



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 19, 1990

In reply refer to: A-90-151 through -155

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July 19, 1989, a McDonnell Douglas DC-10-10, operated by United Airlines as flight 232, en route from Denver, Colorado, to Chicago, Illinois, with 296 persons on board, experienced an in-flight emergency following the fragmentation and separation of the No. 2 engine fan disk. The airplane crashed during an attempted emergency landing to runway 4/22 at Sioux Gateway Airport (SUX), Sioux City, Iowa.

During the accident, the airplane separated into four sections and portions burned. Of the 296 persons on board, 110 passengers and 1 flight attendant were fatally injured: 35 of these persons, some with traumatic blunt force injuries, died of asphyxia secondary to smoke inhalation, and 76 died of blunt force trauma. Of the remaining 185 persons, 47 sustained serious injuries, 125 sustained minor injuries, and 13 were not injured.

Sioux Gateway is a joint-use airport accommodating civilian and Iowa Air National Guard aircraft. The Iowa Air National Guard provides aircraft rescue and fire fighting (ARFF) services for the facility, which is certificated under Federal Aviation Administration (FAA) regulations 14 CFR 139 as an Index B airport. The index is based on the largest airplane with an average of five or more scheduled daily departures; the regulations stipulate the minimum level of fire fighting equipment and agents for each index. For SUX, Index B was based on an airplane equivalent to the Boeing 737-200 series and requires, as a minimum, 1,500 gallons of water for foam production. An airport serving McDonnell Douglas DC-10 series airplanes, for example, would be classified as an Index D-level airport for ARFF services and would require more than double the quantity of fire extinguishing agents required for an Index B airport.

During the accident, the center section of the main cabin, containing 207 passengers, separated from the fuselage and slid about 650 feet before it came to rest inverted 300 feet in a cornfield that was adjacent to runway 17/35, an active runway. The resting place was about 3,700 feet from the

initial impact on runway 4/22. As the cabin slid, it opened a path westward through 7-foot-high cornstalks. This path was subsequently used by two ARFF vehicles to approach the wreckage to a position from which fire fighters attacked the postcrash fire. The fire quickly propagated from beneath the airplane's right wing root to the front of the inverted fuselage; after about 8 minutes, the fire penetrated the interior of the fuselage. During the attack on the fire, the wind was from the north at about 10-12 knots, which helped to keep the fire away from the fuselage but which also obscured the fire fighter's visibility.

The Safety Board's investigation of this accident has disclosed several problems associated with the ARFF's ability to control continuously the postcrash fire at the accident airplane's right wing root. The investigation also identified deficiencies in the design and operation of the Kovatch A/S32P-18 (P-18) water supply vehicle, the absence of FAA requirements to test fire service vehicles regularly at their maximum discharge capacity, delays in correcting reported deficiencies in Kovatch P-18 fire service vehicles, and problems related to agricultural operations on airport property. It is undetermined if the interruption of foam application increased loss of life.

Fire Fighting Equipment

The first two ARFF vehicles to arrive at the scene of the accident began a mass application of foam immediately. The bottom of the inverted fuselage section of the airplane was blanketed with foam, and the foam blanket temporarily suppressed the fire during the evacuation of passengers and crew. After the depletion of water aboard the two ARFF vehicles, a Kovatch P-18 water supply vehicle was positioned adjacent to the two ARFF vehicles and a 2 1/2-inch hose was connected between the P-18 and each vehicle. When the P-18 water pump was charged to its maximum capacity of 500 gallons per minute (gpm), a restriction developed in the vehicle's tank-to-pump hose that stopped all water flow to the two ARFF vehicles. Thus, the airport's primary attack vehicles could not be replenished with water to continue attacking the fire.

Two Sioux City Fire Department pumper trucks subsequently resupplied the airport's ARFF vehicles. However, during the delay of about 8 minutes, no extinguishing agent was applied to the fuselage, and the fire at the airplane's right wing root intensified. Soon thereafter, fire penetrated the cabin, resulting in deep-seated fires that could not be attacked by exterior fire fighting tactics. Despite attempts to advance hand lines to the interior of the airplane, the fire intensified inside the cabin and burned out of control for about 2 1/2 hours.

The Kovatch P-18 water supply vehicle has no foam-producing capability and is designed primarily to supply water to the primary ARFF vehicles. As certified by the manufacturer, this vehicle has a water capacity of 2,000 gallons and a maximum water pump discharge rate of 500 gpm.

In September 1988, the Iowa Air National Guard purchased the P-18 through the Air Force and placed it in service at SUX. The Safety Board has learned that during the 2 years preceding this accident, the Air Force purchased 210 Kovatch P-18 water supply vehicles. The Safety Board has also learned that some P-18's are based at joint-use airports that are certified by the FAA as having ARFF capabilities in compliance with 14 CFR 139.

Although the Kovatch P-18 water supply vehicle was listed in the SUX airport certification manual, the airport fire chief testified at the Safety Board's public hearing that the vehicle had never been tested to its maximum discharge capacity of 500 gpm. In the absence of Air Force/FAA requirements to perform maximum capacity discharge tests, the fire chief relied on the manufacturer's pre-delivery factory tests of the pump's ability to discharge 500 gpm with two 2 1/2-inch lines attached. Additionally, the fire chief stated that SUX tested the P-18 weekly at nominal pressure and discharge capacity at less than 500 gpm.

During the Safety Board's investigation, the P-18's tank-to-pump suction hose assembly, a soft, 11-inch by 4 1/2-inch inside diameter Gates rubber hose, P/N NR75W, was removed from the vehicle and examined at the SUX facilities. The examination disclosed that the 2-inch-long internal polyvinyl chloride (PVC) stiffener installed in the hose had rotated laterally 90°. Kovatch stated that the internal stiffener in the soft hose assembly is required to prevent the hose from collapsing. Kovatch also stated that the stiffener was installed by a press fit in the center of the hose.

Examination of the rotated stiffener strongly suggests that when the P-18 operator attempted to resupply the two ARFF vehicles with water via the two 2 1/2-inch hoses with the pump set to its maximum rated capacity of 500 gpm, a momentary high-pressure surge occurred within the tank-to-pump piping system that caused the stiffener to move and rotate to a position that blocked the flow of water to the pump.

In examining the susceptibility of the internal stiffener to displace and rotate, the Safety Board found that the stiffener's length was about half the internal diameter of the soft suction hose. Because of the small size of the stiffener and because it was not clamped, it was free to rotate and block the flow of water or even to slide towards the pump intake, making the soft suction hose susceptible to collapse.

The Safety Board is concerned that the design of the P-18, which uses a soft suction hose at a critical location upstream of the vehicle's pump and depends on the stiffeners, is susceptible to blockage. This concept is used not only in the P-18 but in other pumpers manufactured by Kovatch. A hose made of more rigid material, which would have obviated the need for an internal stiffener or an improved stiffener design, is necessary to reduce the likelihood of hose blockage regardless of operating conditions.

On February 15, 1989, a P-18 operated by the Air Force at Tyndall Air Force Base, Florida, was unable to supply water to an ARFF vehicle during a

pumping operation. The Air Force determined that the "A/S32P-18 tank suction line was restricted by a PVC [stiffener] inside [the] rubber suction line...and [they] installed [a] clamp around [the] hose and PVC to hold it in place." On August 16, 1989, a similar P-18 deficiency was found at Malmstrom Air Force Base, Montana.

Following discussions with the Air Force, Kovatch issued Technical Service Bulletin 86-KFT5-P-18-5, dated August 21, 1989, which called for the removal of the tank-to-pump hose assembly installed on all 210 A/S32P-18 vehicles and the replacement of the hose assembly with a new tank-to-pump hose assembly that has a 4-inch PVC internal stiffener. Kovatch agreed to supply hose modification kits directly to air bases whose addresses were provided by Warner Robins Air Logistics Center.

On August 22, 1989, the Air Force issued a Materials Deficiency Report that directed a one-time test of all Kovatch P-18 vehicles at the maximum pump discharge rate of 500 gpm and the replacement of the 2-inch stiffener with the 4-inch stiffener. Within 30 days, eight Air Force bases responded that tests found deficiencies similar to those described in this letter and the bases replaced the 2-inch stiffeners with 4-inch stiffeners.

The Air Force has advised the Safety Board that it anticipates completing the modification of all 210 Kovatch vehicles during 1990. The Safety Board is concerned, however, that in the interim, unmodified Kovatch P-18 vehicles may still be in service. Because of the demonstrated deficiency of the Kovatch P-18 vehicle, the Safety Board believes that the Air Force should expedite the completion of the hose modification program on the remaining Kovatch vehicles and require unmodified vehicles to be removed from service.

The Safety Board is also concerned that 14 CFR 139 certificate holders are not required to test on a regular schedule all fire service equipment at the maximum rate discharge capacity. In the absence of scheduled maximum capacity testing, deficiencies in the operation of key fire service equipment may remain undetected. The Safety Board believes that all fire fighting and water supply equipment should be tested at full rated capacity prior to being accepted for ARFF service and then tested on a regularly scheduled basis thereafter. This will also ensure that inservice apparatus also can discharge at full capacity.

Agricultural Operations on Airport Property

During the Safety Board's public hearing, the fire chief testified that visibility obscured by the height of corn stalks and the wind-blown smoke limited the access of ARFF vehicles to the east side of the inverted cabin. The height and density of the corn stalks also interfered with seeing passengers, some of whom were on the ground and others who were walking through the corn trying to find a path away from the burning cabin. Also, scattered debris and possible hidden fires from fuel spills could not be seen. Furthermore, the airport had received about 2 inches of rain during the 2 days prior to the accident, and the fire chief was concerned that ARFF vehicles could become mired in the soft ground. Thus, the fire chief ordered

the attack on the fire from the east side of the fuselage and decided not to move the ARFF vehicles to the other side of the burning fuselage.

The SUX Director of Aviation testified during the Safety Board's public hearing that about 1,200 acres of airport land is used for growing corn and soybeans, which are a major source of airport income, and that similar land use is prevalent adjacent to and in the general vicinity of the airport. In accordance with FAA guidelines for agricultural leases on airports, SUX leases nonaeronautical use areas for growing corn and soybeans adjacent to all active and inactive runways and taxiways.¹ Although the placement of the agricultural crops at SUX was in accordance with 14 CFR 139, the airport emergency plan did not include procedures for ARFF activities within the crop environment. Furthermore, the FAA has no guidance for ARFF operations in unique terrain, where crops can limit visibility and mobility of ARFF vehicles.

As demonstrated by this accident, airports that have substantial portions of aircraft operations on runways and taxiways adjacent to crops need to reexamine their rescue and fire fighting procedures. The Safety Board believes that ARFF commanders and fire fighters should be prepared for situations that can arise after an aircraft accident on unique terrain and among conditions that can jeopardize the lives of aircraft occupants and fire fighters. For example, where crops limit access of ARFF vehicles, airport emergency plans could consider the following: alternative techniques for attacking an aircraft fire under reduced visibility conditions and limited access; the use of a helicopter for directing the fire attack; the mobility of the ARFF vehicles in the crop environment; and requirements for special equipment and training of ARFF personnel for responding to accidents in unique terrain.

The Safety Board has learned that the FAA is reviewing its airport certification guidelines to provide further guidance to airport operators on the wildlife hazards management requirements of 14 CFR 139.² The Safety Board understands that under these proposed guidelines, certificated airports will be encouraged not to start agricultural programs on their land and to confine agricultural areas established along the perimeter of the airport to as far from the runways as possible, and no closer than 1,200 feet to the runway centerline. The Safety Board believes that the FAA should, on an interim basis, expedite the issuance of the proposed advisory circular and require an annual review of each certificated airport to ensure that agricultural crops grown on or adjacent to airport property do not limit or restrict ARFF activities.

¹ Federal Aviation Administration, Airports Division, Central Region. August 1989. Recommended guidelines for agricultural leases on airports. Kansas City, MO.

² Federal Aviation Administration. [In preparation]. Airport Wildlife Hazard Management. Advisory Circular AC 150/5200-32. Washington, DC 20591

Furthermore, agricultural operations on airport property can promote wildlife habitats that have been shown to affect the safety of aircraft. For example, the FAA has reported that about 1,200 to 1,500 bird strikes occur annually and that most of these strikes occur on or immediately adjacent to the airports (see footnote 2). Considering the risks to the safety of aircraft and concomitant emergency response limitations, the Safety Board believes the FAA should review its policy that permits agricultural operations on the property of certificated airports.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Direct Airport Certification Safety Inspectors to require 14 CFR 139 certificate holders to inspect the suction hoses on Kovatch A/S32P-18 water supply vehicles to verify that they incorporate the modifications described in Kovatch Technical Service Bulletin 86-KFTS-P-18-5 and to immediately remove from service A/S32P-18 vehicles that have not been so modified. (Class II, Priority Action) (A-90-151)

Amend 14 CFR 139 to require airport operators to perform maximum capacity discharge tests of all emergency response fire fighting and water supply vehicles before the vehicles are accepted for service and on a regularly scheduled basis thereafter. (Class II, Priority Action) (A-90-152)

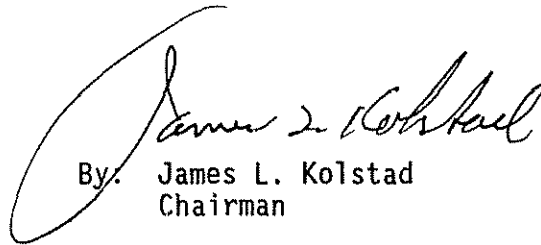
Make available to all 14 CFR 139 certificated airports an account of the circumstances of the accident described in Safety Recommendation letter A-90-151 through -155 as they relate to the deficiencies identified with the Kovatch A/S32P-18 water supply vehicle. (Class II, Priority Action) (A-90-153)

Develop guidance for airport operators for acceptable responses by aircraft rescue and fire fighting equipment to accidents in crop environments on airport property. (Class II, Priority Action) (A-90-154)

Require annual airport certification inspections to include examinations of airfield terrain to ensure, where practicable, that surface obstructions, including agricultural crops, do not interfere with rescue and fire fighting activities. (Class II, Priority Action) (A-90-155)

Also, as a result of its investigation, the Safety Board issued safety recommendations A-90-147 through -150 to the Department of the Air Force.

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER and HART, Members, concurred in these recommendations. BURNETT, Member, filed the following statement.



By: James L. Kolstad
Chairman

BURNETT, Member, dissenting statement:

We should classify as "Class I, Urgent Action" those safety recommendations which relate specifically to the existing Kovatch A/S32P-18 vehicles, i.e., the first, second and fourth recommendations to the U.S. Department of the Air Force and the first and third recommendations to the Federal Aviation Administration.