



National Transportation Safety Board

Washington, D.C. 20594

Aircraft Accident Brief

Accident Number: LAX03MA292
Operator: Sundance Helicopters, Inc.
Aircraft and Registration: Aerospatiale AS350BA, N270SH
Location: Near Grand Canyon West Airport, Arizona
Date: September 20, 2003
Adopted On: October 30, 2007

HISTORY OF FLIGHT

On September 20, 2003, about 1238 mountain standard time,¹ an Aerospatiale AS350BA² helicopter, N270SH, operated by Sundance Helicopters, Inc., crashed into a canyon wall while maneuvering through Descent Canyon, about 1.5 nautical miles (nm) east of Grand Canyon West Airport (1G4) in Arizona. The pilot and all six passengers on board were killed, and the helicopter was destroyed by impact forces and postcrash fire. The air tour sightseeing flight was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 135. Visual meteorological conditions (VMC) prevailed for the flight, which was operated under visual flight rules on a company flight plan. The helicopter was transporting passengers from a helipad at 1G4 (helipad elevation 4,775 feet mean sea level [msl]) near the upper rim of the Grand Canyon to a helipad designated “the Beach”³ (elevation 1,300 msl) located next to the Colorado River at the floor of the Grand Canyon.

About 0745, the accident pilot flew the accident helicopter on an operational check flight at the company’s base at McCarran International Airport (LAS), Las Vegas, Nevada. After the short local flight, Sundance ground personnel (consisting of loaders and a tour coordinator) boarded the helicopter about 0840 and flew with the accident pilot on a 45-minute flight from LAS to 1G4 to commence the day’s Descent Canyon tour operations. The director of operations estimated that each flight from 1G4 to the Beach helipad lasted about 3.5 minutes (see figure 1).

¹ All times in this report are mountain standard time based on a 24-hour clock. Nevada times are Pacific daylight time and have been converted to mountain standard time, which is 1 hour ahead of Pacific daylight time.

² The accident helicopter was modified with a different engine model and other configuration changes. See the section titled, “Aircraft Information,” for more details.

³ Sundance designated names for each of its helipads.

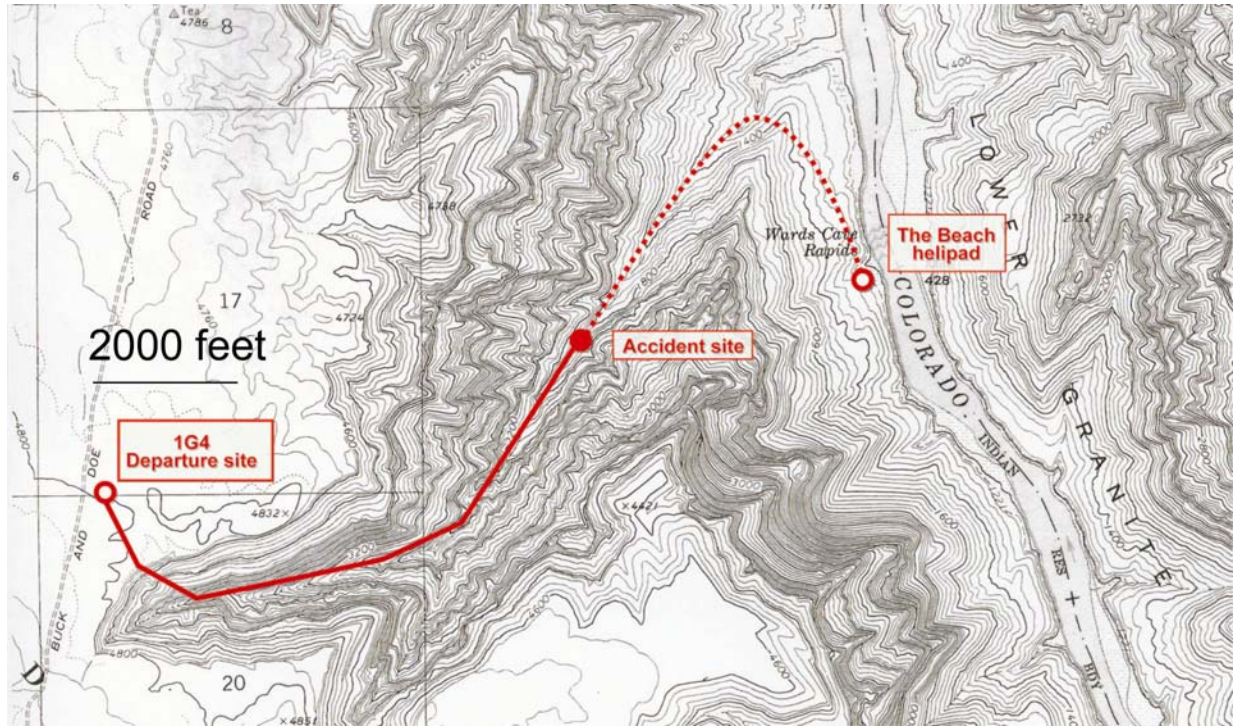


Figure 1. Topographic chart showing the 1G4 departure site, the accident site, and the prescribed route through Descent Canyon to the Beach helipad.

These flights were part of an advertised tour package in which Sundance pilots flew passengers through Descent Canyon, dropped them off at the Beach helipad for a scenic boat ride on the Colorado River, then picked them up at the Beach helipad later in the day for a return flight to 1G4 through another scenic canyon.⁴

The accident flight was the pilot's 11th flight through Descent Canyon that day. The helicopter lifted off from 1G4 about 1237 and flew to the rim of Descent Canyon. The tour coordinator stated that she did not hear the pilot make either the first customary radio call⁵ stating that he was lifting off from the helipad or the second customary radio call advising that he was entering Descent Canyon en route to the Beach helipad. A pilot for Papillon Grand Canyon Helicopters, who departed in his helicopter from 1G4 and flew through Descent Canyon about 2 minutes before the accident flight, stated that he did not hear any radio calls from the accident pilot and did not know that a helicopter was behind him in the canyon.

The Sundance tour coordinator and a Papillon loader at 1G4 stated that they observed the accident helicopter hover at the rim of Descent Canyon for about 30 to 45 seconds before beginning a level descent. They stated that the helicopters usually flew directly from the loading pads to the top of Descent Canyon and either nosed down into the canyon or hovered for only a

⁴ See the section titled, "Airport and Route Information," for additional details.

⁵ Three helicopter tour operators conducted flights from 1G4, which had no air traffic control tower. The operators had an unwritten agreement that pilots would use the common traffic advisory frequency to announce each departure from the helipads and each entry into Descent Canyon. According to Sundance personnel, these calls were made almost without exception.

few seconds before descending nose-low into the canyon. The Sundance tour coordinator stated that ground personnel assumed that the accident pilot may have been waiting for the Papillon helicopter to clear the canyon before he initiated his descent.

The Papillon pilot who descended his helicopter ahead of the accident flight stated that, while he was approaching the helipad next to the Colorado River, he noticed a fireball rising on the canyon wall behind him in Descent Canyon. There were no known witnesses or air traffic control radar data to provide information on the accident flight's progress inside the canyon after it descended out of view of the witnesses at 1G4.

The main wreckage was located on a canyon wall ledge about 400 feet beyond a near-vertical canyon wall that showed evidence of gouging consistent with a main rotor blade strike (see figure 2).⁶



Note: This photograph was taken by a National Transportation Safety Board investigator on February 4, 2004, during a canyon topography documentation flight. The wreckage was previously removed from the site.

Figure 2. Initial main rotor blade impact location and main wreckage location.

⁶ See the section titled, "Wreckage and Impact Information," for additional details.

PERSONNEL INFORMATION

The Pilot

The pilot, age 44, held an airline transport pilot certificate for airplane multiengine land and rotorcraft-helicopter and commercial pilot privileges for airplane single-engine land. Additionally, he held a certified flight instructor certificate with ratings for airplane single and multiengine, rotorcraft-helicopter, and instrument airplane and helicopter. A Federal Aviation Administration (FAA) first-class airman medical certificate was issued to the pilot on September 16, 2003, with no restrictions.

The accident pilot owned and operated a flight school in Rancho Cucamonga, California, from January 1990 to May 2000. When Sundance hired the pilot in May 2000, he had logged 5,400 total flight hours, 4,360 hours of which were in helicopters. At the time of the accident, the pilot had logged about 7,860 total flight hours, 6,775 hours of which were in helicopters. Company records indicated that he flew about 2,300 hours in Sundance's AS350BA, AS350B2, or Bell 206 helicopters. Sundance records indicated that the pilot had flown about 228, 86, and 25 hours in the 90, 30, and 7 days, respectively, preceding the accident. The pilot completed his recurrent ground training in the AS350 on February 20, 2003; his recurrent flight training in the AS350 on June 29, 2003; and his last 14 CFR Part 135 check in the AS350 on July 27, 2003. FAA records indicated no accident, incident, or enforcement action involving the pilot.

Statements from Passengers from an Earlier Tour with the Accident Pilot

National Transportation Safety Board investigators were able to locate and obtain statements from some passengers who had flown with the accident pilot earlier that day.⁷ A passenger on board a tour that departed about 1000 stated that the pilot hovered the helicopter near the top of the canyon for a few moments then "banked right and nose-dived into the canyon." He stated that the canyon was very narrow during part of the descent and that the pilot was flying the helicopter "very fast and swerving back and forth." He stated that the flight back to the top was uneventful until the pilot hovered the helicopter "very close" to the canyon wall about 100 feet from the canyon rim. He stated that the pilot followed the contour of the canyon wall closely and made "quick movements and fast stops" that the passenger considered excessive. According to the passenger, the company owner called him after the accident and told him that Sundance pilots "were not supposed to fly the way the pilot had flown them into the canyon that [day]."

Another passenger on the same flight described the initial descent into the canyon as a "severe drop" without warning. She described the descent as a "scary, free fall ride." A third passenger on the same flight stated that the pilot "pointed the nose of the helicopter straight

⁷ Safety Board investigators attempted to obtain the names and contact information for all of the passengers who flew with the accident pilot on the 10 flights before the accident flight; however, Sundance did not record this information. Most of the tours were booked through brokers and/or casino hotels in the Las Vegas area, which are not required to retain records. Despite numerous subpoenas issued by the Safety Board and attempts to obtain the contact information, only a few passengers' information was obtained.

down into the canyon, and the helicopter tilted to the right during the descent.” He stated that no one took pictures during the descent because “they were all hanging on with both hands” and that his friend’s wife screamed during the entire descent to the canyon floor.

Previous Passenger Complaints About the Accident Pilot

On July 5, 2001, Sundance received a fax from a passenger who complained about the accident pilot’s flying after a Descent Canyon flight on June 1, 2001. The passenger demanded a refund and stated, “being a heart patient with ... a very dangerous pilot in charge of the helicopter, I thought I was about to die. He flew so fast and dangerous, I could not believe his behavior.” No evidence was found indicating that Sundance had taken action against the pilot in response to this fax.

In a memorandum dated August 17, 2001, Sundance’s chief pilot informed the pilot and the company’s director of operations of disciplinary action to be taken against the pilot because of another customer complaint about his flying. The memo stated that the owner of Air Vegas took a ride from 1G4 to the Beach helipad and reported “that he was asked if he wanted a helicopter ride or an ‘E’ ticket ride.^[8] He received a ride that included abrupt banks^[9] and that did not meet the standards [of the] Tour Operators Program of Safety (TOPS).”¹⁰ The memo concluded that “this type of flying is not tolerated at Sundance Helicopters and is grounds for disciplinary action.” The memo informed the pilot that he was being suspended for 1 week without pay, and the pilot signed it, acknowledging that he had received and read it.

A review of Sundance flight records revealed evidence that the flight suspension had not been enforced. In an April 12, 2004, e-mail to Safety Board investigators, Sundance’s director of operations stated that the pilot was not suspended immediately because “at that time we were short of pilots.” He added that the company decided to have the accident pilot “serve his suspension later when we were not as busy or had more pilots.” He stated that, “after a couple of months when the activity slowed down, the chief pilot and I forgot to enforce the suspension.”

Statements from Sundance Helicopters’ and Other Operators’ Personnel

A former Sundance tour coordinator and loader stated that she had flown many times with the accident pilot on the Descent Canyon route and that “hundreds of people flew with [the accident pilot] and knew the way he flew ... he scared people down the canyon.” She stated that on those flights she thought “if one little thing goes wrong, we are, you know, dead.” She added,

⁸ An “E” ticket ride refers to a classification formerly used by Disneyland® Park for the most thrilling ride attractions.

⁹ Air Vegas was a Part 135 operator that flew passengers to 1G4 to take tours with Sundance. During a postaccident interview, the Air Vegas chief executive officer stated that the “descent was a little too fast and too showy” and that he was concerned that Sundance would get complaints from passengers about such “hot rod” flying. He stated that he was uncomfortable during the ride, even with his previous Air Force aviation experience, and that he recalled “feeling too close to the right side [of the canyon].”

¹⁰ TOPS guidelines specify, in part, that tour flights be conducted with bank angles of no more than 30°, pitch angles of no more than 10°, smooth flight transitions, and a maximum speed of 120 knots. See the section titled, “Sundance Helicopters’ Participation in Tour Operators Program of Safety,” for additional details.

“[w]hen he had tours ... I could hear tourists screaming [on the radio] as he went in.” She provided Safety Board investigators a copy of a videotape she filmed during a flight through Descent Canyon with the accident pilot in November 2001. She stated that the accident pilot “flew very close to the canyon wall. Banked off one wall and then turned the other way, almost upside down.”¹¹

A former Sundance pilot who flew for the company from July 2000 to June 2003 stated that the accident pilot was “an extremely good pilot, above average. He was more qualified in the helicopter than the job demanded; he was a phenomenal man to work with.” He stated that flight profiles for descents into Descent Canyon were “typically 10° to 15° nose-down, no more than 30° angle of bank. Those were Sundance Helicopters’ rules and didn’t change in the canyon.” He noted that those limits were sometimes exceeded with bank angles of “at least 60° to 70°, 30° to 40° nose-low.” He added that the accident pilot “worked the helicopter, pushed the aircraft, and pushed the rules of flight in Descent Canyon.”

The former Sundance tour coordinator and a Papillon operations manager at 1G4 stated that the accident pilot was known as “Kamikaze.” The Papillon operations manager stated that he first heard the name used in reference to the accident pilot from two other Papillon ground employees. He stated that they used the name after watching him fly over Papillon’s helicopters during refueling or passenger loading operations in a manner that involved stopping his helicopter in a hover, dipping its nose towards them, and then going on. He added that the accident pilot flew over him many times and that “I know how he flew.” The Papillon operations manager stated that many pilots talked about the accident pilot’s flying and that Papillon’s chief of safety had discussed these concerns with the accident pilot. He noted that the accident pilot “was always very nice, but didn’t change.” The former Sundance pilot acknowledged that the accident pilot “was called a name. He had the name for flying the [expletive] off the helicopter.” He added, “I went to him and talked to him about it. Personally, I have never seen him take the helicopter to any point he could not easily bring it back from.”

Another Sundance pilot, who was also flying Descent Canyon tours from 1G4 on the day of the accident, estimated that the accident pilot flew the descent “doing 120 to 140 knots.” She stated that “some pilots would keep it a little lower, 110 to 120 knots.” She stated that she “hugged the left side of the canyon in case she got a jack stall^[12] during the descent.”

Sundance’s director of operations stated that descent rates into the canyon were likely at least 2,000 feet per minute (fpm). He added that he thought most pilots flew at speeds between 100 and 110 knots at an average descent rate of about 1,000 fpm; however, he noted that descent rates could reach up to 1,500 to 2,000 fpm and “possibly as high as 2,500 feet per minute.” He noted that pilots descend from about 4,800 feet to about 1,200 feet msl (about 3,600 feet) in 3 to 3.5 minutes.

¹¹ See the section titled, “Examination of In-flight Descent Canyon Videotape,” for details.

¹² A jack stall, or servo transparency, is a phenomenon that can occur during certain flight conditions and affect the pilot’s flight controls. See the section titled, “Additional Information,” for more details.

AIRCRAFT INFORMATION

General

The accident helicopter was originally an AS350B model, serial number 1864, manufactured on October 23, 1985. On April 18, 1996, the helicopter was converted to an AS350BA model in accordance with Eurocopter Service Bulletin (SB) 01.35R2, dated April 19, 1995.¹³ Modifications included structural changes, new main rotor blades, a new tail rotor, and modifications to the drive system.¹⁴

Sundance purchased the helicopter on March 2, 1999, and the helicopter's registration was issued on June 17, 1999. Sundance modified the helicopter in May 2002 in accordance with Supplemental Type Certificate (STC) SR00805SE, replacing the original Turbomecca Arriel engine with a Honeywell LTS 101-600A-3A engine.¹⁵ At the time of the accident, the helicopter had accumulated about 10,890 hours total time and 54,976 cycles.¹⁶ The engine had accumulated about 9,516 hours total time and 12,465 cycles.¹⁷ The helicopter was not equipped and was not required to be equipped with a flight data recorder or cockpit voice recorder.

Maintenance and Inspection History

The helicopter's last 30-hour, 100-hour, and 500-hour inspections were accomplished on September 17, 2003, at an aircraft time of about 10,880 hours. Thirty-hour inspections were also completed on September 3, 8, and 13, 2003. One-hundred-hour and 200-hour inspections were also completed on September 3, 2003. No discrepancies were noted with any of the records for these inspections. Safety Board investigators reviewed the helicopter's maintenance log sheets for the period from January 1, 2002, to September 19, 2003. No discrepancies were noted with any of the records, and the records indicated that all airworthiness directives and SBs were accomplished.

The computer-generated and -maintained status printout, generated on September 22, 2003 (which comprises inspections that are due or life-limited parts that have overhaul or retirement times and on-condition replacement), was reviewed. The printout was compared to the daily maintenance logs for accuracy and to determine whether required inspections had been accomplished; no discrepancies were found.

The company maintenance malfunction/information reports, comprising concise descriptions of the aircraft data; engine data; reported part data; and replacement part data, were

¹³ The helicopter was manufactured by Aerospatiale in 1985. In 1992, Aerospatiale merged with MBB to form Eurocopter. Since the merger, the AS350 has been identified as a product of both manufacturers.

¹⁴ See the Airworthiness Factual Report, which is available in the public docket for this accident (LAX03MA292), for more details.

¹⁵ The engine modification was accompanied by revisions to the helicopter's rotorcraft flight manual to include supplements to the performance information for rotor speed, rate of climb, and maximum torque.

¹⁶ An aircraft cycle is one complete takeoff and landing sequence.

¹⁷ An engine cycle is one complete startup and shutdown sequence.

also reviewed. The form is primarily used to document premature part removals and unscheduled maintenance events. No discrepancies were noted.

Incident History

Two incidents involving the accident helicopter were identified following a query of Safety Board and FAA accident and incident databases for the time period since Sundance acquired the helicopter. The first incident occurred on May 23, 2000, during an attempted landing at a remote helipad in which the vertical fin assembly struck a rock and received minor damage. The helicopter was inspected and repaired in accordance with Eurocopter-approved inspection and repair procedures. On July 30, 2000, the helicopter was involved in a second incident, which occurred during a turn in low-level flight when a main rotor blade struck a tree. The helicopter was inspected and repaired in accordance with Eurocopter-approved repair procedures.

Three precautionary landings as a result of in-flight anomalies were recorded in the helicopter's maintenance logs. None of the precautionary landings resulted in damage, and the anomalies were resolved according to maintenance manual procedures. The events and associated corrective actions were recorded as follows:

- July 14, 2002: Engine chip light - removed, cleaned chip detector plug, penalty run, returned to service.
- June 4, 2003: Lost A[/]C and hydraulics - replaced A[/]C & hydraulic belts, test flown, returned to service.
- September 2, 2003: Engine failure (governor failure) - R[emoved] & R[eplaced] governor, test flown, returned to service.

Weight and Balance

Sundance personnel computed the helicopter's weight and balance for the accident flight. The helicopter's gross weight was calculated to be 4,107 pounds¹⁸ with a center of gravity (c.g.) of 128.4 inches aft of datum. According to the Eurocopter Flight Manual, the weight and c.g. were within operational limits.

METEOROLOGICAL INFORMATION

Sundance provided pilots a one-page weather summary for the Las Vegas area compiled at 0730 on the day of the accident. The summary, initialed by the accident pilot and other pilots who read it, reported the current weather as winds from 210° at 4 knots, visibility 10 statute

¹⁸ The calculations included fuel weight of 335 pounds (about 35 percent of total load capacity), the pilot's weight (140 pounds), and the total weight for the front and aft row passengers (216 pounds and 646 pounds, respectively). The passengers were weighed before departure and were allowed to carry only a camera.

miles (sm) and clear below 12,000 feet, and a temperature of 19° Celsius (C). The forecast weather was listed as winds from 040° at 5 knots until 1000, and 040° at 5 knots from 1000 to 2000. The summary did not contain weather information for the Grand Canyon area, and 1G4 did not have official weather reporting capability. Witnesses in the Grand Canyon West area at the time of the accident reported clear skies and no turbulence.

The closest official National Weather Service (NWS) observation station was at Kingman Airport, Kingman, Arizona, about 49 nm south of the accident site. The weather observation at 1256 was reported as wind from 350° at 4 knots gusting to 14 knots, visibility unrestricted at 10 sm, sky clear below 12,000 feet, temperature 32° C, dew point temperature -6° C.

A review of infrared satellite imagery collected from 1200 through 1300 revealed that no significant clouds or weather were indicated over the Grand Canyon area. At 1230, the radiative temperature over 1G4 was about 38.34° C.¹⁹ Based on this temperature, the density altitude at 2,000 feet (the approximate elevation of the initial point of impact) was calculated to be about 5,100 feet.

Upper air soundings at NWS facilities in Flagstaff, Arizona, and Desert Rock indicated winds of 10 knots or less below 10,000 feet and no significant turbulence or windshear at the time of the accident.

AIRPORT AND ROUTE INFORMATION

The airport, 1G4, is located about 33 nm northwest of Peach Springs, Arizona, at an elevation of 4,825 feet msl. The nontowered airport has one asphalt runway, 17/35, which is 5,058 feet long and 60 feet wide. Helicopter operations are conducted at designated helipads (elevation 4,775 feet msl) adjacent to the runway. Pilots use a single common traffic advisory frequency.

The helipads at 1G4 are near the upper rim of the Grand Canyon about 400 yards from the rim of Descent Canyon, which is at an elevation of 4,820 feet msl. Descent Canyon is a side (tributary) canyon to the Grand Canyon and terminates at the Colorado River, which flows through the Grand Canyon. The Beach helipad, elevation 1,300 msl, is located next to the Colorado River.

Sundance flights from 1G4 to the Beach helipad were flown through Descent Canyon. Return flights from the Beach helipad to 1G4 were flown through Quartermaster Canyon, which is located south of Descent Canyon.

¹⁹ Radiative temperature is a surface-based temperature.

WRECKAGE AND IMPACT INFORMATION

Examination of the accident site and surrounding area revealed the initial impact point was a gouge in a near-vertical canyon wall about 1.2 nm from the canyon rim at an elevation of about 2,000 feet msl. The gouge was of a size and shape consistent with a main rotor blade impact, and a fragment from the tip of a main rotor blade was found near the base of the wall near this location. The main wreckage was located on a canyon wall ledge about 400 feet beyond the gouge location at an elevation of about 1,960 feet msl (see figure 3). The main debris field measured about 70 feet long by 40 feet wide.



Note: This photograph was taken by a Safety Board investigator on February 4, 2004, during a canyon topography documentation flight. The wreckage was previously removed from the site.

Figure 3. Overview of initial main rotor blade impact location, main wreckage location, and prescribed route of flight.

The fuselage body structure was destroyed by impact forces and postcrash fire. The left and right cabin forward doors were found in the main debris area and did not exhibit fire damage. They were found structurally complete with no window plastic attached. The doors exhibited vertical crushing on the lower forward area with a crush angle of about 30°, consistent with horizontal flight into upsloping terrain. Crush damage to both doors was symmetrical in appearance (see figure 4).

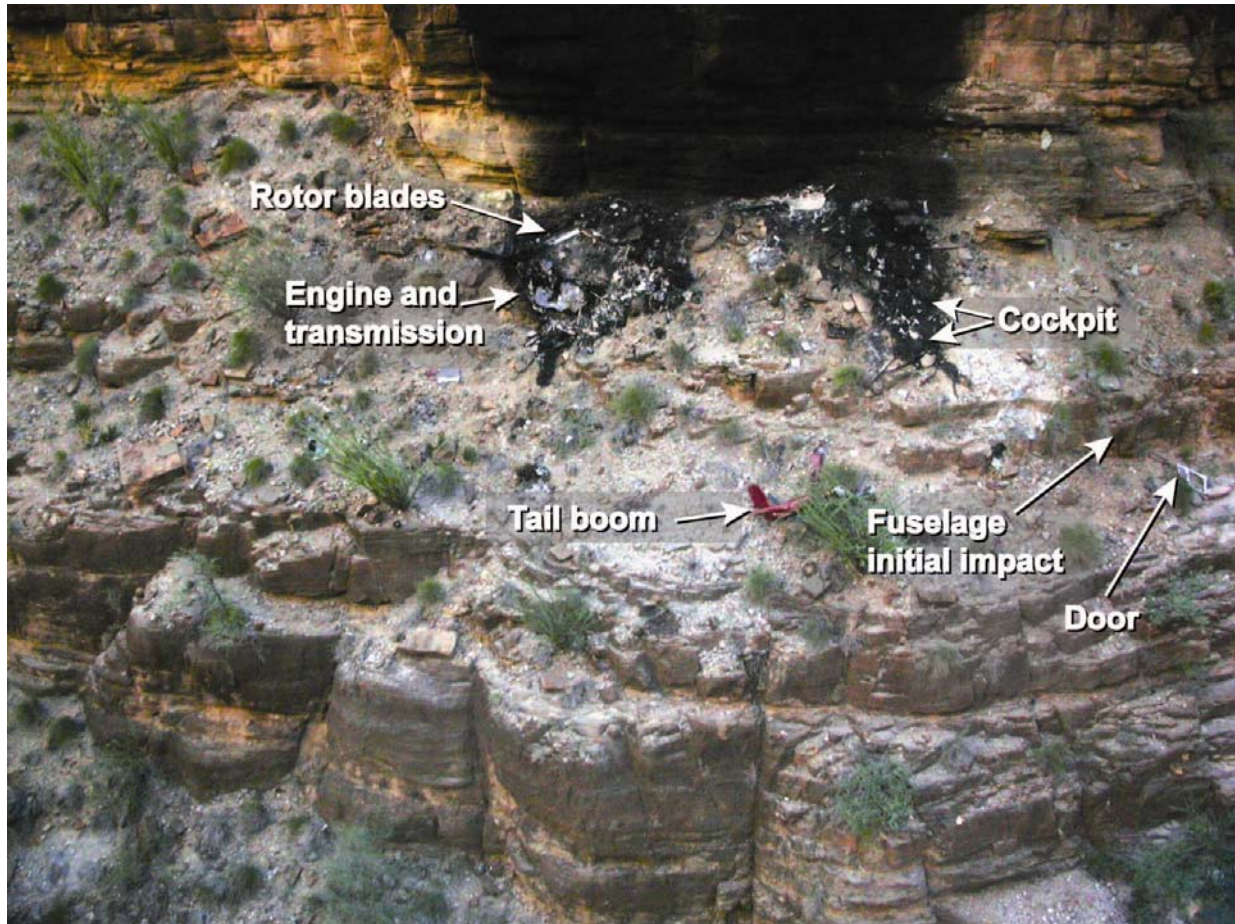


Figure 4. Main wreckage debris field.

The major portions of all three main rotor blades were observed at the main wreckage site, and each exhibited extensive impact and fire damage. All blades showed evidence of splintering at the outboard section of the blade. Two of the blades were attached to the hub assembly. The third blade was located adjacent to the transmission and other hub sections and exhibited evidence of severe impact and fire.

All three pitch links were found with the hub assembly; all were securely attached, bolted, and safety-wired to the rotating swash plate. One of the pitch links was separated at the pitch horn and exhibited signs of overload. The drive links were found securely attached. The mast was intact and appeared to be securely attached to the transmission. The rotating and nonrotating swash plates were intact with all securing hardware in place; there were no indications of any preimpact abnormalities. Portions of at least one main rotor blade and one of the blade tip weights were found along the debris path between the initial rotor strike location and the main wreckage impact site. No blade pieces were found before the rotor strike location.

The three hydraulic servo units on the transmission assembly remained securely attached after impact. The hydraulic pump was recovered and exhibited fire damage. The pump's integrity did not appear to have been breached, and the unit could be rotated by hand. The tail rotor servo exhibited severe fire damage with the housing partially melted.

MEDICAL AND PATHOLOGICAL INFORMATION

The Maricopa County Medical Examiner's Office, Phoenix, Arizona, performed an autopsy on the accident pilot and determined that the cause of death was "multiple blunt force trauma and thermal injuries." No preexisting medical conditions were found. A routine analysis was conducted for major drugs of abuse and prescription and over-the-counter medications, and the results were negative. No autopsy reports were obtained for the passengers.

TESTS AND RESEARCH

Engine and Rotor System Examinations

Postaccident examination of the impact- and fire-damaged wreckage indicated the fuselage and rotor blades were intact before the crash. Postaccident examination and testing of the engine, transmission, main and tail rotors, and hydraulic pump revealed no preexisting defects or malfunctions.

Servo Actuator System Examinations

The four servo actuators were subjected to x-ray computed tomography scanning to document their internal condition. Bio-Imaging Research, Inc., performed the scanning under the direction of Safety Board investigators. A three-dimensional reconstructed image of the actuators was created as part of the evaluation. Each actuator was examined for signs of missing or damaged components, blocked hydraulic passages, or other anomalies. None of these failure conditions was found (with the exception of damage caused by impact or fire). The servos were then disassembled and inspected. No evidence of any preimpact mechanical malfunctions was found.

Study of Digital Camera Images

Four digital cameras were recovered from the accident site and sent to the Safety Board's Vehicle Recorder Laboratory in Washington, D.C., for examination. Image data were recovered from two cameras, one of which contained photographs from the accident flight. Digital photographs taken by a passenger on the accident helicopter during a flight with the accident pilot earlier on the day of the accident were also sent to the Safety Board's laboratory for examination and comparison. A comparison study of photographs indicated that the accident flight entered the canyon near the entry point identified in the image from the earlier flight.

The study used a digital image from the earlier flight that was taken from inside the accident helicopter and that depicted the helicopter in a level attitude to establish assumed values for the level attitude by determining reference angles for the helicopter's left-door frame and the horizontal terrain. The study compared these reference values with reference lines from canyon terrain features to estimate the accident helicopter's pitch and bank angles in three other images that were taken by the passenger on the earlier flight (see figure 5).



Figure 5. View of the level attitude reference angles for the accident helicopter.

Figure 6 shows a left bank angle of 69° , calculated using the obtained level attitude values for the helicopter. Figure 7 shows the helicopter in a 55° nose-low pitch. Figure 8 shows the accident helicopter in flight near the bottom of the canyon. The airspeed indicator shows an airspeed between 145 and 150 knots, and the artificial horizon indicates that the helicopter is in a slight left bank with near-level pitch. The helicopter appears to be at low altitude and close to the right canyon wall.²⁰

²⁰ The Sundance CEO reviewed the photograph depicted in figure 8 and estimated that the helicopter's altitude was about 100 to 150 feet agl and that its horizontal clearance from the right wall of the canyon was about 75 to 100 feet.

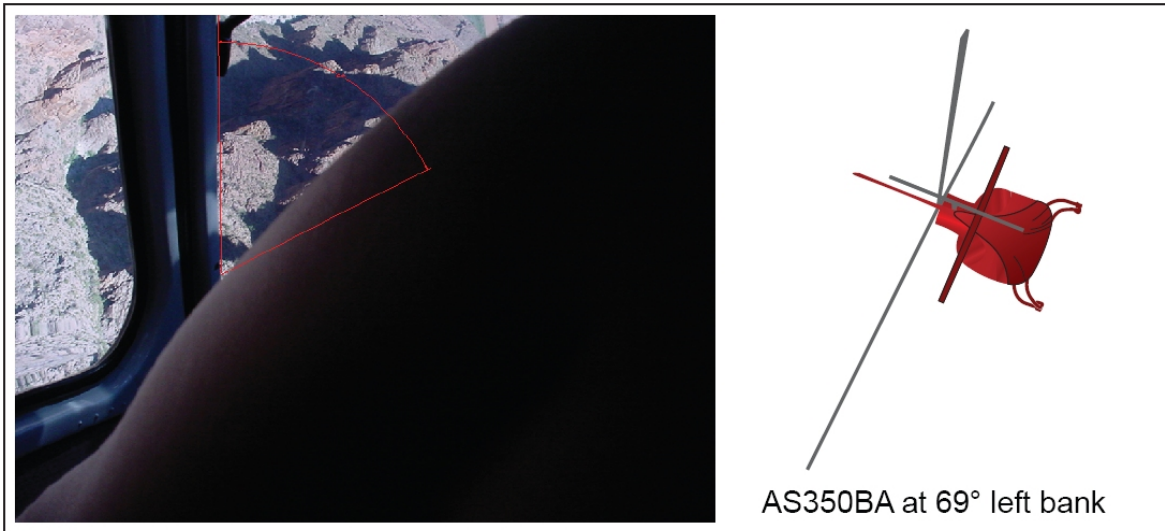


Figure 6. Passenger photograph showing the accident helicopter in a 69° left bank and a tail-view graphic depicting an AS350BA at that bank angle.

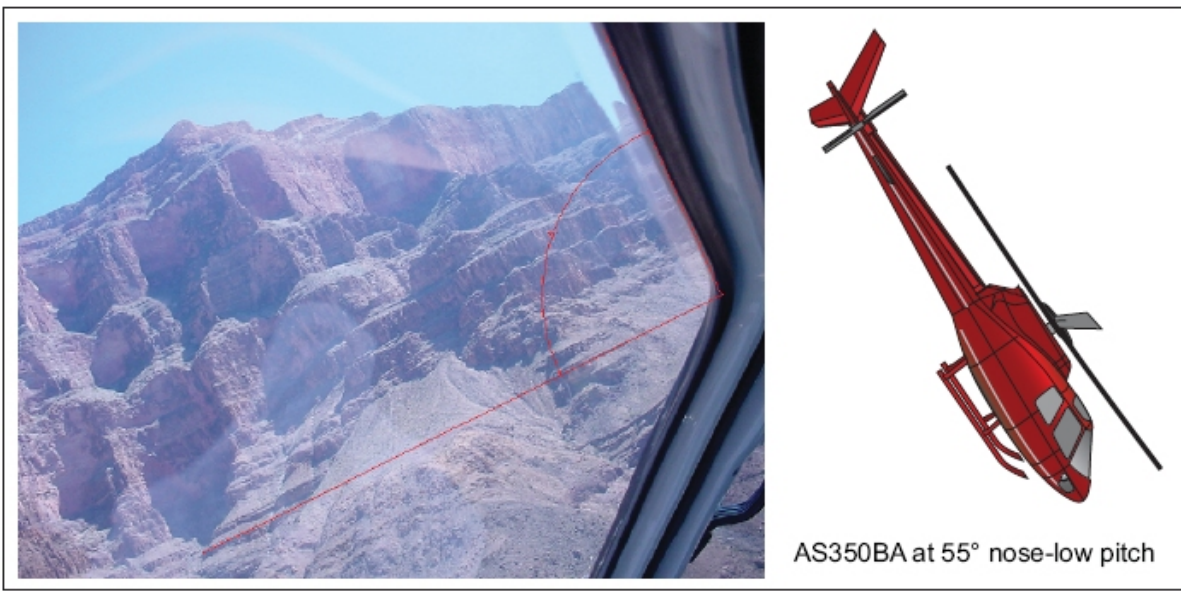


Figure 7. Passenger photograph showing the accident helicopter in a 55° nose-low pitch and a side-view graphic depicting an AS350BA at that pitch angle.



Figure 8. Passenger photograph showing the accident helicopter at low altitude, close to the canyon's right wall, and flying at an indicated airspeed between 145 to 150 knots.

Study of In-flight Videotape Images

A 14-minute videotape taken by a former Sundance tour coordinator in 2001 was examined at the Safety Board's laboratory. The videotape captured several flight legs with the accident pilot, including one flight into Descent Canyon. A study was performed using the images to determine the helicopter's average speed and pitch and bank angles during the flight through Descent Canyon. The majority of the recording was filmed from the left front passenger seat.

The study determined that the duration of the flight was about 61 seconds from the time the helicopter entered the canyon until it exited above a small ridge near the bottom of the canyon. The helicopter's average ground speed during the 1.8 nm flight in the canyon was between 106 knots and 109 knots, based on the duration of the flight and distance traveled. The videotape indicated that the helicopter reached its most extreme nose-down pitch attitude of about 40.5° just after it crossed over the canyon rim and began its descent.

The videotape also showed the helicopter reaching steep bank angles several times throughout the flight. Safety Board investigators examined the bank angle in the two steepest

turns; one to the left and one to the right. The maximum left bank angle was about 99° , about 25 seconds into the flight, and the steepest right bank angle was about 53° during the helicopter's exit from the canyon (see figures 9 and 10).²¹

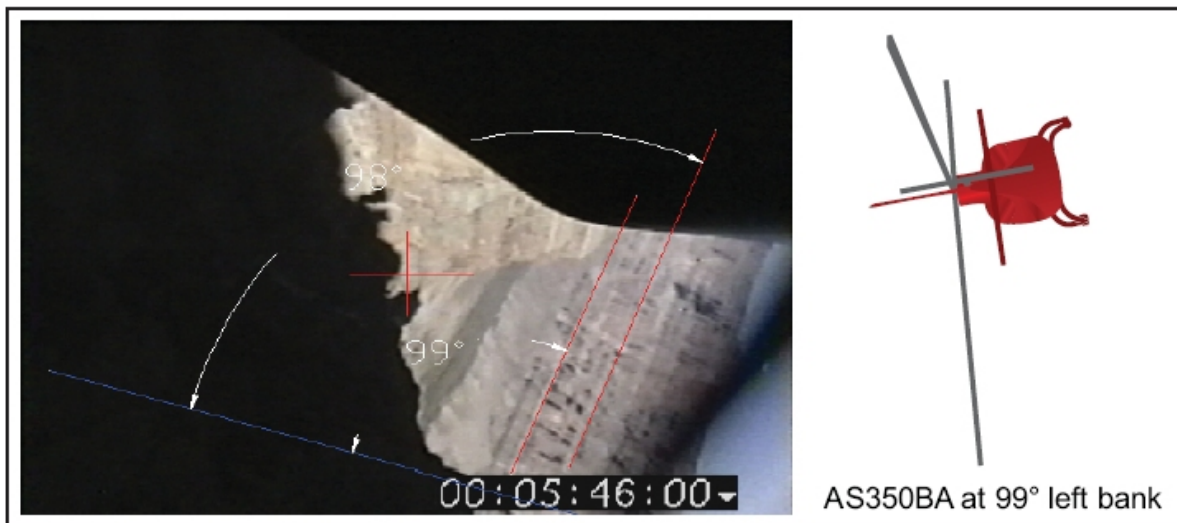


Figure 9. Passenger videotape image showing the helicopter in a 99° left bank and a tail-view graphic depicting an AS350BA at that bank angle.

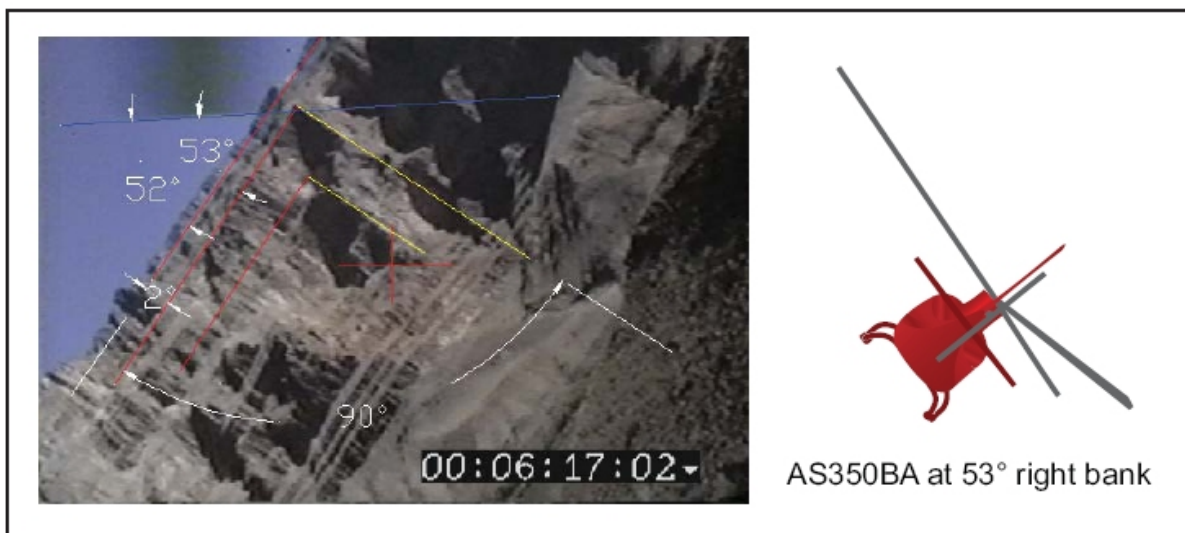


Figure 10. Passenger videotape image showing the helicopter in a 53° right bank and a tail-view graphic depicting an AS350BA at that bank angle.

²¹ A copy of this videotape is available in DVD format from the Safety Board's Records Management division. The videotape study is available in the public docket for this accident (LAX03MA292).

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Sundance Helicopters, Inc., based in Las Vegas, began operations in 1985 as a helicopter pilot training company. The company expanded its operations in 1987 to include air tours. At the time of the accident, Sundance operated six AS350BA helicopters (including the accident helicopter), five AS350B2 helicopters, and three Bell Helicopter Textron 206B3 helicopters. Sundance holds an FAA Part 135 air carrier operating certificate.

According to company records, its total helicopter activity on all routes, including the Descent Canyon route, averaged about 50,000 cycles a year during the 1-year period before the accident and had been increasing. Sundance's records also indicated that company helicopters conducted about 11,400 flights between 1G4 and the Beach helipad during 2002 using the Descent Canyon route and that, from January 1, 2003, to the date of the accident, Sundance pilots had flown the Descent Canyon route about 11,000 times.

Sundance Helicopters' Operating Procedures

Sundance's Operations Manual, Revision 33, dated December 4, 1998, outlines company operating procedures at 1G4 and the Descent Canyon vicinity. Subsection 3.03, Company Policies and Procedures, "Safety Standards," states, in part, the following:

A. It is the intention and policy of this company to establish and operate with the highest of safety standards. Employees must operate within the scope of all company policies and Federal Aviation Regulations. The operations of the company are governed by the applicable parts of FAR Parts 432, 91, 119, and 135, the Operations Specifications, and this Operations Manual, approved by the FAA.

B. The Company's Safety Standards will be maintained by thorough training of all ground and flight personnel.^[22] Safety and good judgment must be the top priority in conducting all operations.

In addition, Sundance management set a 120-knot maximum speed limit for Eurocopter operations into Descent Canyon.²³ Diving into the canyon was also prohibited.²⁴

Sundance Helicopters' Participation in Tour Operators Program of Safety

Sundance is a member of TOPS, which is a voluntary, independent industry organization formed in 1996 by a group of air tour operators to enhance and promote air tour safety and to

²² The FAA approved Sundance's training program on May 15, 1997.

²³ Sundance's chief pilot issued an operations memorandum to all pilots dated June 15, 2000, restricting the airspeed in Descent Canyon to 120 knots indicated airspeed.

²⁴ Sundance's chief pilot issued an operations memorandum to all pilots dated February 19, 2001, prohibiting dives into Descent Canyon and reiterating that flights must be conducted in accordance with TOPS standards.

“provide the public with access to scenic areas while in the care of good, safe and professional air tour operators.”

According to the TOPS program overview, approved TOPS operators have committed to “a higher standard of safety, sharing safety knowledge and to self-policing those standards.” The program includes management, pilot qualifications and training, maintenance, ground support personnel, and aircraft equipment. TOPS standards require managers to “establish and enforce standards to ensure that safety is the primary consideration for all air tour operations. These standards include avoiding any perception of a thrill ride, aerobatics,^[25] nap-of-the-earth flying or unnecessary abrupt maneuvers.”

According to Sundance’s management, the TOPS operational standards included the following flight limitations:

- Minimum en route altitude of 500 feet agl, except for ridgeline transitions
- Minimum visibility of 1 mile
- Angle of bank not more than 30°
- Angle of pitch not more than 10°

TOPS members also agree to annual independent safety audits, which are conducted by independent evaluators who are paid by TOPS. According to the last TOPS safety audit report on Sundance completed before the accident on July 16, 2003, the audit examined management policy, the company’s safety and medical program, flight operations procedures, heliport operations, flight coordination, maintenance, aircraft servicing, ground support equipment, and ground support personnel. The audit focused on ground-based operations and did not include announced or unannounced en route flight operations audit activities between Las Vegas and 1G4, from 1G4 to the Beach helipad, or along any established Sundance flight route.²⁶ According to the final report from the TOPS auditor, Sundance met and/or exceeded TOPS standards and required no remedial action.

Sundance Helicopters’ Surveillance of Descent Canyon Operations

According to Sundance management, the company did not require pilots to demonstrate to a company check airman how they conducted flights between 1G4 and the Beach helipad

²⁵ According to 14 CFR 91.303, “aerobatic flight means an intentional maneuver involving an abrupt change in an aircraft’s attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.” The regulation states that “no person may operate an aircraft in aerobatic flight ... below an altitude of 1,500 feet above the surface.” In addition, 14 CFR 91.307 states that “no pilot of a civil aircraft carrying any person (other than a crewmember) may execute any intentional maneuver that exceeds, (1) A bank of 60° relative to the horizon; or (2) A nose-up or nose-down attitude of 30° relative to the horizon” unless “each occupant of the aircraft is wearing an approved parachute.”

²⁶ The TOPS auditor indicated that he considered the flights from 1G4 to the Beach helipad as on-demand passenger transportation flights rather than “tour” flights and that, therefore, those flights were not subject to being audited.

through Descent Canyon. Sundance's chief executive officer (CEO) stated that all pilots were trained and route-checked in Grand Canyon airspace and that this training included operating out of a landing location near the Beach helipad. Sundance management representatives also stated that the accident pilot was not given a route check after his August 17, 2001, reprimand for exceeding the TOPS flight maneuvering limitations during a Descent Canyon tour. Sundance's director of operations stated that he had never flown with the accident pilot on a tour flight into Descent Canyon and that he had not asked other Sundance management personnel to perform a check flight with the accident pilot on the Descent Canyon route.²⁷

Federal Aviation Administration Surveillance of Descent Canyon Operations

The FAA's Las Vegas Flight Standards District Office (FSDO) was responsible for oversight of Sundance's operations. The flight route from 1G4 to the Beach helipad was in class G airspace and was outside the airspace encompassed by Special Federal Aviation Regulation (SFAR) No. 50-2.²⁸ A Safety Board review of FAA surveillance records for Sundance indicated that 15 program tracking and reporting subsystem (PTRS) inspections had been conducted between 2001 and the date of the accident, including airworthiness and operations inspections. Three of the inspections focused on helicopter airworthiness items, and 12 related to operations items. All required program inspections were completed, according to FAA records. In addition, the PTRS contained nine entries relating to the accident helicopter between October 1, 2002, and September 20, 2003. For each of these entries, the FAA reported satisfactory results with no enforcement actions initiated.

The FAA principal operations inspector (POI) assigned to Sundance stated that he had conducted oversight at Sundance since 1993. He added that he was the assigned POI for 11 operators within the geographic area covered by the Las Vegas FSDO, including 8 helicopter and 3 fixed-wing operators, all but one of which conducted Grand Canyon tours. He stated that the oversight involved about 69 helicopters and 32 airplanes.

The POI stated that he was authorized to conduct proficiency flight and line checks on any air taxi flight route but that, because of workload and time constraints, he limited these checks of Sundance pilots to include only the SFAR 50-2 routes over Grand Canyon National Park and the routes to and from Las Vegas. He stated that he conducted on-site surveillance at 1G4 about three times a year.

The POI stated that he had never flown with the operator down Descent Canyon or taken the Descent Canyon tour and was not familiar with the route. He stated that before the accident he was not aware of the number of daily flights conducted by Sundance into Descent Canyon. He

²⁷ According to Sundance Helicopters' CEO, the chief pilot conducted random surveillance by driving to remote locations along routes of flight and observing the flights. The CEO stated the terrain precluded the chief pilot from observing Decent Canyon flights from ground locations.

²⁸ SFAR 50-2 contains special flight rules in the vicinity of Grand Canyon National Park to reduce the impact of aircraft noise on park visitors. SFAR 50-2 delineates the dimensions of the flight rules area, flight-free zones, and flight corridors; establishes reporting requirements for commercial sightseeing air carriers operating in the special flight rules area; prohibits commercial sightseeing operations during certain time periods; and limits the number of aircraft that can be used for commercial sightseeing operations.

further stated that, if there were more than 1,000 flights per year, he would have conducted surveillance of the operator in Descent Canyon.

The FAA assistant POI (APOI) assigned to Sundance for 7 years before the accident also stated that he had never flown with the operator down the Descent Canyon route. The APOI stated that he did not know the frequency of the Sundance tour flights into Descent Canyon, and he estimated that about 20 daily roundtrips were conducted there. He noted that operators were not required to report tour flight frequency because the route was outside the Grand Canyon SFAR. He added that surveillance would have been increased if he had been aware that Sundance's canyon activity was more than 40 trips a day.

ADDITIONAL INFORMATION

Other Company Pilot Actions

Investigators interviewed two passengers who flew with the other Sundance pilot who was conducting flights from 1G4 through Descent Canyon on the day of the accident. One tourist who flew with that pilot on the day of the accident stated that the descent into the canyon was "like a thrill ride." He stated that they flew very close to the canyon walls and that during the ascent, one of the passengers handed the pilot a camera and that the pilot took a picture while flying out of the canyon. Another passenger on the same flight stated that the pilot also took pictures during the descent. A passenger who had flown in helicopters in the military described the descent flown by the other Sundance pilot as "thrilling, more enjoyable than it was scary." He stated that the helicopter was pointed about 45° down during the descent.

Hydraulic Control System Servo Transparency Phenomenon

On December 19, 2003, the FAA issued Special Airworthiness Information Bulletin (SAIB) No. SW-04-35 alerting owners and operators of Eurocopter France AS350B, BA, B1, B2, B3, D, AS355E, and EC120B model helicopters that pilots can encounter a phenomenon known as servo transparency, servo reversibility, or jack stall during high airspeed, high collective pitch, high gross weight, high G-loads, and high density altitude conditions. The bulletin stated, in part, the following:

Pilots and operators may misunderstand this phenomenon. This aircraft phenomenon occurs smoothly, and can be managed properly if the pilot anticipates it during an abrupt or high load maneuver such as a high positive g-turn or pull-up.

Servo transparency begins when the aerodynamic forces exceed the hydraulic forces and is then transmitted back to the pilot's cyclic and collective controls. On clockwise turning main rotor systems, the right servo receives the highest load when maneuvering, so servo transparency results in uncommanded right and aft cyclic motion accompanied by down collective movement. The pilot control

forces to counter this aerodynamically induced phenomena are relatively high and *could give* an unaware pilot the impression that the controls are jammed. If the pilot does not reduce the maneuver, the aircraft will roll right and pitch-up.

You should understand that *servo transparency is a natural phenomenon* for any flyable helicopter. **BASIC AIRMANSHIP** should prevent encountering this phenomenon by avoiding combinations of high speed, high gross weight, high-density altitude, and aggressive maneuvers, which exceed the aircraft's approved flight limitations.

During the investigation of another accident²⁹ in which the servo transparency phenomenon test data were reviewed, Eurocopter representatives stated that the transparency phenomenon is transitory (lasting only 2 to 3 seconds) and can be immediately corrected by pilot actions to reduce G loads. If uncorrected by the pilot, the resultant aircraft reaction to the servo transparency will reduce the factors that contribute to the severity of the maneuver. The Eurocopter representatives also stated that the controls are fully operable throughout the entire transparency event; however, the force required to effect movement of the flight controls against the rotor system dynamic feedback loads increases significantly. Eurocopter stated that the force feedback for each control channel would be dependent in part on the amount of G loads experienced; however, the company estimated that about 22 pounds of force would be required to move the collective in the "up" or increased-pitch direction, with the same amount of force required to move the cyclic to the left. In addition, flight test data indicated that servo transparency could not be encountered if the collective was raised less than 50 percent.

Eurocopter's chief pilot and an FAA test pilot conducted additional servo transparency test flights in December 2003. Flight test results also indicated that servo transparency was impossible to encounter if the collective was less than 50 percent and also indicated that the flight condition was difficult to enter at airspeeds less than 100 knots. All servo transparency entries and sustainment were accomplished with intentionally high G forces, at high gross weights, and at high entry speeds and were difficult to sustain. All servo transparency conditions during these flight tests ceased when the collective was reduced.

In addition, a Safety Board investigator who is also a rated helicopter pilot conducted several test flights in an AS350 helicopter with Eurocopter's chief instructor pilot at the company's Grand Prairie, Texas, facility in December 2003. A Safety Board study of servo transparency data collected from Eurocopter flight tests, SBs, the FAA and Safety Board staff flights indicated that the onset of the servo transparency condition can be predicted based on the helicopter's weight, altitude, and maneuver loading. The study indicated that, unless the entry maneuver or atmospheric condition inducing the servo transparency condition is violent, pilots would receive a warning, via cyclic control vibration, that servo transparency onset was occurring and that properly trained pilots can exit or avoid this flight condition by proper manipulation of the flight controls.

²⁹ National Transportation Safety Board, *Uncontrolled Descent and Impact with Terrain, Eurocopter AS350-B2 Helicopter, N169PA, Meadview, Arizona, August 10, 2001*, Aircraft Accident Brief NTSB/AAB-04/02 (Washington, DC: NTSB, 2004).

In addition, flight test data indicated that, when the collective flight control position was at or below the 50 percent raised position, servo transparency did not occur regardless of the helicopter's maneuvering load, weight, or altitude. Servo transparency onset was possible when the helicopter was subjected to high maneuvering loads at high forward airspeeds during operations at high gross weights and high pressure altitudes but ceased immediately after the pilot reduced the flight control forces, especially the collective, which reduces total maneuvering loads.

Postaccident Actions

Following the accident, Sundance implemented a "zero-tolerance" policy with regard to pilot actions that break company rules. According to the CEO, any one instance of intentional rulebreaking is grounds for dismissal with no second chances.³⁰ The CEO indicated that employees, not just management, participate in enforcing the zero-tolerance policy.

The company also took several initiatives to enhance its safety program. Among these were the installation of on-board video imaging equipment and periodic reviews of video recorded during tour flights.³¹ According to the CEO, the cameras were installed to help management better monitor the pilots' performance during tours; however, Sundance also sells the videos recorded during tours to passengers for souvenirs, which helps offset the costs of the program. The CEO stated that the pilots are not able to turn off the cameras once the system is running; thus, the cameras continually record raw data for review. The director of operations hired after the date of the accident stated that the company routinely reviews selected videos, which assists in evaluating the pilots' performance. The CEO stated that one pilot was dismissed after a review of recorded data revealed "inappropriate flying."

The director of operations stated that another method the company uses to track pilot performance is through a "survey card" available to each passenger to fill out. He stated that any responses relating to safety of flight issues are immediately evaluated and that the CEO reviews all survey cards received. The CEO stated that management personnel contacts all passengers who indicate concerns on the cards. He also stated that the company implemented a policy directive so that employees, particularly the marketing department and tour coordinators, understand how various types of customer complaints are to be handled and by whom. For example, the directive states that complaints pertaining to safety issues are to be reported immediately to the director of operations, chief pilot, an owner, or the designated operations duty officer.

The CEO stated that the company also has implemented a "Ride-A-Long" program in which passengers with a piloting background are placed on flights free of charge and incognito for observation purposes. He stated that the Ride-A-Long participants are provided an in-depth

³⁰ In a July 6, 2007, statement, the CEO stated that, in the preceding 3.5 years, five pilots were fired under the zero-tolerance policy. He stated all of the dismissals resulted from reports to management by other Sundance pilots or employees or from a violation that was witnessed directly by management.

³¹ According to Sundance's CEO, all but one of the company's helicopters was equipped with the video cameras. He stated that one helicopter did not have the video equipment installed because Sundance acquired it on a short-term lease.

survey to complete after the flight. He stated that company pilots are aware of the program but are not aware when they are selected for an observation flight. He stated the company attempts to do one Ride-A-Long flight each quarter. The director of operations indicated that the use of the survey card, videos, and other in-house safety programs are valuable tools in monitoring tours, maintaining the company's quality of service, and ensuring pilot compliance with company policy and safety practices.

ANALYSIS

General

The pilot was properly trained and certificated in accordance with Federal regulations and company requirements. No evidence indicated any preexisting medical conditions that might have adversely affected his performance during the accident flight.

The helicopter was properly certificated and equipped in accordance with Federal regulations and approved procedures. No evidence indicated preexisting engine, system, or structural failures. The investigation found no maintenance discrepancies or recurring system anomalies.

VMC with light winds prevailed at the time of the accident, and weather was not a factor.

The accident was not survivable because of high impact forces and fire.

Accident Scenario

The helicopter's main rotor blade struck a near-vertical canyon wall in flight. The resulting damage to the main rotor system likely rendered the helicopter uncontrollable, and the helicopter subsequently impacted a canyon wall ledge. There were no known witnesses or radar data to provide information about the accident flight's progress through Descent Canyon before the accident; however, information and photographs provided by passengers who rode on a previous tour with the accident pilot and evaluation of the locations of the initial rotor strike and the main wreckage site indicate that the accident flight was consistent with the accident pilot's typical flight profile through Descent Canyon. Further, the locations of the initial main rotor blade strike and the main wreckage impact site, which were about 400 feet apart horizontally and at similar altitudes, were consistent with the accident helicopter flying at a high airspeed in a near-level flightpath when its main rotor blade first struck the canyon wall.

A Safety Board investigator performed a study of servo transparency data collected from Eurocopter flight tests, SBs, the FAA and Safety Board staff flights to evaluate the characteristics of the phenomenon as applicable to the accident helicopter's configuration. The study determined that several conditions were required to induce the phenomenon, including high airspeed, high collective pitch, and high G-loads. Although the accident flight was likely traveling at a high airspeed, on the basis of the pilot's typical flight through the canyon and the impact site evidence, there is no evidence to suggest that any of the other conditions required to induce the phenomenon, such as high-G maneuvers or maneuvers requiring the collective to be raised more than 50 percent, would have been performed by the pilot.

Pilot History of Risk-Taking Behavior

The investigation determined that, although the accident pilot was experienced and considered highly skilled, he repeatedly flew recklessly and well outside Sundance's operations policy, Federal regulations, and TOPS standards for Grand Canyon tour operations. Information provided by passengers, a former Sundance pilot, a former Sundance tour coordinator, and personnel from other air tour operators, as well as photographs and a videotape of the pilot flying the accident route, all indicated that the accident pilot regularly exceeded the maximum of 30° bank and 10° pitch—sometimes by extreme margins and into the realm of aerobatic flight—during flights with passengers on board. The pilot was reprimanded for his reckless flying in August 2001 after Sundance management received a complaint from a passenger.

Although a former Sundance pilot described the accident pilot's skills as "extremely good," he acknowledged that the pilot "pushed the aircraft, pushed the rules of flight in Descent Canyon." The former Sundance ground employee who recorded the videotape stated that he "flew very close to the canyon wall" and "banked off one wall and then turned the other way, almost upside down."

Flights to the accident site through Descent Canyon with Sundance's chief pilot indicated that a steep descent profile was required to reach the accident site. On the basis of the wreckage location information and the pilot's documented history of aggressive flying (in the form of witness statements, photographs, videotape evidence, and passenger complaints), the investigation determined that these numerous examples of risky flying behavior, in aggregate, consistently violated Sundance and TOPS procedures, and represented a deliberate and repetitive disregard of safe flying margins while transporting passengers through Descent Canyon.

Although Sundance had procedures in place to prevent unprofessional practices and the type of reckless behavior exhibited by the accident pilot, there was no emphasis on these procedures to ensure that the pilot adhered to them. Sundance was aware of at least two previous passenger complaints about the accident pilot; however, no evidence was found indicating that Sundance management ever took any steps to correct the accident pilot's flying habits in Descent Canyon. For example, the investigation determined that a written reprimand given to the pilot 2 years before the accident, which called for a 1-week suspension without pay, was never enforced. The director of operations' assertion that the pilot's suspension was postponed because the company was short of pilots defeated the purpose of the reprimand. The company's failure to enforce the reprimand might have conveyed to the pilot and other Sundance pilots that the completion of tours was more important than safety policies and procedures or that the company did not consider such flying practices to be serious safety concerns.

Sundance Helicopters' Surveillance of Descent Canyon Operations

Sundance management did not have a route check proficiency policy in place that required pilots to demonstrate to a company check airman how they conducted flights between 1G4 and the Beach helipad through Descent Canyon. In addition, the accident pilot was not given a route check after his August 2001 reprimand for exceeding the TOPS flight maneuvering limitations and company policies during a Descent Canyon tour. Further, Sundance's director of

operations stated that he had never flown with the accident pilot on a tour flight into Descent Canyon and had not asked other Sundance management personnel to perform a check flight with the accident pilot on the Descent Canyon route.

Flight checks are valuable tools because they allow the chief pilot to observe the flying pilot in the cockpit and note any problems or nonadherence to standard operating procedures. Although the chief pilot did conduct flight checks of pilots, he had never conducted one through Descent Canyon, an area where thousands of flights occurred each year. Despite being aware of the accident pilot's reckless performance in Descent Canyon, Sundance management did nothing to assess the pilot's adherence to standard operating procedures and to ensure that the accident pilot was flying in accordance with TOPS and company safety standards.

Federal Aviation Administration Surveillance of Descent Canyon Operations

The flight route from 1G4 to the Beach helipad was in class G airspace and was outside the airspace encompassed by SFAR 50-2. The FAA POI assigned to Sundance stated that he was authorized to conduct flight and line checks on any air taxi flight route. However, because of workload and time constraints, he limited these checks to the SFAR routes over Grand Canyon National Park, which are subject to additional rules for air tour operators that do not apply to the class G airspace in the vicinity of the Grand Canyon, and to routes to and from Las Vegas. The POI stated that he conducted on-site surveillance at 1G4 about three times a year but that neither he nor his assistant had ever flown with the operator down Descent Canyon or taken the Descent Canyon tour and that he was not familiar with the route. Although visiting an operator's base is part of the FAA's overall surveillance program, in this instance it did not accomplish the objective of determining the operator's compliance with regulatory requirements and safe operating practices or detecting the need for regulatory, managerial, and operational changes.

According to company records, Sundance conducted about 11,400 flights between 1G4 and the Beach helipad during 2002 using the Descent Canyon tour route and had flown the Descent Canyon route about 11,000 times between January 1, 2003, and the date of the accident. However, neither the POI nor the APOI knew the frequency of the Sundance tours into Descent Canyon, and neither conducted any in-flight surveillance of the tour operations there. If the FAA had provided such surveillance, it may have observed the reckless flying that was observed by passengers and may have taken action to ensure Sundance's compliance with safe operating procedures in Descent Canyon. However, without such surveillance, no opportunity existed for the FAA to identify pilots who operated in a careless manner through Descent Canyon.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's disregard of safe flying procedures and misjudgment of the helicopter's proximity to terrain, which resulted in an in-flight collision with a canyon wall. Contributing to the accident was the failure of Sundance Helicopters and the Federal Aviation Administration to provide adequate surveillance of Sundance's air tour operations in Descent Canyon.