



BY WAYNE ROSENKRANS

SURVIVAL ON THE HUDSON

Inattention to safety briefings, life vests and life lines increased risks after US Airways Flight 1549 touched down.

The public's intuition that "fortuitous" circumstances contributed to all occupants surviving the January 2009 ditching of an Airbus A320 in the Hudson River has been seconded by the final accident report of the U.S. National Transportation Safety Board (NTSB) on US Airways Flight 1549.¹ Now-famous

images of people without life vests or life lines standing on the wings, however, contain a less obvious message about shared responsibility for safety aboard aircraft. Rather than dwell on the unusually favorable circumstances, the NTSB took the opportunity to redirect the attention of government, the airline industry and the

traveling public to the critical survival factors they do control.

For example, noting that “only about 10 passengers [of 150] retrieved life vests themselves after impact and evacuated with them” and that only 77 retrieved flotation-type seat cushions, the survival factors sections of the report essentially said that crewmembers and passengers disregard at their peril the life-saving knowledge and equipment provided. “The NTSB notes that, after exiting the airplane through the overwing exits, at least nine passengers unintentionally fell into the water from the wings,” the report said.

Several explanations were offered by investigators. “Although the accident flight attendants did not command passengers to don their life vests before the water impact, two passengers realized that they would be landing in water and retrieved and donned their life vests before impact, and a third passenger attempted to retrieve his life vest but was unable to do so and, therefore, abandoned his attempt,” the report said. “Many passengers reported that their immediate concern after the water impact was to evacuate as quickly as possible, that they forgot about or were unaware that a life vest was under their seat, or that they did not want to delay their egress to get one. Other passengers stated that they wanted to retrieve their life vest but could not remember where it was stowed.” In all, 101 life vests were left stowed under passenger seats.

The accident analysis does not devalue the positive outcomes of the captain’s judgment, the cabin crew’s performance or the passengers’ orderly behavior, and the report notes, “The NTSB concludes that the captain’s decision to ditch on

the Hudson River² rather than attempting to land at an airport provided the highest probability that the accident would be survivable. ... Contributing to the survivability of the accident was the decision making of the flight crewmembers and their crew resource management during the accident sequence; the fortuitous use of an airplane that was equipped for an extended-overwater [EOW]³ flight, including the availability of the forward slide/rafts, even though it was not required to be so equipped; the performance of the cabin crewmembers while expediting the evacuation of the airplane; and the proximity of the emergency responders to the accident site and their immediate and appropriate response to the accident,” the report said.

The lessons learned reflected the importance of leaving as little to chance as possible in preparations to survive an aircraft accident. “The investigation revealed that the success of this ditching mostly resulted from a series of fortuitous circumstances, including that the ditching occurred in good visibility conditions on calm water and was executed by a very experienced flight crew. ... “The investigation revealed several areas where safety improvements are needed,” the report said.

The accident airplane was one of 20 EOW-equipped A320s — among the airline’s fleet of 75 A320s. Each of four slide/rafts was rated to carry 44 people and had an overload capacity of 55. Also aboard, but not counted toward EOW equipment, were two off-wing ramp/slides, one at each pair of overwing exits.

“The accident airplane had the statements, ‘Life Vest Under Your Seat’ and ‘Bottom Cushion Usable for Flotation,’ printed on the [overhead] passenger service units (next to the reading light switches) above each row of seats,” the report said. The four life lines were designed to be retrieved after ditching from an overhead bin, attached to top corners of door frames on both sides of the airplane fuselage and anchored to a designated point on top of each wing.

The importance of these items becomes clear by considering that only two detachable slide/rafts were available for Flight 1549 occupants



© AP Photo/Alexandre Valerio

Close proximity of personnel and vessels capable of rescuing Flight 1549 occupants overcame the serious threat of cold water immersion.





Top, one passenger jumped into the 41° F (5° C) Hudson River from door 1L before the slide/raft was deployed manually; bottom, overwing-exit life line-attachment points were unused, and nine passengers fell into the water.

— at door 1L and door 1R — with a combined capacity to carry 110 of the 155 occupants if the airplane had sunk before they were rescued. The NTSB determined that about 64 occupants were rescued from these slide/rafts, while about 87 were rescued from the wings and off-wing ramp/slides.

Survival Scenario

Loss of thrust in both engines prompted the captain of Flight 1549 to commit to the ditching as the safest course of action despite its necessitating an evacuation in harsh winter temperatures. The flight crew later said that its top priority then was to touch down with a “survivable sink rate.” Analysis of the digital flight data recorder showed that “the airplane touched down on the Hudson River at an airspeed of 125 kt calibrated airspeed with a pitch angle of 9.5 degrees, [a descent rate of 12.5 fps] and a right roll angle of 0.4 degree,” the report said.

The evacuation began within seconds after the airplane’s rapid deceleration on the river’s surface after

touchdown at about 1527 local time. The captain opened the flight deck door and commanded an evacuation by speaking directly to the forward flight attendants and passengers. He observed then that the evacuation already had begun.

“The water in the back of the airplane rose quickly, which, in addition to improvised commands from flight attendant B to ‘go over the seats,’ resulted in numerous passengers climbing forward over the seatbacks to reach a usable exit,” the report said. “However, some aft passengers remained in the aisle queue to the overwing exits. Many of these passengers noted that, when they arrived at the [overwing] exits, the wings were crowded and people were exiting slowly. They also reported that the aisle forward of the overwing exits was completely clear and that the flight attendants were calling for passengers to come forward to the slide/rafts.”

The NTSB estimated the evacuation sequence and timing: The left overwing exits were opened by passengers at 1530:58, contrary to the airline’s ditching procedures, and the first passenger subsequently exited; flight attendant A opened door 1L to its locked-open position against the fuselage at 1531:06, and no water entered, but this crewmember had to operate the manual inflation handle to deploy the slide/raft because the automatic system appeared to have failed; flight attendant C opened door 1R at 1531:11, automatically causing full deployment of the slide/raft at 1531:16; one passenger jumped into the water from door 1L at 1531:23 before its slide/raft began to inflate; the slide/raft at door 1L began to inflate at 1531:26; the first vessel arrived on scene at 1534:40; and the last vessel departed the scene after rescuing the last passengers from the left off-wing ramp/slide at 1554:43.

Eight of the passengers exited the aircraft, re-entered the aircraft to obtain one or more life vests, then exited from a different door. Flight attendant B did not become aware of a serious injury to her left shin until aboard the door 1R slide/raft.

“A review of passenger exit usage indicated that, in general, passengers from the forward and mid parts of the cabin evacuated through the exit closest to their seats,” the report said. “However,

aft-seated passengers indicated that water immediately entered the aft area of the airplane after impact and that the water rose to the level of their seat pans within seconds; therefore, they were not able to exit from their closest exits because these exits were no longer usable.”

Several safety equipment irregularities occurred, affecting crew actions and passenger behavior. “Flight attendant C ... stated that door 1R started to close during the evacuation, intruding about 12 in [30 cm] into the doorway and impinging on the slide/raft,” the report said. “She stated that she was concerned that the slide/raft would get punctured, so she assigned an ‘able-bodied’ man to hold the door to keep it off of the slide/raft.”

One female passenger with a lap-held child received assistance from a fellow passenger shortly before the touchdown. “When the captain [announced] ‘Brace for impact,’ the male passenger in [seat] 19F offered to brace her [nine-month-old] son for impact,” the report said. “The lap-held child’s mother [in seat 19E] stated that she thought the passenger in 19F ‘knew what he was doing,’ and she gave her son to him.” None of these passengers was injured.

All three flight attendants described the evacuation process as relatively orderly and timely. The captain and first officer said that while assisting the cabin crew with the evacuation, they observed passengers without life vests outside the airplane. “[The captain and first officer] obtained some life vests from under the passenger seats in the cabin and passed them out to passengers outside of the airplane,” the report said. The flight crew also conducted the final cabin inspection to ensure no passengers had been left, then exited onto the slide/raft at door 1L.

Emergency Response

Air traffic control tower personnel at LaGuardia Airport activated the area’s emergency alert notification system via its crash telephone at 1528:53. This immediately notified numerous agencies to respond with predetermined personnel and equipment according to the LaGuardia Airport emergency plan. The airport dispatched one

rescue boat. Personnel from New York Waterway (NY WW) also responded to the accident although they were not part of the emergency plan.

“The airplane was ditched on the Hudson River near the NY WW Port Imperial Ferry Terminal in Weehawken, New Jersey,” the report said. “Many NY WW ferries were operating over established routes in the local waterway, and the ferry captains either witnessed the accident or were notified about it by the director of ferry operations. Seven NY WW vessels responded to the accident and recovered occupants.”

The first responders considered the winter weather conditions a serious risk to survival. “The post-crash environment, which included a 41° F [5° C] water temperature and a 2° F [minus 17° C] wind chill factor, and a lack of sufficient slide/rafts (resulting from water entering the aft fuselage) posed an immediate threat to the occupants’ lives,” the report said. “Although the airplane continued to float for some time, many of the passengers who evacuated onto the wings were exposed to water up to their waists within two minutes.”

The Port Imperial Ferry Terminal was designated as the central triage site; nevertheless, captains of vessels dropped off the Flight 1549 occupants at the closest locations in New York and New Jersey because the aircraft was drifting and some passengers were wet and at risk of cold-induced injury.

Among the 45 passengers and five crewmembers transported to hospitals, flight attendant B and two passengers had sustained serious injuries. One of those

Top, the detachable door 2L slide/raft was one of two unavailable due to aft water entry; bottom, a manual inflation handle and a ditching release handle were found in the forward galley.



Top, life vest storage pouches were beneath economy-class seats on Flight 1549; bottom, the FAA had tested four underseat stowage configurations.



passengers was admitted to a hospital for treatment of hypothermia. The other was treated for a fractured xiphoid process, an “ossified extension” of the lower part of the sternum. “Two passengers not initially transported to a hospital later furnished medical records to the NTSB showing that one had suffered a fractured left shoulder and the other a fractured right shoulder,” the report said. “Flight attendant B sustained a V-shaped, 12-cm-long 5-cm-deep [5-in by 2-in] laceration to her lower left leg that required surgery to close.” The cause of flight attendant B’s laceration was a vertical beam that punctured the cabin floor in front of her jump seat about 11 in (28 cm) forward of the seat pan.

Life Vest Awareness

Passenger interviews indicated that about 70 percent of the passengers did not watch any of the preflight safety briefing. “The most frequently cited reason for [inattention] was that the passengers flew frequently and were familiar with the equipment on the airplane, making them complacent,” the report said.

Flight 1549 passengers could learn about the availability of life vests only from the safety information cards in seatback pockets or the overhead statements, although some assumed that all commercial passenger jets carry life vests.

“US Airways’ FAA-accepted In-Flight Emergency Manual followed [FAA] advisory circular guidance and specified that, if the airplane is equipped with both flotation seat cushions and life vests, flight attendants should brief passengers on both types of equipment, including the location and use of life vests,” the report said. “The cockpit voice recorder recorded flight attendant B orally brief the location and use of the flotation seat cushions; however, it did not record her brief the location of or the donning procedures for life vests. ... A life vest demonstration was not required because the flight was not an EOW operation.”

Braced But Injured

The safety information cards also provided instructions on the operation of the emergency exits and depicted passenger brace positions that were similar to FAA guidance on brace positions. Three of four seriously injured passengers were hurt during the airplane’s impact with the water.

“The two female passengers who sustained very similar shoulder fractures both described assuming similar brace positions, putting their arms on the seat in front of them and leaning over,” the report said. “They also stated that they felt that their injuries were caused during the impact when their arms were driven back into their shoulders as they were thrown forward into the seats in front of them. The brace positions they described were similar to the one depicted on the US Airways safety information card.”

The passenger seats on the accident airplane were 16-g compatible seats. The NTSB noted that new seats have a nonbreakover seatback design, which minimizes head movement and body acceleration before striking the seatback from behind, resulting in less serious head injuries.

“Guidance in [FAA Advisory Circular 121-24C] did not take into consideration the effects of striking seats that do not have the breakover feature because research on this issue has not been conducted,” the report said. “The NTSB concludes that ... in this accident, the FAA-recommended brace position might have contributed to the shoulder fractures of two passengers.”

U.S. National Transportation Safety Board

U.S. Federal Aviation Administration

Unused Life Vests

Overall, 19 passengers attempted to obtain a life vest from under a seat, and 10 of them reported difficulties retrieving it. “Of those 10 passengers, only three were persistent enough to eventually obtain the life vest; the other seven either retrieved a flotation seat cushion or abandoned the idea of retrieving flotation equipment altogether,” the report said.

Most passengers who attempted to don or donned life vests already were seated in a slide/raft, ramp/slide or standing on a wing. “Of the estimated 33 passengers who reported eventually having a life vest, only four confirmed that they were able to complete the donning process by securing the waist strap themselves,” the report said. “Most of the passengers who had life vests either struggled with the strap or chose not to secure it at all for a variety of reasons.”

Airline industry safety standards for overwater flight have not anticipated scenarios in which passengers exit onto the wings after a ditching, the report said. “Each overwing exit pair [in this case] was equipped with an automatically inflating, off-wing Type IV exit ramp/slide,” the report said. “The off-wing ramp/slides did not have quick-release handles [for detachment].”

Despite a regulation requiring the life lines at overwing exits — which are intended to be opened by passengers, not flight attendants — circumstances in which they could be used effectively after ditching have been unclear, the report said. The passenger safety information card lacked information about the location of the life lines and how to use them. “Further, no information is provided to passengers about life lines during the preflight safety demonstration or individual exit row briefings,” the report said, and placards above the overwing exit signs only depicted deployed life lines from a pair of overwing exits. The NTSB concluded that life lines could have been used to assist Flight 1549 passengers on both wings, “possibly preventing them from falling into the water.”

The off-wing ramp/slides on the accident airplane, as is typical in the industry, had no

quick-release girts to enable occupants to free the ramp/slides from the sinking airplane for flotation out of the water or handholds. “Some passengers immediately recognized their usefulness and boarded the ramp/slides to get out of the water,” the report said. “Eventually, about eight passengers succeeded in boarding the left off-wing slide and about 21 passengers, including the lap-held child, succeeded in boarding the right off-wing ramp/slide.”

Summary statements in the report encouraged the government and airline industry to reconsider past NTSB recommendations validated by facts of this event. “The circumstances of this accident demonstrate that even a non-EOW flight can be ditched, resulting in significant fuselage breaching,” the report said. “Therefore, all passengers, regardless of whether or not their flight is an EOW operation, need to be provided with adequate safety equipment to ensure their greatest opportunity for survival if a ditching or other water-related event occurs.”

To read an enhanced version of this story, go to flightsafety.org/asw/jul10/hudsonsurvival.html.

Notes

1. NTSB. “Aircraft Accident Report: Loss of Thrust in Both Engines After Encountering a Flock of Birds and Subsequent Ditching on the Hudson River, US Airways Flight 1549, Airbus A320-214, N106US, Weehawken, New Jersey, January 15, 2009.” Accident Report NTSB/AAR-10/03, PB2010-910403, Notation 8082A, May 4, 2010. The report contains safety recommendations, including references to NTSB safety recommendations dating from the 1980s that remain relevant to survival factors. It is available at www.ntsb.gov/publictn/2010/AAR1003.pdf.
2. About two minutes after takeoff, at an altitude of 2,800 ft, the aircraft experienced an almost complete loss of thrust in both engines after encountering a flock of birds and subsequently was ditched about 8.5 mi (14 km) from LaGuardia Airport, New York City, New York, U.S. The accident occurred Jan. 15, 2009.
3. EOW operations, with respect to aircraft other than helicopters, are operations over water at a horizontal distance of more than 50 nm (93 km) from the nearest shoreline.

‘Most of the passengers who had life vests either struggled with the strap or chose not to secure it at all for a variety of reasons!’