National Transportation Safety Board
Washington, D.C. 20594

Aviation Accident Brief

Accident Number:	SEA05MA199
Operator:	Heli-USA Airways, Inc.
Aircraft and Registration:	Aerospatiale AS350BA, N355NT
Location:	Haena, Hawaii
Date:	September 23, 2005
Adopted On:	March 5, 2007

HISTORY OF THE FLIGHT

On September 23, 2005, about 1415 Hawaiian standard time,[1] an Aerospatiale AS350BA helicopter, N355NT, registered to Jan Leasing, LLC, and operated by Heli-USA Airways, Inc., of Las Vegas, Nevada, encountered adverse weather and crashed into the Pacific Ocean several hundred feet off the coast of Kailiu Point, near Haena, Hawaii, on the island of Kauai. The sightseeing air tour flight was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 135 and visual flight rules (VFR) with a company flight plan in effect. Localized instrument meteorological conditions (IMC) prevailed in the vicinity of the accident site. Three passengers were killed, and the commercial pilot and two other passengers received minor injuries. The flight departed from Lihue Airport (LIH), Lihue, Hawaii, on the island of Kauai, at 1354 for the intended 45-minute tour.

The flight was operated under Special Federal Aviation Regulation (SFAR) 71, "Special Operating Rules for Air Tour Operators in the State of Hawaii,"[2] and in accordance with a certificate of waiver or authorization approved for Heli-USA by the Federal Aviation Administration (FAA) Honolulu Flight Standards District Office (FSDO) in Honolulu, Hawaii.[3] The flight proceeded westbound from LIH, which is on the southeastern part of the island, on the operator's standard clockwise tour route around the island (see figure 1).[4]

[1] All subsequent times are reported in Hawaiian standard time based on a 24-hour clock, unless noted otherwise. Hawaiian standard time is coordinated universal time minus 10 hours.

[2] SFAR 71 prescribes the operating rules for airplane and helicopter air tours conducted in Hawaii. It includes requirements for helicopter flotation equipment, performance plans, and operating limitations; minimum flight altitudes; and passenger briefings.

[3] Under SFAR 71, the minimum altitude for tour flights is 1,500 feet above ground level (agl) and no closer than 1,500 feet to any person or property, unless otherwise authorized. Heli-USA's certificate of waiver or authorization allows its pilots to deviate from the minimum altitude requirement and to descend as low as 500 feet agl over FAA-approved site-specific locations and traverse FAA-approved transition segments as low as 1,000 feet agl.

[4] The operator reported that the intended tour route was to depart from LIH and proceed west, which is the standard harbor departure, to the first tour site, Hanapepe Valley. From there, the tour was to proceed northwest to Waimea Canyon, then north to the Na Pali Coast, then northeast along the coastline to the northern end of the island to Kailiu Point. The tour was then to proceed south to Hanalei Valley and then to Waialeale Crater before returning to LIH.

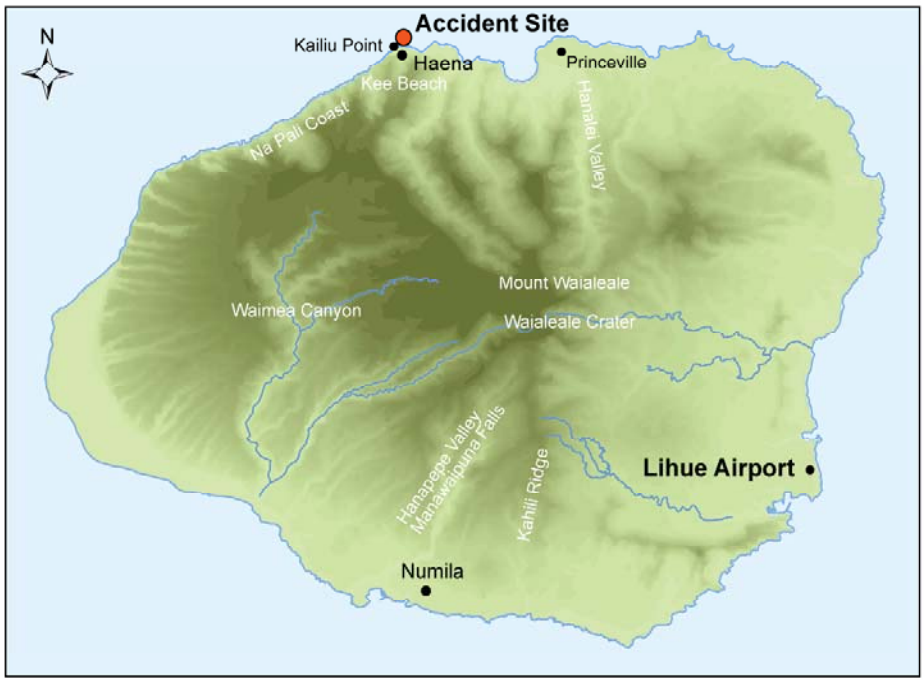

Figure 1. Map of Kauai.

The pilot reported that the weather and visibility were good during the initial part of the tour. The pilot stated that he flew the helicopter over the Na Pali Coast on the northern part of the island at 2,000 feet above ground level (agl) and that the weather along the coastline was clear and without rain. The pilot stated that he saw rain showers offshore as the flight approached Kee Beach and Kailiu Point on the northern part of the island.

The pilot reported that, as the flight came around Kailiu Point, he "suddenly saw [a McDonnell Douglas (MD)-500 helicopter] coming straight for [his helicopter]" and that he made a left turn to avoid it. He stated that, when he leveled his helicopter out of the turn, it was "already inside the storm," and it encountered heavy rain. Two passengers reported that they saw another helicopter flying in the opposite direction but that it was far below them, and one passenger stated that it was far enough below them that she thought it was a bird. Both of these passengers said that their helicopter made no evasive maneuver, or any maneuver, before entering what they described as "a wall of pure rain and thick clouds."

The pilot stated that, while the helicopter was in the heavy rain, he could still see down and to the right to the coastline and that he reduced the helicopter's airspeed and initiated a descent to maintain visual reference to the beach. One passenger reported that he could not see anything in the heavy rain and that he was about to say something about this to the pilot when the pilot announced that they were turning back. The pilot said that he started a right turn over the beach and that, during the turn, the helicopter's airspeed dropped to zero and the helicopter started to rapidly descend.

The pilot said that his control inputs were not effective and that he realized that the helicopter was going to hit the beach at a high rate of descent. The pilot stated that he applied full power and that the helicopter's rate of descent suddenly stopped. He stated that the helicopter went back up in the air momentarily and entered an immediate hard spin to the left, which took the flight over the water.

The pilot stated that he instructed the passengers to open the doors to get ready for the water impact and that the helicopter hit the water, bounced back into the air, and continued to spin. The pilot said that he transmitted a mayday call on the radio and that the helicopter impacted the water again and remained on the surface spinning. The pilot stated that the helicopter was submerged to the belly panel when it stopped spinning, then it rolled to the right and immediately began to sink.

A pilot flying a tour for another operator said that he heard the mayday call over the common traffic advisory frequency (CTAF)[5] and twice attempted to fly his helicopter in the Kee Beach area to try to locate the downed helicopter but was unable to do so because of poor visibility. While returning to the airport to alert rescue authorities, he saw another Heli-USA helicopter in flight and used the CTAF to inform that pilot of the mayday call. That Heli-USA pilot then conducted a brief search and spotted an oil slick on the water extending toward the area of poor weather. He made an unscheduled landing on a beach to let out his passengers[6] then searched the area near the oil slick. He said that the visibility was low but usable and that he saw debris and people in the water. He used his radio to direct U.S. Navy aircraft into the area.

PERSONNEL INFORMATION

The pilot, age 43, held a commercial pilot certificate with a rating for rotorcraft helicopter and a private pilot certificate with a rating for airplane single-engine land; he did not hold an instrument rating. His most recent FAA second-class airman medical certificate was issued on October 29, 2004, with the limitation that he "shall possess glasses for near and intermediate vision."

A review of the pilot's logbook indicated that, on the date of the accident, he had accumulated about 2,814 hours total flight time, which included about 29 hours simulated instrument experience, 939 hours night flight, and 334 hours in AS350-series helicopters. The pilot reported that, during the 90 days, 30 days, and 24 hours before the accident, he had flown about 176 hours, 115 hours, and 6 hours, respectively. He reported that he had conducted about 233 tours around Kauai and that those tour routes were similar to the route of the accident flight.

The pilot was hired by Heli-USA on July 29, 2005, about 2 months before the accident, and he completed his initial training and received 4.5 hours of flight instruction at the Heli-USA base in Las Vegas. The initial training included 40 hours of ground instruction, in accordance

[5] Pilots can use CTAFs to carry out advisory practices while operating in airspace that lacks an operating air traffic control tower.

[6] The pilot made the unscheduled landing to let out the passengers so that he could use his helicopter to assist with the emergency. Two of the passengers volunteered to remain on board to help search for the downed helicopter.

with Heli-USA's FAA-approved Part 135 training program. On August 1, 2005, the pilot passed the 14 CFR 135.293 (a) and (b) and 14 CFR 135.299 airman competency checkrides in Las Vegas in the AS350-series helicopter. The pilot subsequently completed his SFAR 71 training and an additional 3.5 hours of flight instruction in Kauai. The pilot completed his SFAR 71 checkride in Kauai on August 7, 2005, with a company check airman, and he conducted his first tour flight on August 8, 2005. His logbook revealed that he had flown about 177 hours while employed with Heli-USA.

AIRCRAFT INFORMATION

The helicopter was manufactured in 1987 as an AS350B model and was converted to an AS350BA model in 1997.[7] It was powered by a Turbomeca Arriel 1B turboshaft engine. It was configured with three seats in the front row and four seats in the second row, and the pilot position was the front right seat. Each passenger seat was equipped with a lap belt, and the pilot seat was equipped with a lap belt and shoulder harness. The helicopter was not equipped, and was not required to be equipped, with flotation equipment.[8]

A review of the maintenance records indicated that the helicopter had accumulated about 11,483 total hours and that the engine's total time was about 13,560 hours. The helicopter's most recent continuous airworthiness inspection, a 100-hour inspection, was completed on September 16, 2005. At the time of the accident, the helicopter had accumulated about 39 hours since the inspection.

METEOROLOGICAL INFORMATION

The only official National Weather Service (NWS) reporting facility on the island of Kauai was located at LIH, about 20 miles southeast of the accident site, at an elevation of 153 feet above mean sea level. The airport was equipped with an automated surface observing system augmented by certified NWS observers as necessary. At 1353,[9] the meteorological aerodrome report (METAR) included winds from 090° at 9 knots, visibility unrestricted at 10 miles, and few clouds at 2,400 feet. The METAR for 1453 included the same wind and visibility conditions but with few clouds at 1,500 feet.

The Hawaii Area Forecast (FA) issued at 1140 on September 23, 2005, and valid until midnight, indicated that a tropical storm was about 300 miles northeast of Hilo, Hawaii, and was

[7] The conversion, performed in accordance with the manufacturer's Service Bulletin 1.35, included the replacement of the main and tail rotor blades and other retrofits to increase the helicopter's useful load and other performance parameters.

[8] According to SFAR 71, a single-engine helicopter may be used to conduct air tours in Hawaii without helicopter flotation equipment, provided that the flight either does not go beyond the shore or that each person on board the helicopter is wearing approved flotation gear. Per Heli-USA's operations specifications, each person on board the helicopter was wearing a quick-donning life vest in a pouch around his/her waist. Following the accident, Heli-USA voluntarily began to equip its Hawaii-based helicopters with flotation equipment. By December 2006, Heli-USA had five Hawaii-based helicopters, and all were equipped with floats.

[9] FAA and NWS weather information products are reported in coordinated universal time. The times in this section have been converted to Hawaiian standard time.

moving northwest and weakening.[10] The FA indicated that, for Kauai and adjacent waters, conditions were forecasted to include scattered clouds at 2,000 feet, ceilings broken to overcast at 3,500 feet with tops to 12,000 feet, temporary ceilings below 3,000 feet in cumulonimbus clouds with tops to 40,000 feet, and visibility below 3 miles in thunderstorms and heavy rain. The outlook was for VFR conditions to prevail.

An in-flight weather advisory,[11] airmen's meteorological information (AIRMET) Sierra update 8 for instrument flight rules conditions, was issued at 1355 and was valid until 1800. The AIRMET warned of mountain obscuration over the islands of Oahu and Kauai and indicated that the mountains would be temporarily obscured above 1,500 feet because of clouds, thunderstorms, and rain. The conditions were expected to continue beyond 1800.

The terminal aerodrome forecast (TAF) closest to the accident site was for LIH and was issued at 0744 and was valid at 0800 for a 24-hour period. From 0800, the forecast was for winds from 080° at 8 knots, visibility better than 6 miles, and scattered clouds at 2,500 feet. From 1400, the forecast was for winds from 100° at 12 knots, visibility better than 6 miles with rain showers in the vicinity, scattered clouds at 2,500 feet, and ceiling broken at 3,500 feet, and, temporarily between 1400 and 1800, visibility 5 miles in moderate rain showers, scattered clouds at 2,500 feet, and overcast at 3,500 feet.

Meteorological Study of Weather Data

The closest NWS Weather Surveillance Radar-1988 Doppler (WSR-88D) was located in Numila, Hawaii, on the island of Kauai, about 21 miles south of the accident site. The WSR-88D is a computer-controlled radar system that automatically creates a complete series of scans in a specific sequence. The scan completed at 1403 depicted areas of reflectivities of 15 to 25 decibels (dBZ) in the immediate vicinity of the accident site. Echoes in the 25-dBZ intensity range are typically associated with rain showers or developing cumulonimbus or other towering cumulus clouds.[12] The echo intensity images derived from WSR-88D, however, do not represent the true reflectivity and/or intensity of the activity encountered by the accident helicopter; high terrain between the WSR-88D system and the accident site resulted in significant beam blockage below 5,000 feet over the accident site.[13]

A review of satellite imagery data[14] indicated that, at 1400, low- to mid-level clouds obscured most of the island of Kauai with several areas of towering cumulus to cumulus

[10] A forecast discussion bulletin issued by the NWS weather forecast office in Honolulu at 0955 indicated that the tropical storm would not directly affect the islands; however, indirect impacts, such as light trade winds and high surf, were expected.

[11] In-flight advisories are forecasts to notify en route aircraft of the possibility of encountering hazardous weather conditions. The NWS weather forecast office in Honolulu issues advisories for the Hawaiian Islands.

[12] Echoes of this intensity correspond with the video integrator and processor (VIP) intensity "Level 1" or "very light." According to FAA Advisory Circular 00-24B, "Thunderstorms," light to moderate turbulence with lightning is possible in VIP Level 1 weather.

[13] A Safety Board meteorology specialist performed a beam-height calculation for the accident site.

[14] Geostationary Operations Environmental Satellite number 10 data was obtained from the National Climatic Data Center and displayed on the Safety Board's Man-computer Interactive Data Access System workstation. Both

congestus clouds; the radiative cloud top temperatures in the vicinity of the accident site corresponded to cloud tops from 17,000 to 24,000 feet. The 1430 infrared image depicted developing cumulonimbus clouds over the northern shore of Kauai and in the vicinity of the accident site; the radiative cloud top temperatures in the vicinity of the accident site corresponded to cloud tops from 19,000 to 30,000 feet. Images from 1330 to 1430 depicted broken to overcast layers of stratocumulus and towering cumulus clouds extending over the interior sections and the northwest and north shores of Kauai. The images showed several towering cumulus clouds capable of producing rain showers embedded within the cloud layers; the accident site was located under one such band of towering cumulus clouds at 1400. By 1430, an elongated area of cumulus congestus to cumulonimbus clouds extended from the accident site northeastward.

A study was performed using the upper air sounding for 1400 and the observed and derived stability parameters. The data indicated an unstable, moist, low-level environment with a relative humidity of 75 percent or more from the surface to approximately 5,000 feet. The sounding supported a moderate to high risk of thunderstorms, with the K-index[15] indicating an approximate 80 percent chance of thunderstorms. The study determined that the maximum vertical velocity of the potential convective updrafts in thunderstorms was 160 knots, the wind gust or potential outflow winds from thunderstorms were about 41 knots, and the sounding was favorable for microburst development with outflow winds of 55 knots.

Microbursts are small-scale intense downdrafts, which, upon reaching the surface, spread outward in all directions from the downdraft center. This causes both vertical and horizontal windshears that can be extremely hazardous to all types and categories of aircraft, especially at altitudes below 1,000 feet, because the conditions can produce a situation in which it is difficult to control the aircraft. A typical microburst lasts about 15 minutes and occurs in a space of less than 1 mile horizontally and within 1,000 feet vertically. Due to their short life span, small size, and the fact that they can occur over areas without surface precipitation, microbursts are not easily detectable using conventional weather radar or windshear alert systems.

Weather Information Sources Available to the Pilot

According to company personnel, pilots usually obtain their weather information from a combination of sources, including the FAA Flight Service Station (FSS) in Honolulu, local television reports, various Internet sites, and the LIH automatic terminal information service (ATIS).

According to the pilot, he arrived for work on the day of the accident about 0615, obtained a printout of FAA and NWS weather information from the direct user access terminal system (DUATS)[16] and noted nothing unusual about the information. The accident flight was his

visible and infrared imagery was obtained surrounding the time of the accident.

[15] The K-index is a measure of thunderstorm potential based on the vertical temperature lapse rate and the amount and vertical extent of low-level moisture in the atmosphere.

[16] DUATS provides pilots access to FAA and NWS alphanumeric preflight weather information, such as FAs, TAFs, METARs, and AIRMETs, via personal computer.

seventh tour flight of the day, and he had just finished his lunch break. In preparation for the flight, he spoke with a representative located at the company base in Princeville, Hawaii, on the northern part of Kauai, to see if there were any schedule changes. The pilot did not ask the representative about the weather conditions in that area. The pilot stated that, before departure on the accident flight, he listened to the LIH ATIS, which reported no adverse weather.

For in-flight weather information, tour pilots also use the CTAF to exchange brief, informal statements regarding their weather observations;[17] however, the high terrain in the middle of the island can limit the effective range of these transmissions.

Weather Conditions Observed by Pilot Witnesses

Three other tour pilots were conducting helicopter flights in the area of Kailiu Point within minutes before and after the accident. One pilot, who flew along the Na Pali Coast about 15 minutes before the accident flight, stated that the conditions at that time were clear with rain showers just off the point at Kee Beach. The pilot stated that he maintained an altitude of about 1,500 to 2,000 feet agl and that his flight entered heavy rain conditions when he passed Kailiu Point about 1400. He stated that he initiated a gradual descent to about 300 feet agl to maintain visual contact with the shoreline and that he did not encounter any turbulence, downdrafts, lightning, or windshear while maneuvering through the rain. He stated that his helicopter emerged from the storm abeam Haena and that he announced over CTAF that "Haena is clear, blue, and twenty-two"[18] and advised other flights to avoid the showers. He stated that unknown pilots made two inquiries over the CTAF about the intensity of the showers and that he responded "intense" and "heavy duty."

Another tour pilot stated that he heard the report over the CTAF of "heavy duty rain showers" at Kee Beach. He stated that he asked about the visibility over the CTAF but received no reply. He stated that, when his flight reached the Kee Beach area, he saw a "super dark misty rain shower" and decided to turn his helicopter around rather than enter the weather.[19] He estimated that the visibility associated with the storm at that time was about 1/8 mile or less. He stated that the air was smooth with no thunder or lightning and that the water was smooth with no white caps. He stated that he discontinued his tour and was on his way back to base when he heard the mayday calls over the CTAF.

A third tour pilot stated that he was flying his helicopter about 1,500 feet agl headed northeast along the Na Pali Coast when he heard the mayday calls. Shortly thereafter, he saw the

[17] These informal air-to-air communications differ from pilot reports (PIREPs), in which pilots provide weather observation reports in a standard format to FAA ground facilities that serve as collection points for the exchange of PIREP information with other pilots and en route aircraft. According to the FAA *Aeronautical Information Manual*, among other uses, air traffic control facilities can use PIREPs for air traffic weather-avoidance procedures; FSS can use the information to brief other pilots or to provide in-flight advisories and weather-avoidance information to en route aircraft; and the NWS can use the information to verify or amend conditions contained in aviation forecasts and advisories.

[18] The pilot's statement was slang for visibility unlimited, or clear.

[19] This helicopter was an MD-500, and its direction of flight was consistent with the helicopter that the accident survivors reported seeing flying below their helicopter before it entered the storm.

helicopter that had turned around and was returning to base, and he discussed the mayday calls with that pilot. He stated that he continued his flight northeast, and, after passing Kailiu Point, his flight entered the rain. He stated that he initiated a gradual descent to about 500 feet agl to maintain visual reference with the coastline but that the weather was getting worse and he did not think he could continue and maintain VFR. He chose to turn back, and, while reversing course, he had to descend the helicopter to 100 feet agl to maintain visual contact with the shoreline until he exited the storm. He stated that the conditions inside the storm were smooth with no turbulence or windshear.

WRECKAGE AND IMPACT INFORMATION

The wreckage was located several hundred feet off the shoreline near Kee Beach in about 60 feet of water. The wreckage was recovered on September 25, 2005, and transported to LIH for examination.

Examination revealed that control continuity could be established throughout the fuselage, and evidence of rotational signatures and component system continuity was noted. The tail boom, horizontal and vertical stabilizers, and the tail rotor system showed no evidence of preimpact anomalies. All main rotor blade root sections remained attached to the main rotor hub.

The engine remained attached to the airframe and was removed for examination. The compressor blades turned freely when manually rotated and showed no evidence of foreign object damage or anomalies. The main rotor transmission was removed for examination, and rotation occurred when the main rotor head was turned. No evidence of any preimpact mechanical malfunction of the helicopter's airframe, engine, or systems components was observed.

MEDICAL AND PATHOLOGICAL INFORMATION

Postmortem examinations revealed that the cause of death for the passengers from the front left and center seats was "drowning." The cause of death for the passenger from the rear right center seat was reported as "cardiac arrest due to near drowning." The coroner noted no serious injuries on any of the passengers.

SURVIVAL ASPECTS

During the tour flight, two passengers were seated in the two front seats to the left of the pilot, and the other three passengers were seated in rear seats.[20] The two surviving passengers, who had been seated in rear seats, reported that they received a safety briefing before departure and that each passenger was wearing a personal flotation device (PFD) in a pouch attached around the waist.

[20] The passengers occupied the rear right seat, rear right center seat, and the rear left seat; the rear left center seat was empty.

The passenger who was seated in the right rear seat stated that, after the helicopter rolled, the right side of the cabin was engulfed in water within about 3 seconds. He stated that he remembered the pretakeoff safety briefing and took off his headset and donned his PFD vest; however, he noted that the vest interfered with his ability to find and unlatch his seat belt and that it took him "precious seconds" to open the waist pouch to remove and don the vest. He stated that he exited the helicopter out the right side door but that he could not recall opening it. He stated that he pushed and kicked hard to make it to the water's surface, where he observed heavy rain, thunder, and lightning.

The passenger from the left rear seat stated that she did not know how to swim and was panicked. She stated that she donned her PFD vest but had trouble remembering the safety briefing and tried to inflate it while inside the helicopter but could not figure out how to do it.[21] She stated that she attempted to assist the passenger in the rear right center seat, who was having difficulty because he was tangled with his headset. After she exited the helicopter out the left side and reached the surface, she still could not figure out how to inflate her PFD. The passenger from the right rear seat assisted her by pulling at least one of the inflation handles to inflate her vest for her.

The passenger from the right rear seat stated that he then dove back down to the helicopter to attempt to extricate the passenger from the rear right center seat. When he resurfaced with that passenger, who was having difficulties breathing, he put that passenger's PFD vest over the passenger's head and inflated it for him.[22]

The pilot stated that he was already completely under water when he released his seatbelt. He stated that, as he made his way out the helicopter's left side, he tried to see or feel for passengers as he exited, but he did not find anyone. He stated that he made his way to the surface then tried to dive back down to the helicopter, but he could not find its door. He then returned to the surface and found one passenger being supported by two others. He stated that he helped one of the passengers don and inflate a life vest and that he donned and inflated his own vest.

Recovery personnel found the body of the passenger in the front center seat still secured in the seat by the lap belt and wearing an uninflated PFD vest. The body of the passenger from the front left seat was found floating facedown in the water and wearing a PFD vest. First responders recalled that the passenger's PFD vest appeared inflated, but they did not know if only one or both chambers appeared inflated. At some point during recovery of the victim, the PFD was removed from the body and misplaced; therefore, it was not available for examination to determine its actual inflation configuration.

[21] The safety briefing video instructed the passengers to remove their headsets before donning the PFD vests. The video also showed how to use the PFD's inflation handles and the manual inflation tubes, and it instructed the passengers not to inflate their vests until after exiting the helicopter.

[22] The survivors attempted to assist the passenger by providing aided breathing and chest compressions before rescue arrived, but the passenger died later that day.

TESTS AND RESEARCH

Examination and Functional Testing of Recovered Personal Flotation Devices

Four of the six PFDs from the accident were recovered for examination;[23] all of the recovered PFDs were Hoover Industries model FV-35E, manufactured in accordance with Technical Standard Order (TSO)-C13e. This model PFD features two separate inflation chambers that a user must inflate separately by pulling each chamber's plastic handle. According to the PFD's design, each chamber is equipped with a pressurized, 16-gram, carbon dioxide cylinder that punctures when the handle is pulled, releasing the pressurized gas into the chamber to inflate it fully within 2 seconds. Each chamber is also equipped with an oral inflation tube into which the user can blow to inflate the chamber.

One of the recovered PFDs belonged to the passenger in the front center seat. Examination revealed that neither chamber was inflated and that the plastic inflation handles were not pulled. Testing revealed both chambers inflated when the handles were pulled. The three other recovered PFDs were, on the basis of passenger interviews, those that were used by the pilot and the two surviving passengers, though it was not known which PFD belonged to which occupant. Examination of these vests revealed one had both chambers inflated, and the other two vests each had only one chamber inflated. Examination and testing of one PFD that had only one chamber inflated revealed the other chamber inflated when the handle was pulled.

Examination of the other PFD that had only one chamber inflated revealed that the inflation cylinder for the uninflated section was dimpled in the discharge area but was not punctured. Testing revealed that, after the dimpled cylinder was reinstalled in the PFD, pulling the inflation handle punctured the cylinder, and the chamber inflated.

Water-Immersion Performance Demonstration of Personal Flotation Devices

Heli-USA provided the investigative team with two PFDs: one was a Hoover Industries model FV-35E, and the other was an Eastern Aero Marine model KSE-35HC2L8.[24] Heli-USA had recently retired both PFDs from service after about 12 months of use in accordance with the manufacturers' recommended inspection interval.[25] These PFDs were used for water-immersion demonstrations to examine donning procedures and to compare vest performance with one and both chambers inflated.

[23] According to interviews with the survivors, of the two PFDs that were not located, one belonged to the passenger from the rear right center seat, and the other belonged to the passenger whose body was found floating facedown in the water.

[24] The Eastern Aero Marine model KSE-35HC2L8 is also manufactured in accordance with TSO-C13e.

[25] Each PFD manufacturer recommends that the PFDs be returned for inspection at specified intervals. On the recommended annual inspection dates, Heli-USA retired the PFDs from service and replaced them with new ones. The Honolulu FSDO requires its air tour operators to maintain the PFDs in accordance with the manufacturer's instructions (the requirement is included in Section D104 of each operator's approved operations specifications). Although Heli-USA's operations specifications were approved by the Las Vegas FSDO, and Section D104 did not specifically reference PFD maintenance, Heli-USA followed the manufacturer's recommended inspection intervals.

Two test subjects[26] entered the water before donning the PFD vests, and each described that the vests were "relatively easy" to put on but that two hands were required to place the vest over the head while in the water. The subjects found that, with only one vest chamber inflated, each PFD provided flotation for the wearer, and they were able to remain at the surface with their heads above the water. The subjects also found that, with only one chamber inflated, if they simulated unconsciousness and made no attempts to right themselves, it was possible for them to float facedown. With both vest chambers inflated, it was not possible for either subject to float facedown; the PFDs rolled them to a faceup position within seconds. According to TSO-C13e, which specifies that the PFD must right a wearer who is in a facedown position, the buoyant force needed to meet the TSO is determined with both chambers inflated.

During the demonstration, when the subjects first attempted to pull the inflation handles one at a time, the investigator found that one chamber on the Eastern Aero Marine PFD failed to inflate when the handle was pulled. Examination revealed that the threaded cylinder for that chamber was not screwed securely into its housing. When the investigator properly seated the cylinder and then pulled the inflation handle, the chamber inflated.

Following these demonstrations, another Hawaii air tour operator voluntarily examined 13 PFD vests that had been recently retired from service after about 1 year of use.[27] Each PFD had 2 inflation cylinders, and the operator reported that 18 of the 26 cylinders were loose in their housings.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Heli-USA is based in Las Vegas and conducts Part 135 air tours in Las Vegas and on the islands of Kauai and Oahu, Hawaii. At the time of the accident, the company operated 9 helicopters, including the accident helicopter, and employed 20 pilots and 13 mechanics; 3 helicopters, 6 pilots, and 4 mechanics were used for the company's operations in Hawaii.

[26] One test subject was 5-feet 5-inches tall and weighed 128 pounds, and the other was 6-feet 3-inches tall and weighed 195 pounds.

[27] Such a voluntary inspection by the operator is only feasible for retired-from-service PFDs because in-service PFDs must remain unopened within their waist pouches to meet FAA airworthiness requirements. The operator had to open the pouches on the retired PFDs to examine the security of the cylinders.

In 1997, Heli-USA began sightseeing operations in Las Vegas under the provisions of 14 CFR Part 91. The company obtained a Part 135 air carrier certificate in March 1999 to conduct on-demand air taxi operations in the contiguous United States and the District of Columbia, and, in 2000, the FAA amended the company's Part 135 operations specifications to allow for operations in Hawaii.

The Las Vegas FSDO issued Heli-USA's Part 135 operating certificate and, as the certificate holding district office, was responsible for all FAA reporting requirements, technical administration requirements, and regulatory oversight of Heli-USA. The Honolulu FSDO was responsible for surveillance of air tour activities within its geographic area; this surveillance included enforcing SFAR 71 rules and Honolulu FSDO-approved SFAR 71 procedures throughout the Hawaiian Islands.

Company Procedures for Weather Information and Adverse Weather

According to Heli-USA's operations specifications, in class G airspace,[28] no flight may be conducted on overland transition segments where the flight visibility is less than 3 statute miles, no flight may be conducted on overwater transition segments where the flight visibility is less than 1 statute mile, and no flight may be conducted closer than 300 feet above, below, or horizontally from any cloud. The operations specifications also require that en route helicopter operations be conducted a minimum of 500 feet above raw terrain and no closer than 1,500 feet from any person, structure, vehicle, or vessel.

According to Heli-USA's general operations manual, pilots are required to obtain valid aeronautical weather information from FAA- or NWS-approved sources. The manual also states that, for VFR operations, the pilot may "use weather information based on your own observations or on those of other acceptable sources[29] to supply appropriate observations" if no reports are available from the approved sources.

The general operations manual also provides procedures for encounters with adverse weather and states that pilots should "avoid flight through or near thunderstorms" and should "not trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm." The manual states that, when flying a helicopter under VFR, a pilot must maintain visual surface reference sufficient to safely control the helicopter.

Special Federal Aviation Regulation 71 Procedures Regarding Adverse Weather

Heli-USA's Honolulu FSDO-approved SFAR 71 procedures manual contains adverse-weather provisions that enable pilots to deviate from the SFAR 71 minimum altitude requirement to avoid poor weather, if necessary. According to the manual:

[28] The accident occurred in class G airspace, which, according to the FAA *Aeronautical Information Manual*, chapter 3-3-1, is "uncontrolled" airspace that "has not been designated as" class A, B, C, D, or E airspace.

[29] These sources include television news reports and radio reports.

> In the event that unforecasted weather conditions are encountered, so as to prevent flight along the planned flight path, the pilot in command must use his/her judgment in order to safely circumnavigate the weather. In doing so, the following must be accomplished, [among others]: A radio report transmitted to another company or non-company aircraft, air traffic control agency or FSS of your intended route and the extent of the weather conditions encountered. … Should weather conditions deteriorate to a condition that would disallow the tour to continue in compliance with SFAR 71, the pilot will declare the air tour terminated and return to base. In this event the flight will be conducted in accordance with the regulations of … Part 135.

According to 14 CFR 135.205, the daytime VFR minimum visibility requirement for helicopter operations at or below 1,200 feet agl in class G airspace is 1/2 mile. The requirements of 14 CFR 135.207 state, "No person may operate a helicopter under VFR unless that person has visual surface reference … sufficient to safely control the helicopter."

ADDITIONAL INFORMATION

Preflight Safety Briefing

According to Heli-USA personnel, the passengers were shown an approximate 4-minute safety video before they boarded the helicopter.[30] A review of the video showed that the safety topics included a briefing that demonstrated various aspects of the vest-type PFD, including how to remove it from the waist pouch and place it over the head. The video instructed the passengers to remove their headsets before donning the vests. The video also identified the two red handles to be pulled to inflate the vest and the two oral tubes to blow into in case the vest does not inflate. In addition to the safety video, the passengers received verbal instructions from ground personnel and the pilot when they boarded the helicopter and were asked if they had any questions.

Previous Weather-Related Air Tour Accident on Kauai

During the National Transportation Safety Board's investigation of the September 24, 2004, accident on Kauai involving a Bali Hai Helicopter Tours, Inc., air tour flight that encountered reduced visibility and crashed into a ridgeline, killing the pilot and the four passengers,[31] the Safety Board found evidence that the pilot of that helicopter had flown into clouds on previous tours and that he had previously performed ridgeline crossings at low altitudes in areas where the minimum flight altitude, per SFAR 71, was 1,500 feet agl. In addition, some Hawaii air tour pilots interviewed did not fully understand the minimum altitude requirements established by their FAA-approved SFAR 71 deviation authorizations.

[30] SFAR 71 requires that, before takeoff, passengers on air tour flights that include any segment beyond the shore must receive a briefing on water ditching procedures, use of required flotation equipment, and emergency egress from the aircraft in the event of a water landing.

[31] National Transportation Safety Board, *Weather Encounter and Subsequent Collision into Terrain, Bali Hai Helicopter Tours, Inc., Bell 206B, N16849, Kalaheo, Hawaii, September 24, 2004*, Aviation Accident Report NTSB/AAR-07/03 (Washington, D.C.: NTSB, 2007).

During that investigation, Safety Board investigators also met with Honolulu FSDO personnel in February 2005 to discuss air tour oversight and surveillance issues. FSDO personnel reported that, from October 1995 to 2003, the FSDO had a dedicated geographic surveillance unit (GSU) that provided direct oversight of all air tour operators in Hawaii and was responsible for ensuring compliance with SFAR 71. The GSU was equipped with surveillance cameras, binoculars, video cameras, and other equipment that the inspectors used to monitor tour operations and ensure that the pilots were complying with cloud and terrain clearance requirements. The GSU also used a number of innovative surveillance methods, such as monitoring air tour activity from remote locations and sending inspectors posing as tourists on revenue flights. According to FSDO personnel, the GSU was highly successful.

That investigation found that, however, by late 2003, the Honolulu FSDO needed to fill operations and airworthiness inspector positions and that the GSU inspectors were reallocated. After the GSU was officially disbanded in May 2004, there were no inspectors dedicated to providing direct surveillance of air tour flights in Hawaii. By the time of the Heli-USA accident, the Honolulu FSDO still did not have a GSU or other means of providing direct surveillance of commercial air tour operations.

ANALYSIS

Accident Sequence

The air tour flight departed LIH, on the southeastern part of the island, and headed west to begin a clockwise tour around the island. Weather forecasts for the afternoon included VFR conditions with the possibility of reduced visibility in thunderstorms and heavy rain. The pilot stated that, while flying the helicopter along the island's northern coastline, he maneuvered the helicopter to avoid traffic, and it entered a storm with heavy rain and reduced visibility. The passengers reported that the helicopter made no evasive maneuvers before entering the adverse weather.

The pilot stated that, while in the heavy rain, he descended the helicopter to maintain visual reference to the beach. The pilot then decided to turn back, and, while doing so, the helicopter's airspeed went to zero, and the helicopter rapidly descended. The pilot added full power and control inputs, but the helicopter continued to descend, and it crashed into the water several hundred feet off shore. Survivors reported they observed heavy rain, thunder, and lightning while they were in the water.

Microburst Phenomena

A weather study found that satellite infrared imagery for the location and timeframe of the accident indicated the rapid development of cumulus clouds capable of producing heavy rain showers, and stability and energy indices indicated potentially strong updrafts and downdrafts. The heavy rain showers and building thunderstorm activity reported by witnesses and the sounding profile supported the presence of embedded wet-type microburst activity. Statements from the pilot and passengers regarding the helicopter's rapid descent in torrential rain are consistent with an encounter with a microburst event.

Weather-Reporting Facility Limitations

No weather reporting facility is located on the north end of the island where the accident occurred, and the weather facility on the south end of the island is unable to observe the weather on the north end reliably because of interference from high terrain in the middle of the island. The WSR-88D radar's depiction of the convective area showed only light showers in the immediate vicinity of the accident site; however, the actual weather conditions were likely much stronger than what was depicted. Although a radar system capable of accurately observing the north end of the island could not have detected the presence of a microburst, the characteristics of the storm encountered by the accident helicopter (and two of three other tour helicopters in the area) would have produced strong reflectivity returns.

In the absence of reliable and timely official weather information, Kauai air tour pilots typically use their own judgment on the basis of the appearance of the weather to determine whether to proceed. Because the island's unique weather patterns involve daily, brief, localized rain showers, it is not unusual for Kauai air tour pilots to encounter and briefly penetrate areas of precipitation during tours. For example, of the three other tour pilots who approached the storm

associated with the accident, one elected to turn back without entering the conditions and two chose to fly through it. Because of the rapidly changing characteristics of the storm, each pilot likely encountered different conditions. The three pilots (including the accident pilot) who entered the storm found that they did not quickly break out of the weather as expected.

Federal Aviation Administration Surveillance of Air Tours in Hawaii

One year before this accident, an air tour accident involving Bali Hai Helicopter Tours, Inc., occurred on the island of Kauai on September 24, 2004, after the pilot decided to continue the flight into deteriorating weather rather than deviate from his tour route; the helicopter entered IMC and crashed into mountainous terrain, killing the pilot and the four passengers. During the Safety Board's investigation of that accident, the Board noted that, for a number of reasons, the Honolulu FSDO has not been able to enforce the SFAR 71 regulations and deviation authorizations adequately. This situation and other factors led the Board to conclude in the Bali Hai accident report that, "because the Honolulu FSDO is not providing direct surveillance of and enforcement of SFAR 71, pilots continue to violate SFAR 71 and the certificate of waiver or authorization requirements, either intentionally or unintentionally, thus, placing themselves and their passengers at unnecessary risk for accidents, particularly in marginal weather conditions." The Board determined that a contributing factor in the Bali Hai accident was "inadequate FAA surveillance of SFAR 71 operation restrictions" and issued a safety recommendation in the report to address the issue.[32]

At the time of the Heli-USA accident, the Honolulu FSDO still did not have a means to provide direct surveillance of air tour activities. Although some operators had FAA-approved procedures that allowed pilots to descend below the SFAR 71 minimum altitudes to avoid unforecasted weather, provided that they canceled their tours and returned to base under Part 135 rules, there is evidence that pilots from multiple operators were not properly following these procedures and that there was little threat of enforcement consequences for doing so. Of the three pilots who chose to enter the adverse weather, all had to descend below the SFAR 71 minimum altitude to maintain visual contact with the shore. Although one pilot reported he canceled his tour and returned to base, another pilot (the accident pilot) crashed while attempting to reverse course, and the pilot who successfully made it through the storm at 300 feet agl continued his tour, rather than cancel it and return to base as required. The Safety Board is concerned that, without adequate FAA surveillance, the very safety provisions that were put in place to protect passengers from flight in unsafe weather conditions could be used by some pilots to enter—rather than avoid—such weather to continue revenue flights, placing themselves and their passengers at unnecessary risk for accidents.

Survivability Issues

Although each occupant on the accident flight wore a PFD and received instruction on its use as required under SFAR 71, not all were successful in completing the procedures for donning

[32] On February 13, 2007, the Safety Board adopted the report, which contained Safety Recommendation A-07-21, to recommend that the FAA "develop a permanent mechanism to provide direct surveillance of commercial air tour operations in the State of Hawaii and to enforce commercial air tour regulations."

the PFD, exiting the helicopter, and properly inflating the PFD, even though all were physically capable of doing so. Of the three passengers who were killed, none sustained any serious or incapacitating trauma injuries during the impact sequence, and each died of drowning or drowning-related circumstances. Staff considered several factors that may have affected each passenger's outcome, including the speed at which the helicopter sank, PFD-donning and egress procedures, safety briefing clarity, and the mechanical condition of the PFDs.

Lack of Helicopter Flotation Equipment

The helicopter sank quickly; thus, the passengers had little time to help themselves or others before they were submerged. According to the FAA, "while the proper donning and securing of a life preserver may not take a lot of time under normal non-stressful situations, it can be a time-consuming process in a time of high stress."[33] The Safety Board notes that, although some survivors reported they either experienced or observed other passengers experience difficulties in completing the PFD and egress procedures, none of the difficulties alone (such as the one passenger's difficulties with the headset) should have rendered survival impossible.

In its 1995 special investigation report (SIR) on the safety of the U.S. air tour industry,[34] the Safety Board noted that the combined use of PFDs and helicopter flotation equipment would provide the optimum level of safety for air tour passengers in the event of emergency ditching. In the SIR, the Board pointed out that, although the FAA's original draft of SFAR 71 called for the use of both PFDs and helicopter flotation systems, the final version allowed Hawaii air tour operators to provide only one or the other. The Board urged the FAA to reconsider this provision of SFAR 71 and to evaluate the use of helicopter floats for other overwater air tour locations.

In response to the SIR, on October 22, 2003, the FAA issued a notice of proposed rulemaking (NPRM) for national air tour safety standards that stated the following:

> The FAA has determined that equipping certain helicopters with floats for over-water operations increases the likelihood of occupant survival in the event of an emergency water ditching. Floats would allow the helicopter to remain on the surface of the water for a longer period of time, thus allowing the occupants time to exit while the helicopter is still on the surface of the water.

In the NPRM, the FAA also stated that it recognized the need for more stringent flotation equipment requirements for commercial air tours and proposed that "single-engine helicopters and certain multi-engine helicopters operated in commercial air tours over water would have to be equipped with fixed or inflatable floats … unless the flight over water is necessary only for take off or landing." However, when the FAA issued the final rule on February 8, 2007, the rule

[33] This statement is in the FAA's notice of proposed rulemaking, "National Air Tour Safety Standards," Docket No. FAA-1998-4521, Notice No. 03-10, issued on October 22, 2003, in *Federal Register,* Vol. 68, No. 204.

[34] National Transportation Safety Board, *Safety of the Air Tour Industry in the United States*, Special Investigation Report NTSB/SIR-95/01 (Washington, D.C.: 1995).

stated that helicopters need not be equipped with floats if each occupant is wearing a life preserver while the helicopter is within power-off gliding distance of the shoreline.

In this accident, helicopter floats would have likely kept the helicopter on the water surface longer. Because all of the passengers (including the nonsurvivors) either donned or attempted to don their PFDs and because all likely perceived the immediate need to exit the helicopter, the Safety Board concludes all of the passengers would have had the opportunity to don their PFDs and egress the helicopter successfully had the helicopter not sunk so quickly.

The Safety Board also notes that the accident helicopter was initially traveling over the shore but ended up over the ocean as the emergency progressed. Further, the ditching emergency was not related to a loss of engine power. Therefore, the Board concludes that, with regard to helicopter flotation equipment, there should be no exceptions for overwater takeoffs and landings and no distinction between single- and multi-engine helicopters.

Personal Flotation Device Inflation Issues

During demonstrations of representative PFDs, test subjects reported that it was relatively easy to don the PFDs and inflate both chambers, even when the procedures were performed in the water. According to the demonstrations of the two PFD models, the test subjects found it was not possible to float facedown with both chambers inflated.

Examination of the recovered PFDs found that, of the three PFDs that were worn by the survivors, only one had both chambers inflated. One recovered PFD with an uninflated chamber showed no evidence that any attempt had been made to inflate it, and it functioned properly when tested. The other recovered PFD with one uninflated chamber showed evidence that someone had attempted to inflate it but was unsuccessful, likely because of an incompletely seated cylinder.

Because the PFD worn by the passenger who was found floating facedown was not recovered for examination, it was not possible to determine its inflation configuration or to conclude whether both chambers could have inflated if the handles were pulled. Also, because it is not known at what point in the egress sequence this passenger drowned, it is not possible to conclude whether a fully inflated PFD could have saved this passenger's life.

Of the two PFDs provided for the water-immersion demonstration, one had a chamber that failed to inflate because of an improperly seated cylinder. Also, another Hawaii air tour operator reported 18 of 26 cylinders were loose on 13 PFDs examined. All of these PFDs (the 2 provided for testing and the 13 others examined) had been recently retired from service after about 1 year of use in accordance with the manufacturers' recommendations and the Honolulu FSDO's requirements for air tour operators. Because the PFDs must remain sealed in their pouches to meet airworthiness requirements, it is not possible for the operators to inspect the cylinders themselves between recommended inspection intervals. The Safety Board is concerned that the number of improperly seated cylinders found within such a small sample size may

indicate that similar problems exist elsewhere and could include instances in which both cylinders on one PFD are not secure.

The Safety Board concludes that, without a solution to the cause of and how to prevent inflation cylinder unseating, passengers are no longer assured that their flotation devices will perform as designed in the event of an emergency and that further evaluation is needed to determine whether design, maintenance, and/or in-service handling issues are related to the problem. Although the PFDs are equipped to allow for oral inflation of the chambers, the Board is concerned that, in the case of passengers who cannot swim, the 2-second cylinder inflation would be more preferable than attempting oral inflation and that panicked passengers may forget about the oral inflation option.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the accident was the pilot's decision to continue flight into adverse weather conditions, which resulted in a loss of control due to an encounter with a microburst. Contributing to the accident was inadequate Federal Aviation Administration surveillance of Special Federal Aviation Regulation 71 operating restrictions. Contributing to the loss of life in the accident was the lack of helicopter flotation equipment.