therefore, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

Provide clear guidance to operators of passenger and cargo aircraft operating under 14 *Code of Federal Regulations* Parts 121, 135, and 91K on flight crew procedures for responding to evidence of a fire in the absence of a cockpit alert based on the guidance developed by the 2004 smoke, fire, and fumes industry initiative. (A-07-97)

Ensure that the performance requirements for smoke and fire detection systems account for the effects of cargo and cargo containers on airflow around the detection sensors and on the containment of smoke from a fire inside a container and should establish standardized methods of demonstrating compliance with those requirements. (A-07-98)

Require that fire suppression systems be installed in the cargo compartments of all cargo airplanes operating under 14 *Code of Federal Regulations* Part 121. (A-07-99)

Provide guidance to aircraft rescue and firefighting personnel on the best training methods to obtain and maintain proficiency with the high-reach extendable turret with skin-penetrating nozzle. (A-07-100)

Require airport inspectors to ensure that Part 139 airports with cargo operations include cargo aircraft in their aircraft rescue and firefighting aircraft familiarization training programs. (A-07-101)

Require cargo operators to designate at least one floor level door as a required emergency exit and equip the door with an evacuation slide, when appropriate. (A-07-102)

Require all emergency exits on cargo aircraft that are operable from the outside to have a 2-inch contrasting colored band outlining the exit. (A-07-103)

The Safety Board also issued recommendations to the Cargo Airline Association and the Pipeline and Hazardous Materials Safety Administration.

In your response to the recommendations in this letter, please refer to Safety Recommendations A-07-97 through -103. If you need additional information, you may call (202) 314-6649.

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred with these recommendations.

[*Original Signed*]

By: Mark V. Rosenker
Chairman

Safety Recommendation Reiteration List

SR Number	Reiteration Number	Report Number	Report Date	Accident Description	Accident City	Accident State	Accident Date
A-07-100	1	AAR-09-04	6/30/2009	Ground Fire Aboard Cargo Airplane, ABX Air Flight 1611, Boeing 767-200, N799AX	San Francisco	CA	6/28/2008