Burning Issues

U.S. pilot unions, ARFF specialists and the NTSB assess shortcomings of freighter fire fighting.

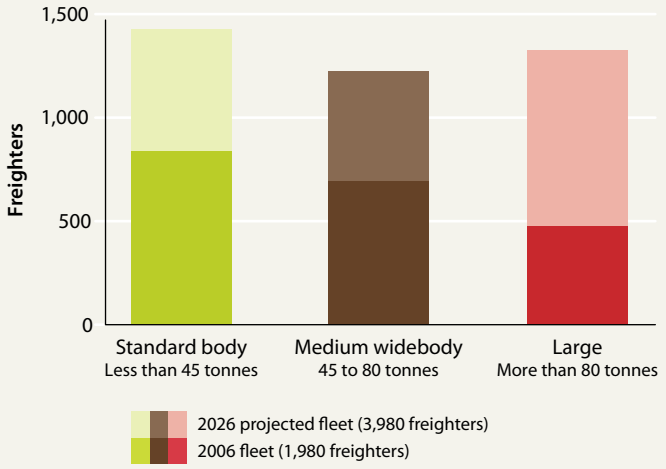
BY WAYNE ROSENKRANS

Frustrating fires in which cargo airline pilots narrowly escape from a freighter burning on an airport runway — and intense flames ultimately can rob accident investigators of causal evidence — have rekindled calls for wide-ranging reforms in the United States. With freighter traffic growth projections by Boeing Commercial Airplanes averaging 6.2 percent annually from 2006 to 2026 (Figure 1), the Federal Aviation Administration (FAA) and National Transportation Safety Board (NTSB) have joined freighter manufacturers, U.S. cargo airlines, aircraft rescue and fire fighting (ARFF) officials and pilot organizations in revisiting core assumptions about how to protect people, airplanes and cargo when freighter fires occur.

Debates about the reforms have not included much data on the incidence of these fires or formal risk analyses. But the sense of stakeholders expressing opinions at recent meetings is that the effectiveness of ARFF firefighters in these scenarios does make a difference in whether occupants are rescued, the aircraft and cargo are saved or adverse economic consequences from temporary closure of an airport are minimized.

Several vocal advocates of change — the Air Line Pilots Association, International (ALPA), the ARFF Working Group, the Independent Pilots Association[1] and the NTSB — acknowledge that ongoing research and development by freighter manufacturers, individual airlines, fire departments and the FAA are advancing cargo fire safety on several fronts (*ASW*, 11/06, p. 28). They argue, however, that ARFF capability to handle freighter fires no longer should depend

Freighter Fleet Projection



1 tonne = 1,000 kg/2,205 lb

Source: Boeing Commercial Airplanes

Figure 1

on airports voluntarily exceeding regulatory requirements but should involve amendment of federal transportation law and related regulations.

The investigation of the UPS Air Cargo Flight 1307 accident at Philadelphia International Airport in February 2006 has advanced this discussion because the accident involved circumstances that recall earlier ARFF responses to freighter fires (Table 1, p. 38).[2] The NTSB's final report included among ARFF-related findings that "growth of the fire after landing was fed by air entering through open doors and burnthrough holes"; the response was adversely affected by firefighters' unfamiliarity with the main cargo door; some personnel were not trained adequately on using a Snozzle[3] turret; and freighter diagrams should be available to firefighters. NTSB recommended in part that the FAA "require airport inspectors to ensure that [U.S. Federal Aviation Regulations (FARs) Part 139, *Certification of Airports*] airports with cargo operations include cargo aircraft in their [ARFF] aircraft familiarization training programs."

Describing the urgency of in-flight and ARFF solutions for freighter fires, Ron Wickens of FedEx Express told a July 2006 NTSB public hearing on the Flight 1307 accident, "Our tests show that if the fire is not contained in the [cargo] container and it migrates, the airplane has about 40 minutes and it is lost. There is nothing you can do [with currently required systems]; it is out of control. It is going to go down. We are going to continue to follow existing procedures for depressurization, but we want to supplement what we have today with a fire-suppression system."

Constructive Criticism

The ARFF community and other professions have criticized the ARFF response to the fire aboard Flight 1307, finding reason to believe that best practices in freighter fire tactics still may not be adopted widely. If correct, this is important primarily for its life safety implications.

Capt. Gary Loesch, who was the initial ARFF incident commander for the Philadelphia Fire Department, explained during the July 2006 NTSB hearing the tactics used and the problems encountered. Contrary to tactics that some freighter fire specialists recommend, several doors were opened to apply water, significant time and effort were expended trying to gain interior access via the main cargo door, and operations to pierce the fuselage skin and inject foam extinguishing agent did not begin until fire breached the top of the fuselage.

"The tactics that we used [initially were] stretching 1 3/4-in [4.4 cm] hand lines in an attempt to make [entry] into the interior of the aircraft," Loesch said. "Those particular tactics are basic tactics that we use even on, say, a dwelling or a building fire. … Once we were finally able to make entry into the aircraft, we had hand lines up on the left hand side and the right hand side and also up at the L1 door. … [ARFF vehicle] roof turrets and bumper turrets were used at the rear after [firefighters] entered the rear door on the right hand side. We used it for streams to try to knock down the fire."

Efforts to open the main cargo door also began as soon as ARFF firefighters arrived. "I [ordered] firefighters to go to the main cargo door to attempt to open it as I [ordered] them to open all the lower compartment doors to make access as much as possible to the aircraft,"

Freighter Accidents Reveal ARFF Issues

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Sept. 5, 1996	Newburgh, New York, U.S.	Douglas DC-10-10CF	Destroyed by fire after landing	2 minor, 3 none
The diversion and emergency landing of Federal Express Flight 1406 at Stewart International Airport was prompted by smoke in the cabin cargo compartment. Aircraft rescue and fire fighting responders first attempted to fight the fire from the courier area with handheld hose lines. The incident commander hesitated to use a skin penetrator agent application tool, and unsuccessfully tried to contact the aircraft manufacturer about non-damaging fuselage-access methods. Other firefighters broke the main cargo door control, opened the door by operating this control with pliers and attempted to fight the fire through this opening with handheld hose lines. About 10 minutes later, flames breached the crown of the fuselage. Firefighters then withdrew from their interior attack and aimed water from truck-mounted turrets through multiple flame-breached areas of the fuselage until the fire was extinguished.				
Dec. 18, 2003	Memphis, Tennessee, U.S.	McDonnell Douglas MD-10-10F	Postcrash fuel-fed fire destroyed right wing and side of fuselage	2 minor, 5 none
Three ARFF vehicles operated by the city and two ARFF vehicles contracted by the aircraft operator — operating without a formal agreement specifying their emergency responsibilities — responded to the hard landing and right main gear collapse of Federal Express Flight 647. The captain, first officer and five non-revenue pilots evacuated in about 152 seconds through the cockpit windows, descending via two evacuation tapes. The first city ARFF responders arrived two minutes after the crash alarm. Air traffic control — which failed to immediately clear all ARFF vehicles to the crash site and did not consider the contract ARFF responders to be official mutual aid firefighters — instructed the contract firefighters to hold short of another runway for about two minutes for landing traffic while the airplane burned. On arrival, the city ARFF responders were unaware of how many people were aboard the airplane — which could have jeopardized any rescue if required — although ATC had received this count from the captain. The firefighters were surprised to see seven people exit from the freighter.				

Source: U.S. National Transportation Safety Board

Table 1

Loesch said. "I also used that procedure because I needed to see where the fire actually was and if it was extending in any direction." Difficulty opening the cargo door precluded moving any cargo containers, as had been intended, to gain closer proximity to the seat of the fire.

Capt. John Prater, president of ALPA, during a November 2007 symposium sponsored by ALPA said, "The Philadelphia Fire Department operated a truck equipped … to locate the precise position of a fire within an aircraft fuselage.

U.S. National Transportation Safety Board

Flames breached the top of the fuselage after UPS Air Cargo Flight 1307 landed.

They found the fire. They used the Snozzle, but the Snozzle did not make it to the fire. The tip had been designed for a passenger aircraft — it was not long enough. If the Philadelphia ARFF personnel had been provided the proper training for cargo aircraft configurations and [had known] the loading practices, they could have fought that fire more successfully."

Sgt. Eric Johansen, a firefighter and instructor in the Fire Rescue Division of Dallas/Fort Worth International Airport Fire Services, concurred. "They were pumping thousands and thousands of gallons of water into a DC-8 … if they had … started removing [cargo containers], what would have happened to that aircraft?" Johansen said.

Capt. Michael Moody, a UPS Air Cargo pilot and chairman of the Safety Committee of the Independent Pilots Association, said that he could think of no reason to open the main cargo door and remove cargo containers during the knockdown phase. "If they start taking things out of the aircraft, they will put the airplane on its tail and kill a firefighter; it is easy to tip the aircraft," he said.

Another ARFF specialist summarized the current best practice as quickly cutting a vertical ventilation hole into the burning freighter

Bradley International Airport Fire Department

Firefighters in Windsor Locks, Connecticut, U.S., in May 1991 extinguish a fuel-fed fire burning a Boeing 727-100QC freighter after shrapnel from an uncontained engine failure severed a fuel line during takeoff.

without hesitation. Les Omans, a retired captain and ARFF specialist for the San Jose (California, U.S.) Fire Department, consultant and author of the State of California ARFF training curriculum and the FAA's compact disc for ARFF computer-based training, said, "Every structural firefighter knows that if you stop the fire's vertical ventilation by discharging agent into that hole, you are going to drive the fire horizontally throughout the aircraft, and you are going to help to burn it up. You are just wasting time by [waiting to open a main cargo door, giving] a fire time to build its intensity and spread. … It is no problem, if you have the right-size [handheld rescue] saw and the right-size saw blade, to cut a hole and quickly make your own door opening wherever you want it."

One Level of Safety

The FAA in recent years updated regulations and guidance that directly or indirectly affect freighter operators — such as safer loading practices in 2005 in Advisory Circular 120-85, *Air Cargo Operations,* and revised ARFF requirements for passenger aircraft in the 2006 update of Part 139. These regulations apply only to airports used for specified passenger air carrier operations, but in their FAA-approved airport emergency plans, many Part 139 airports state explicitly or implicitly that ARFF firefighters will respond to incidents involving freighters.

In responding to the NTSB and to public comments about Part 139's omission of any reference to freighter operations, the FAA said that current federal transportation law does not give the FAA authority to regulate ARFF response to freighter fires.[4] Some cargo airlines therefore operate only into Part 139 airports while others do not restrict operations to these airports, said Capt. Shannon Jipsen, a UPS Air Cargo pilot and chairwoman of the Accident Investigation Committee of the Independent Pilots Association. "My hope is that [freighters] will be included in the next cycle of any kind of a rewrite of Part 139," Jipsen said.

Under current airport certification rules, there is no federal funding for ARFF training specifically on freighters, said Chief Brian McKinney of the Dallas/Fort Worth International Airport Fire Services. "That is something [of] concern for us," McKinney said. "Unlike the passenger airline industry with simulators for doors, slides, etc., there is none of that in the cargo industry. … My vision is to construct a new large aircraft simulator with cargo compartments included, possibly a combi configuration with a passenger compartment and a freight deck."

Advocates of improved freighter fire fighting capability see the legal hurdles as only one facet of moving toward what they call "one level of safety" for passenger operations and cargo operations. One related issue, for example, is the adequacy of Class E requirements — which essentially include fire-detection equipment but not fire-suppression equipment — as the minimum for freighters.[5]

Freighter fires have not been identified as a national priority by the Commercial Aviation Safety Team (CAST), although the team includes air cargo operators. Without data to show the relative probability and severity of freighter fires in relation to other commercial aviation safety risks, dispassionate discussions about allocation of resources are difficult compared with many other aviation safety issues. Ongoing introduction of safety management systems within the FAA, airports and cargo airlines provides processes to recognize possible ways to mitigate the threats currently perceived, some advocates said. Capt. Dave Wells, FedEx Central air safety chairman, ALPA, said that his statistics on air cargo accidents from 1990 to 2006 show that 20 percent involved fires. "FedEx has had six hull

Wayne Rosenkrans

Speakers from top, Omans and Jipsen

losses, and five were fires," Wells said.

ARFF stations at U.S. airports generally function within a system of municipal fire stations and a hierarchy of fire command that is separate from airport operations. Typical ARFF firefighters in cities first gain qualifications and experience as structural firefighters, supplemented by aviation/airport training on specialized theory and apparatus. Yet ongoing simulator training at best covers passenger jet fires, symposium presenters said.

The purpose of the relatively small contingent of ARFF firefighters at any airport is to save lives, they said, and their incident-response tactics presume that off-airport structural firefighters — most likely with minimal or no specialized training on aircraft — will handle most of the extinguishment.

Fire Fighting Traps

Various myths about fighting freighter fires and avoiding injury in the process prevail among some structural firefighters — even some ARFF firefighters. To rescue the flight crew and courier-space occupants, assuming they are the only occupants, the ideal situation is for firefighters to enter through the main cabin door. If they enter to fight the fire, however, firefighters may not be able to maneuver themselves along the length of compartments packed tightly with containers that weigh tons. They easily might trip or become entangled in cargo netting across the floor. Moreover, firefighters wearing self-contained breathing apparatus may not fit through openings other than the main cabin door or cargo doors except in the largest freighters.

From the outside, the fuselage skin may be 4.5 ft (1.4 m) from the cargo containers, which means that to apply an extinguishing agent into a burning container — not just the surrounding space — firefighters must work from above the window line and use a sufficiently long Snozzle extension to pierce specific containers by reference to a thermal imaging camera that reveals the fire's invisible heat signature.

In recent years, the Independent Pilots Association helped an ARFF station obtain unserviceable freighter windshields and test techniques for flight deck access and occupant extraction if flight crewmembers are incapacitated or trapped. "How does ARFF get into a [freighter] fuselage that has been structurally compromised, or you have a twisting of the fuselage so that you cannot get the doors or windows open?" Jipsen said. "[As pilots] we're stuck. ARFF rescuers can try to cut in, but where are they going to cut?" This research produced a video showing use of a fire rescue saw — a handheld tool with 12–16 in (30–41 cm) diameter carbide-tip or diamond-tip chopper blade powered by a small gasoline engine and cooled by water from a fire hose — to cut through a typical freighter windshield. The video has been distributed within the ARFF community. Rescue problems require further research, she said.

Near-Term Enhancements

Symposium participants agreed that the introduction of discrete emergency frequency procedures has been disappointing since FAA Advisory Circular (AC) 150/5210-7C, *Aircraft Rescue and Firefighting Communications,* was issued in 1999 (*Airport Operations,* 11–12/00). Fire Chief Robert Donohue of Boston Logan International Airport urged ARFF organizations, pilots and air traffic controllers to take the initiative on optimizing communications using the existing FAA guidance. "If there is no discrete emergency frequency at your airport, go after it — you make the call to them," Donohue said. "Air traffic controllers will tell the flight crew that Logan emergency services are on the frequency, and [we have] another fire captain on a separate maintenance frequency. With

a discrete emergency frequency [program], ARFF provides visual observation and feeds the pilot real-time information."

Dallas/Fort Worth firefighters know that most freighters do not have evacuation slides, Johansen added, so the ARFF incident commander is likely to stand by the runway with an airstair for the L1 door, possibly eliminating the need for as many as 27 occupants to descend via rope, cockpit tape or inertia reel with the risk of serious injury from a fall and/or hand injuries. The ARFF incident commander, using a thermal imaging camera, also can see the heat signature of a fire, advise the flight crew about aircraft brake temperatures and/or cool the brakes with fans on request.

To enable freighters to land with improved in-flight control of fires, air cargo operators already may choose a higher class of cargo compartment — such as the optional Class C configuration of the Boeing 747-400 freighter — or obtain supplemental type certificates to retrofit equipment in Class E cargo compartments. The FAA also has been working with the industry on a new Class F compartment for both passenger and cargo aircraft, specifying detection and fire-suppression standards that could be met, as technology advances, by various chemical agents, special container designs or depressurization procedures.

At the July 2006 NTSB hearing, Wickens described two proprietary FedEx systems that NTSB said are scheduled to be operational under supplemental type certificates in August 2008, reflecting about five years of research and development. The active fire suppression system comprises a system control unit; one overhead reservoir containing compressed inert gas and a proprietary noncorrosive high-density foam extinguishing agent; an overhead array of passive infrared sensors that continuously measure and analyze temperature and rate of temperature change for each of 28 to 30 same-size cargo containers inside the main deck cargo compartment of a widebody freighter; and tubing from the reservoir to an array of overhead penetrator devices.

When the rate of temperature rise for any single cargo container exceeds a preset value, the flight crew receives a fire warning and the respective penetrator automatically punctures that container, and mixes and injects enough foam to fill it. For a widebody freighter, this active system has a weight penalty of about 1,000 to 1,500 lb (454 to 680 kg). Because this system was not designed for typical international pallets, however, FedEx also has developed a passive fire-resistant device called a Peltz bag wrapped around pallets to keep fire in a smoldering condition for at least three or four hours — enough time on the longest company routes across the Pacific Ocean for diversion to an alternate airport and safe landing.

"If [we] can hold the fire and deny it oxygen and combustible gas, we think we can get the airplane to an alternate … and let the fire department do their job," Wickens said. ●

For an enhanced version of this story, go to <www.flightsafety.org/asw/jan08/cargofire.html>.

Notes

1. The Independent Pilots Association is a union representing about 3,000 pilots employed by UPS Air Cargo.
2. On Feb. 7, 2006, about 2359 local time, the McDonnell Douglas DC-8-71F freighter landed in visual meteorological conditions at Philadelphia International Airport, the destination airport, after a cargo smoke indication on the flight deck. The captain, first officer and flight engineer evacuated and received minor injuries; the airplane and most of the cargo then were destroyed by fire. The NTSB said that the probable cause was "an in-flight cargo fire that initiated from an unknown source, which was most likely located within cargo container 12, 13 or 14" and contributing factors were "inadequate certification test requirements for smoke and fire detection systems and the lack of an on-board fire suppression system."
3. A Snozzle is a high-reach extendable turret with a fuselage skin-penetrating nozzle.
4. U.S. Code. Title 49, *Transportation.* Subtitle VII, *Aviation Programs.* Part A, *Air Commerce and Safety.* Subpart iii, *Safety.* Chapter 447, *Safety Regulation.* Section 44706, "Airport Operating Certificates." What prohibits freighters from inclusion in FARs Part 139 are provisions of this law making it applicable only to airports serving "an air carrier operating aircraft designed for at least 31 passenger seats." The FAA also may use ARFF-related exemptions in the law based on passenger boardings or on its determination that the requirements for fire fighting and rescue equipment are unreasonably costly, burdensome or impractical. An October 2005 bill — HR 4123 — unsuccessfully proposed to amend this law to include ARFF requirements if an air carrier operates aircraft that provide all-cargo air transportation and have a maximum certificated gross takeoff weight of 100,000 lb (45,360 kg) or greater.
5. During the Dec. 4, 2007, public hearing on UPS Air Cargo Flight 1307, NTSB Vice Chairman Robert Sumwalt cited the FAA's 1998 explanation of Class E compartments in a letter, which said in part, "In lieu of providing extinguishment in Class E compartments, the FAA requires that a means be provided to shut off the flow of ventilating air to or within the compartment. Additionally, procedures like depressurizing the airplane are stipulated to minimize the amount of oxygen available in the event a fire occurs in a Class E compartment. … This does not preclude the installation of Classes A, B or C compartments in all-cargo airplanes. … The principal reason for using the Class E concept is that the added weight for extinguishing systems and fluid is eliminated, allowing more cargo to be accommodated. Requirement of built-in suppression systems would add considerable weight to the airplane."