CARRIAGE OF HAZARDOUS MATERIALS – FLIGHTCREW PERSPECTIVES

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1. Introduction

The movement of goods and materials, some hazardous, is essential to the prosperity of the world. A significant amount of hazardous goods move by air, with a large portion of the air shipments being carried aboard dedicated all cargo aircraft. The complex national and international regulations governing these shipments, from the time they are packaged for transport through acceptance, loading, transport, storage and delivery has resulted in a safe and successful system. Still, there exist areas of weakness and opportunities for improvement in the all cargo system, which the Air Line Pilots Association, International (ALPA) will address in this paper.

2. Background

Major hazardous materials air transport accidents or serious incidents over the past 35 years, which have occurred on board an aircraft, have involved shipments that were not properly packaged, marked, accepted, loaded or handled. In November of 1973, Pan American Flight 160, a Boeing 707 all cargo flight originating at JFK airport in New York City, attempted to divert to Boston due to a serious fire on the main deck. The fire likely originated because of a spontaneous chemical reaction between leaking nitric acid, improperly packaged and stowed, and the improper sawdust packing surrounding the acid. The main deck of a cargo-only aircraft is a Class E[1] compartment, with the only means of fire suppression being an increase in cabin altitude and elimination of ventilation to starve a fire of oxygen. No active suppression is required, and none was available on the accident aircraft. The aircraft crashed short of the airport in Boston, killing all three crewmembers. This accident highlighted the deficiencies in the regulatory and enforcement system then in place to transport dangerous goods on both passenger and cargo aircraft. To protect the safety of the traveling public until the system could be improved, the ALPA Hazardous Materials Committee developed the S.T.O.P. (Safe Transportation of People) program, where ALPA members refused to carry hazardous materials, except for company materials (COMAT) and certain medical supplies necessary for saving human life. As the hazardous materials regulations, enforcement, and oversight were improved, this program was gradually relaxed and ultimately suspended.

[1] According to FAR 25.858, a Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which: There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station; 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; There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and The required crew emergency exits are accessible under any cargo loading condition.

In February 1988, a fire occurred in the aft cargo hold of American Airlines flight 132 on approach to Nashville, Tennessee. The MD-80 was not equipped with a cargo fire detection or suppression system, and the fire went undetected until smoke began to enter the passenger cabin of the aircraft. After landing, the aircraft was successfully evacuated with no fatalities. Airport Rescue and Fire Fighting personnel eventually extinguished a fully involved fire in the aft cargo hold. The cause of the fire was determined to be an undeclared shipment of hydrogen peroxide and sodium orthosilicate, a shipment forbidden for transport on aircraft. As a result of this accident, the NTSB issued to the FAA Recommendation A-88-122 to "Require fire/smoke detection systems for all class D cargo compartments".

In May 1996, ValuJet flight 592 crashed shortly after takeoff from Miami International Airport, killing all 110 passengers and crew. The FAA had not acted on the NTSB recommendation following the American Airlines 132 accident, and the fire that had developed in the forward cargo compartment of the ValuJet DC-9 again went undetected by the crew until smoke began to enter the cabin. With no means to extinguish the fire, the crew was unsuccessful in bringing the aircraft back to Miami. The fire in the forward cargo hold was caused by an undeclared shipment of oxygen generators, devices normally installed in the cabin and used to chemically produce oxygen for passengers in the event of a loss of cabin pressure. Improperly packaged and illegally shipped, the generators produced temperatures in excess of 500 degrees Fahrenheit when inadvertently activated, as well as a ready supply of oxygen. As a result of this accident, FAA now mandates that all cargo compartments on passenger aircraft be equipped with fire detection and suppression capability.

In September 1996, a Federal Express DC-10 was enroute from Memphis, Tennessee to Boston, Massachusetts. While in cruise, the crew was alerted to a fire on the main deck of the all-cargo aircraft by a Cabin Smoke warning. With no means to actively suppress a fire, the crew raised the cabin altitude of the aircraft and began an emergency diversion to Stewart Airport in Newburgh, New York. The crew was able to successfully evacuate the aircraft, which was ultimately destroyed by fire. While the probable cause of the accident was an in-flight cargo fire of undetermined origin, the NTSB findings did make reference to laboratory equipment that still contained chemicals. This equipment should have been purged, as required by regulation.

3. Discussion

It is one of ALPA's main areas of focus to prevent the introduction of undeclared hazardous materials into the air transport system. For all cargo operations, this largely involves improving shipper and airline personnel awareness of the hazardous material regulations and requirements. As the ease of shipping has improved over the years (it is now possible to place a package in the international air transportation system at thousands of locations), the challenge to adequately educate the shippers (i.e. the public) of these items has increased. Successes have included better information or signage being posted at freight acceptance points, new signage in Post Offices, kiosks displaying prohibited or regulated items being placed in cargo and operator's "stores" facilities, distribution of brochures, and public outreach programs involving magazine articles and press reports. The overall awareness of these actions remains low, however, efforts need to continue to improve the education process. Signage depicting prohibited articles and educating consumers outlining the steps necessary to properly ship declared materials needs to improve, kiosks need to be much more prevalent, and public awareness efforts need to increased and expanded. We are also concerned that employees at many of the third party freight acceptance points (e.g. retail operations that specialize in packaging and providing neighborhood drop-off

points for shipping goods) may not have received the proper training and that the facilities themselves do not have the required signage.

Significant deficiencies also exist in the regulations defining how and when hazardous materials incidents and discrepancies are reported. Unlike flight and maintenance programs, there is currently no immunity program for the reporting of these hazardous materials problems, and the FAA often fines a carrier who reports a discrepancy. This can only serve to discourage reporting, resulting in a lower awareness of the true nature of problems and a less robust safety system. ALPA urges the NTSB to draft a recommendation that the DOT establish a method for carriers to report incidents voluntarily with immunity, while retaining the ability of the FAA to independently investigate carriers and violations, issuing fines where appropriate. Where the carrier is voluntarily self disclosing, there should be no government mandated punitive action.

Within the existing hazardous materials regulations, training represents one of the areas of greatest deficiency and opportunity for improvement. ALPA supports an overhaul of the flight crew training regulations, including mandating specific areas of required training and introducing subject matter modules. The regulations need to be flexible enough to allow training specifically tailored for the functions of the flight crewmember at each individual airline, while maintaining a minimum standard for all crewmembers that transport hazardous materials. Currently within the industry there exists a wide range of flight crew training for hazardous materials, from detailed classroom and practical instruction to a 10 minute video tape and 5 questions, which crews "self certify" they have completed every 18 months. At airlines with only this minimal amount of training, flight crew preparedness may be critically deficient and a flight crew may not be able to correctly handle an emergency situation involving hazardous materials.

The Dangerous Goods Regulations in the United States require that no more than 25 kg of dangerous goods is placed in an inaccessible cargo compartment, with certain exceptions. These exceptions allow greater quantities of Class 2.2 Non-flammable gas, Class 7 Radioactive material, Class 9 Miscellaneous material, and COMAT, e.g. aircraft batteries and spare tires. Much larger quantities of dangerous goods are allowed in accessible cargo compartments, but no requirement exists to define accessibility. It is ALPA's position that all "accessible" dangerous goods be located in cargo compartments within easy access of the flight crew (most forward pallet position on single deck aircraft) or in a cargo container equipped with integral fire detection and active fire suppression. This would reduce the need for a crewmember to attempt to fight a fully involved fire involving dangers goods while in a narrow passageway (often no more than 18 inches wide) in the cabin with nothing more than a fire wand, flashlight, and walk around oxygen bottle. In some cases, the shipment might may also be covered by plastic or placed in a difficult to reach location, making accessibility much more difficult. Additionally, a separate accessible cargo compartment or container equipped with fire suppression would protect known quantities of dangerous goods from a fire from another source. If dangerous goods were involved in a fire for any reason, the severity and intensity of that fire could be greatly increased. By removing all known large shipments of dangerous goods from the general cargo, any efforts to fight a fire in the cabin would be enhanced.

The Federal Aviation Regulations (14 CFR 25.857) require detection of a fire be made known at the pilot station (flight deck). It is ALPA's position that all suppression methods designed to control a fire also be available from that same flight deck station. This issue becomes very important for a two-person crew. If a fire is detected on the aircraft, the flight crew will immediately begin a diversion to the nearest suitable airport while attempting to fight the fire.

This is an extremely high workload operation, and an inopportune time for one of the pilots to be required to leave the flight deck to discharge a suppression agent into a cargo compartment. By leaving the flight deck, only one pilot is left responsible for flying the aircraft, communicating with ATC, and coordinating the diversion. The hazard of deliberately removing one pilot on a two-pilot aircraft during a critical emergency situation is unacceptable and avoidable by providing the means for both flight crewmembers to remain in the cockpit and fight any fire.

The device separating the main deck cargo compartment from the flight deck area is also important in determining the overall safety of a cargo-only aircraft design. In addition to preventing any cargo that has shifted on the main deck from entering the flight deck area, a barrier must also ensure that any smoke be contained within the cargo compartment. The smoke barrier should completely seal the two compartments yet still allow flight crew access to the main deck cargo compartment when necessary.

It is essential for flight crewmembers to be able to breathe and see in order to successfully carry out their duties. The equipment provided to the flight crew for smoke and fire protection is described under FAR 25.1439. This regulation allows for either: masks covering the eyes, nose and mouth; or masks covering the nose and mouth, plus accessory equipment to cover the eyes. The masks provided to meet this regulation are also adequate to meet the crew oxygen requirement of FAR §25.1447. Unfortunately, neither these regulations nor FAR Part 121.337 address the ability of a crewmember to don and use the smoke and vision protection provided by a mask and set of goggles. Additionally, the Technical Standard Order (TSO) used to certify the masks provides for a pass/ fail criterion based on being a percentage the level of contamination within the mask as compared to the ambient conditions. This criterion does not consider the vision requirements of the mask, or the level of contaminants relative to human tolerance. It is quite possible that the level of contaminants inside the mask would become unacceptable, yet the mask would still meet certification criteria due to the high level of contaminants present in the ambient air. Standards do exist that would help ensure the safety of flight crewmembers in a smoke or fire emergency. All vision and breathing equipment should be able to be donned using one hand in fewer than 5 seconds, as is currently the requirement for crew oxygen equipment. The performance of the masks should also be evaluated based on the standards of the National Fire Protection Association (NFPA). The NFPA standards 1981 (Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters, 1992 Ed.) and NFPA 1404 (Standard for a Fire Department Self-Contained Breathing Apparatus Program, 1996 Ed.) contain performance requirements to adequately address the situations faced by crewmembers in an emergency.[2]

Therefore, it is ALPA's recommendation that cargo-only aircraft be equipped with full face, single piece oxygen masks designed to completely protect the mouth, nose, and eyes from smoke or contaminants. These masks must be able to be donned within 5 seconds with one hand, and meet the performance criteria of the NFPA standards. A realistic training program designed to prepare flight crewmembers to accomplish their duties during an actual fire should also accompany these masks.

A spill cleanup kit containing chemically resistant gloves and absorbent material should be available to the flight crew. This spill cleanup kit would allow the flight crew to prevent a

[2] ALPA Position Paper: Hazardous Materials, Cargo Compartments, Smoke/ Fire Management – October 11, 1996

dangerous substance from interacting with other substances, or prevent a spilled substance (i.e. corrosive material) from further damaging the aircraft. When accompanied by a training program that stresses flight crew involvement with spilled substances only when absolutely necessary, a spill cleanup kit enhances the safety of the operation. If the crew has the capability to enter the main deck cargo area, and no built-in suppression agent is available, the crewmembers must be provided with the protective clothing, equipment and training necessary to be successful.

In addition to the design of the aircraft and the equipment provided to the crew, procedures used in a cargo-only aircraft operation can considerably affect the safety of that operation. Compliance with current dangerous goods regulations provides a minimum acceptable level of safety, but ALPA feels several additional precautions would provide a safer operation. All dangerous goods shipments should be loaded in cargo compartments with fire detection and protection. This provision would minimize the effects of a leak or spill and minimize damage from being exposed to a fire from any source. On a cargo-only aircraft without active fire suppression on the main deck, the preferred location for the loading of dangerous goods that is not required to be accessible in flight should be in either a lower cargo compartment or in a specialized dangerous goods container with fire detection and suppression. All shipments of 6.2 (Infectious), and Class 7 (Radioactive) should be located in cargo compartments in such a manner as to preclude flight crew exposure. If this is not possible, these shipments should be restricted from being placed in the portion of the cargo compartment closest to the flight deck.

Regulations also exist requiring that certain substances be segregated or not placed directly next to each other when loaded aboard aircraft. These requirements are based on the potential for harmful interaction between the types of substances, with the requirement for segregation dependent on the class of substances (e.g. flammable liquid, corrosive, oxidizer). The regulations, however, only require that the packages not be in physical contact with each other, often resulting in situations where substances requiring segregation are legally loaded onto the same pallet or in the same container. ALPA feels this situation represents an unacceptable risk, specifically due to the potential spread of a substance after a package failure, and that the regulations need to be revised to codify more specific segregation requirements. ALPA also feels that the present method of defining which materials need to be segregated is not adequate. The regulations currently only consider the hazard class of a substance. This results in a system where all Class 3 Flammable liquids must be segregated from Class 5 Oxidizers and Organic Peroxides. Unfortunately, this approach is not thorough enough to segregate all materials that might dangerously react with each other, since of these materials belong to the same hazard class. For example, materials classified as strong acids and strong bases can react to produce significant amounts of heat or energy that would not be present after a release of only one of the substances. In fact, OSHA and other governmental agencies require the segregation of these substances, but because they are both classified as Class 8 (Corrosive), there is no provision for their segregation in transportation. ALPA feels that this is inappropriate and should be revisited.

ALPA is also concerned with recent trends involving notification to the pilot in command or captain of the aircraft that the flight is carrying hazardous materials. The pilot notification form (NOTOC) used to convey this information is critical to the safe transport of hazardous materials by air. The captain has the authority and responsibility for the aircraft and its contents, and must be informed of any hazardous materials being carried. The flight crew is a major link and some consider the last link in the safety chain. The NOTOC is an integral part of proper acceptance and emergency response, should an incident occur. The content of the pilot notification forms has also been decreasing. Recent international rulemaking has resulted in the coming elimination of

NOTOC forms for major categories of Infectious Substances, including shipments of AIDS and Hepatitis infected biological products. In both of these cases, the packages will still retain certain markings identifying them as hazardous and the packagings will still have to meet stringent standards. There will be, however, no notification to the flight crew that these packages are on the aircraft, making emergency response problematic should an incident occur. ALPA strongly opposes the relaxing of standards concerning what information appears on the NOTOC.

Regulations do not specify when the NOTOC must be presented to the flight crew, only that it is presented as early as practical (49 CFR 175.33(a)). In practice, this often results in the NOTOCs being presented immediately before departure. In cargo aircraft operations, the number of forms and the amount of information contained therein can be substantial. The captain always has the authority to delay a flight, if necessary, to review forms presented shortly before departure. In practice, however, on-time performance pressures serve to create an environment where a thorough review of these forms is difficult, if not discouraged, to the detriment to the hazardous materials safety system. ALPA strongly recommends that if the NOTOC forms are required (i.e. if a shipment has been planned in advance for a flight), that the NOTOC forms be available to the flight crew at the time of flight planning and presented with the flight papers.

In the event of an in-flight emergency involving hazardous materials, flight crews may not have received the necessary guidance to utilize the NOTOC effectively. The ICAO Emergency Response Guidance for Aircraft Incidents involving Dangerous Goods (ICAO Doc 9481, AN/928), developed for use by flight crews while in-flight, outlines a series of actions to be taken in the event of a fire or leak. These actions are specific to the type of substance involved and pertain to the environmental situation within an aircraft. As use of this guide is not mandatory, some carriers are using other emergency response guidance, including material meant for first responders and on scene commanders. Often this material gives guidance that is not usable within an aircraft, since it outlines a sequence of actions to take place on the ground after a release (e.g. evacuate a 10 mile radius). ALPA recommends that the use of the ICAO Emergency Response Guidance be mandatory.

ALPA is also concerned with rulemaking completed as a result of NTSB recommendations following an accident involving a wide-bodied cargo aircraft in September 1996. During the emergency response to this accident, the first responders were unable to conclusively determine what hazardous materials were onboard the aircraft. Recommendation A-98-80 to the Research and Special Programs Administration (RSPA) recommended that RSPA "Require, within 2 years, that air carriers transporting hazardous materials have the means, 24 hours per day, to quickly retrieve and provide consolidated specific information about the identity (including proper shipping name), hazard class, quantity, number of packages, and location of all hazardous materials on an airplane in a timely manner to emergency responders." As a result of this recommendation, rulemaking was initiated which requires copies of the NOTOC to be held at the departure station and available at the destination station.

However, this rulemaking does not adequately addresses the difficulties encountered in obtaining hazardous materials information during the emergency response to the accident above. In part, the proposed regulation requires that the hazardous materials information be accessible at the departure and destination airports. Because the accident aircraft did not land at either the departure or planned destination airport (as would be the case with most emergencies), having copies of the hazardous materials information at these airports would not have been immediately useful. The rulemaking does not address how the emergency response personnel at a diversion

airport would obtain the information. ALPA reiterates our recommendation that air carriers transporting hazardous materials have the 24-hour ability to immediately access any hazardous materials information for a given flight, and have the ability to quickly transmit this information to first response personnel.

4. Conclusions and Recommendations

In summary, ALPA believes that the existing system of transporting hazardous materials by air is safe. However, to improve the system, we make the following recommendations:

1. Support and upgrade shipper and airline personnel awareness programs to prevent the carriage of undeclared hazardous materials.
2. Improve and expand required programs to place hazardous materials signage and kiosks in cargo facilities, stores facilities, Post Offices, and third party shipper locations.
3. Create a Hazardous Materials Self Reporting System with immunity provisions.
4. Expand and improve flight crew training requirements for hazardous materials.
5. Initiate requirements for earlier presentation of the NOTOC to flight crewmembers.
6. Do not allow any further reduction in the information presented on the NOTOC, or in what types of hazardous materials require a NOTOC.
7. Supply protective clothing to the flight crew whenever active fire suppression is not supplied to a cargo compartment accessible to the flight crew. This clothing must be sufficient to protect a crew member while fighting a fire after all other provisions have failed, and should include at a minimum nomex coveralls, a nomex hood, firefighter gloves and be useable with protective breathing equipment and those fire extinguishers provided.
8. Supply Spill Cleanup Kits containing gloves and absorbent material in order to allow the flight crew to prevent a spilled substance from interacting with other dangerous substances, or prevent a spilled substance (i.e. corrosive material) from further damaging the aircraft. Use of such a cleanup kit should be accompanied by appropriate training.
9. Ensure that shipments of dangerous goods are loaded in cargo compartments having fire detection and protection, whenever possible, in order to prevent those shipments from contributing to the severity or intensity of a fire from any source.
10. Adopt procedures to create a preferred location for shipments of Class 6.2 (Infectious), and Class 7 (Radioactive) in the lower cargo compartments in order to preclude flight crew exposure. If this is not possible, these shipments should be restricted from the portion of the cargo compartment closest to the flight deck.
11. Review segregation requirements, both for distance between commodities and for the type of substances to be segregated.
12. Require use of the ICAO Emergency Response Guidance for Aircraft Incidents involving Dangerous Goods (ICAO Doc 9481, AN/928), for all flight crews carrying hazardous materials. Require Air Carriers transporting hazardous materials to access information concerning these shipments via their flight following personnel any time those shipments are in transport.

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