

Midair Collision of Electronic News Gathering Helicopters
KTVK-TV, Eurocopter AS350B2, N613TV, and
U.S. Helicopters, Inc., Eurocopter AS350B2, N215TV
Phoenix, Arizona
July 27, 2007



Accident Report

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Aircraft Accident Report

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**National
Transportation
Safety Board**

490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

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Abstract: This report explains the accident involving two electronic news gathering (ENG) helicopters, N613TV and N215TV, that collided in midair while maneuvering in Phoenix, Arizona. The Eurocopter AS350B2 helicopters, from local channels 3 and 15, had been covering a police pursuit. N613TV, the channel 3 helicopter, was operated by KTVK-TV, and N215TV, the channel 15 helicopter, was operated by U.S. Helicopters, Inc., under contract to KNXV-TV. The safety issues discussed in this report focus on the limitations associated with the primary method of separation used during ENG operations; methods for improving an ENG pilot's awareness of other helicopters operating in the same area; and the need for (1) meetings of Federal Aviation Administration (FAA) and ENG personnel to discuss operational procedures and manage risk, (2) ENG best practices guidelines, and (3) flight recorder systems for smaller aircraft. Safety recommendations concerning these issues are addressed to the FAA.

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Abbreviations and Acronyms

AC	advisory circular
ASRS	aviation safety reporting system
ATC	air traffic control
ATCT	air traffic control tower
ATIS	automatic terminal information system
BEA	Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile
C	Celsius
CAMI	Civil Aeromedical Institute
CFR	<i>Code of Federal Regulations</i>
CVR	cockpit voice recorder
ENG	electronic news gathering
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FDR	flight data recorder
FSDO	flight standards district office
HAI	Helicopter Association International
LED	light emitting diode
LOA	letter of agreement
msl	mean sea level
NBPA	National Broadcast Pilots Association
nm	nautical mile

OpSpec	operations specification
PHX	Phoenix Sky Harbor International Airport
SDL	Scottsdale Airport
SFAR	Special Federal Aviation Regulation
TC	Transport Canada
TOPS	Tour Operators Program of Safety
TSB	Transportation Safety Board (Canada)
TSO	technical standard order
USFS	United States Forest Service
VFR	visual flight rules
VMC	visual meteorological conditions

Executive Summary

On July 27, 2007, about 1246 mountain standard time, two electronic news gathering (ENG) helicopters, N613TV and N215TV, collided in midair while maneuvering in Phoenix, Arizona. The Eurocopter AS350B2 helicopters, from local channels 3 and 15, had been covering a police pursuit. N613TV, the channel 3 helicopter, was operated by KTVK-TV, and N215TV, the channel 15 helicopter, was operated by U.S. Helicopters, Inc., under contract to KNXV-TV. Each helicopter had a pilot-reporter and a photographer on board. The occupants on board both helicopters were killed, and the helicopters were destroyed by impact forces and postcrash fire. The helicopters were operating under the provisions of 14 *Code of Federal Regulations* Part 91. No flight plans had been filed. Visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determines that the probable cause of this accident was both pilots' failure to see and avoid the other helicopter. Contributing to this failure was the pilots' responsibility to perform reporting and visual tracking duties to support their station's ENG operation. Contributing to the accident was the lack of formal procedures for Phoenix-area ENG pilots to follow regarding the conduct of these operations.

The safety issues discussed in this report focus on the limitations associated with the primary method of separation used during ENG operations; methods for improving an ENG pilot's awareness of other helicopters operating in the same area; and the need for (1) meetings of Federal Aviation Administration (FAA) and ENG personnel to discuss operational procedures and manage risk, (2) ENG best practices guidelines, and (3) flight recorder systems for smaller aircraft. Safety recommendations concerning these issues are addressed to the FAA.

1. Factual Information

1.1 History of Flight

On July 27, 2007, about 1246 mountain standard time,¹ two electronic news gathering (ENG) helicopters, N613TV and N215TV, collided in midair while maneuvering in Phoenix, Arizona. The Eurocopter AS350B2 helicopters, from local channels 3 and 15, had been covering a police pursuit. N613TV, the channel 3 helicopter, was operated by KTVK-TV, and N215TV, the channel 15 helicopter, was operated by U.S. Helicopters, Inc., under contract to KNXV-TV. Each helicopter had a pilot-reporter and a photographer on board. The occupants on board both helicopters were killed, and the helicopters were destroyed by impact forces and postcrash fire. The helicopters were operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91.² No flight plans had been filed. Visual meteorological conditions (VMC) prevailed at the time of the accident.

After receiving a report of a police pursuit of a suspect who had reportedly stolen a pickup truck and backed it into a police car after being pulled over, the channel 15 helicopter departed Scottsdale Airport (SDL), Scottsdale, Arizona, about 1222. According to the air traffic control (ATC) transcript, about 1226:08, the channel 15 pilot contacted the air traffic control tower (ATCT) at Phoenix Sky Harbor International Airport (PHX), Phoenix, Arizona; advised that he had automatic terminal information system (ATIS)³ information “Kilo”; and requested to enter the tower’s class B airspace via “Sharp Echo.”⁴ A controller at the local control north position responded to the channel 15 helicopter pilot, stating “proceed via Sharp Echo as requested, say altitude and destination.” The pilot advised that his helicopter was “going to be heading downtown ... eighteen hundred feet [mean sea level (msl)]⁵ ... to intercept the police chase.” About 1229:03, the channel 15 pilot advised the controller that his helicopter would be climbing to 2,000 feet to get out of the way of the police helicopter following the pursuit, which was operating at 1,900 feet at the time,⁶ and the controller acknowledged this transmission.

¹ All times in this report are mountain standard time based on a 24-hour clock.

² U.S. Helicopters could conduct ENG flights under Part 91 pursuant to the aerial work operations exception in 14 CFR 119.1(e)(4)(iii). Section 1.17.2 provides additional information about this issue.

³ An ATIS is a continuous broadcast of recorded noncontrol information in selected terminal areas.

⁴ Both the channel 3 and 15 helicopters were required to enter the airspace above the pursuit according to the provisions of a letter of agreement (LOA) with PHX designated “Sharp Echo.” Section 1.10.2 provides details about the LOA.

⁵ PHX elevation was 1,132 feet msl. To determine pilot-reported altitudes in feet above ground level, subtract 1,132 feet from the altitude.

⁶ According to informal procedures among Phoenix-area ENG pilots, ENG helicopters are expected to fly 500 feet above police helicopters.

The channel 3 helicopter departed SDL about 1232 to cover the police pursuit. The ATC transcript indicated that the channel 3 helicopter pilot contacted the ATCT about 1236:41 and informed the controller, about 10 seconds later, “Sharp Echo ... going where the other helicopters are over there.” The controller responded, “radar contact, proceed via Sharp Echo as requested.”

In addition to the channel 3 and 15 helicopters and the police helicopter, three other ENG helicopters were operating in the airspace over the police pursuit. Table 1 presents the time that each of these helicopters made initial contact with the controller and the altitudes at which they were operating.

Table 1. Helicopters Operating at the Time of the Police Pursuit.

Helicopter	Time of initial contact with controller	Operating altitude(s) (in feet msl)
Police	1222:56	1,800 and 1,900
Channel 15	1226:08	1,800 and 2,000
Channel 12	1229:31	2,500
Channel 5	1235:29	2,200
Channel 3	1236:41	2,000
Channel 10	1244:36	2,400

Note: Some of the altitudes were reported to the controller when the helicopters entered the area, some altitudes were reported to the controller while the helicopters were operating over the scene, and one altitude was reported over a common traffic advisory frequency.

According to informal Phoenix-area procedures, the ENG helicopter pilots were expected to use the same air-to-air frequency to report their position and intentions. The channel 3 and 15 helicopters were equipped with an on-board system that recorded audio and video. The audio recordings indicated that, about 1238:02, the channel 15 pilot stated, “okay, twenty two hundred,” and that, about 1 second later, the channel 3 pilot broadcast that he would be operating at 2,000 feet.

According to the channel 3 and 15 audio recordings, about 1241:02, the channel 15 pilot stated, “I’ll just kinda park it right here.” About 1241:18, the channel 3 pilot broadcast, “OK, I’m gonna move.” Between about 1241:22 and about 1241:26, the channel 15 pilot stated, “where’s three?,” “like how far?,” and “oh jeez.” The channel 15 pilot then transmitted, “three. I’m right over you. Fifteen’s on top of you.” Afterward, the channel 3 pilot questioned which helicopter channel 15 was over, to which the channel 15 pilot responded, “I’m over the top of you.” About 1241:34, the channel 3 pilot indicated that he was operating at 2,000 feet. About 1242:25, the channel 3 pilot stated to the channel 15 pilot, “OK ... I got you in sight,” to which the channel 15 pilot responded, about 3 seconds later, “got you as well.”

Along with their flying duties, the channel 3 and 15 pilots were responsible for reporting information about the event while airborne. (The channel 3 and 15 photographers were responsible for operating a remotely mounted video camera to show the event as it unfolded.) The transmissions over the air-to-air frequency about 1242:25 and 1242:28 were the last times that the channel 3 and 15 pilots coordinated their helicopter’s position or their intentions with

each other. (These transmissions occurred about 4 minutes before the collision.) The rest of the audio recordings comprised narration of the events on the ground or related conversations.

The Safety Board's study of the video recordings (see section 1.16.2) showed that, about 1246:05, the suspect stopped the stolen vehicle. At that time, the channel 3 and 15 pilots were broadcasting,⁷ and, according to estimated helicopter positions based on information from the video recordings, both helicopters were moving. Toward the end of his only report, which started about 1245:43, the channel 3 pilot stated, "looks like he [the suspect] is starting to run ... looks like he's gonna try and take another vehicle ... looks like they've got him blocked in there but he did get," and then the report ended suddenly with an unintelligible word. During his live update that started about 1246:03, the channel 15 pilot stated, "he [the suspect] has stopped ... now it's a foot chase. Now he's in another vehicle ... doors open police ... oh jee," and then the report ended suddenly. The audio recordings indicated that the midair collision occurred about 1246:18.

According to the ATC transcript, about 1246:50, the channel 10 pilot advised the controller, "just had a midair collision over here at the park, two helicopters, two helicopters down." About 1247:17, the controller asked the pilot if he knew which two helicopters were involved in the collision. The pilot indicated that channel 3 and possibly channel 15 were involved. The controller then tried to contact channel 15 but received no response. About 1248:35, the channel 12 pilot informed the controller that the channel 3 and 15 helicopters had been involved in the collision. The main wreckage from both helicopters were located about 160 feet apart in a park.

The channel 10 ENG pilot indicated that the accident helicopters were positioned apart at a reasonable distance when he first noticed them (about 1 minute before the accident). The pilot witness stated that, after the police helicopter broadcast that a carjacking was going to occur, he noticed that the accident helicopters had moved closer together. He further indicated that they impacted shortly afterward, with the channel 3 helicopter breaking into many pieces and the channel 15 helicopter remaining in the air before diving nose first toward the ground.⁸

⁷ The channel 15 broadcast had been live since at least 1242:42, and the channel 3 broadcast was being recorded.

⁸ Other witness accounts are discussed in section 1.18.1.

1.2 Injuries to Persons

Table 2. Injury chart.

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	2	0	2	0	4
Serious	0	0	0	0	0
Minor	0	0	0	0	0
None	0	0	0	0	0
Total	2	0	2	0	4

1.3 Damage to Aircraft

Both helicopters were destroyed by impact forces and postcrash fire.

1.4 Other Damage

A portion of the red main rotor blade from the channel 15 helicopter impacted a parked truck, damaging its hood. Also, the roof of a covered walkway that crossed a pond in the park was damaged as a result of falling debris.

1.5 Personnel Information

1.5.1 The Channel 3 Pilot

The channel 3 pilot, age 42, received a Federal Aviation Administration (FAA) commercial pilot certificate on August 24, 1987, with a rotorcraft-helicopter rating. He also held a certified flight instructor certificate with a rotorcraft-helicopter rating; his most recent certificate was dated April 27, 2007. The pilot's second-class FAA medical certificate was issued on August 8, 2006, with no limitations.

The channel 3 pilot was a backup pilot for and part-time employee under contract to the station. The channel 3 pilot worked full time as the director of operations and a charter pilot for

Westcor Aviation in Scottsdale. As of September 2006 (the date of his latest yearly résumé), he had accumulated 13,579 total flight hours.⁹

The chief pilot for channel 3 reported that, between January 2 and July 5, 2007, the accident pilot flew 79 flights and 124 hours for the station.¹⁰ Westcor Aviation's current director of operations reported that in 2007 the pilot had flown 88 hours during charter operations for the company.

Westcor Aviation reported that the pilot's last flight before the accident occurred 2 days earlier when he flew a charter flight that was scheduled from 0745 to 0900. On the day of the accident, the pilot reported to work at Westcor Aviation at 0900. The company's current director of operations saw the pilot then and stated that he seemed normal with a positive attitude. The pilot had no charter flights scheduled that day and was planning to work for channel 3 from 1600 to 1830, but he reported for work at the station when he received the breaking news story about the police pursuit.

The channel 3 pilot's most recent ground and flight training for the AS350B2 helicopter was completed on June 27, 2007. The pilot's most recent checkride, which occurred on April 27, 2007, was conducted under Part 135 in the AS350B2. The FAA reported that the pilot had not been involved in any previous accidents or incidents and that no enforcement actions had been taken against him.

The channel 3 pilot was not married, did not have children, and lived alone, and close friends did not know his schedule in the 72 hours before the accident. They reported that he did not smoke or drink and that he had been in good health.

1.5.2 The Channel 15 Pilot

The channel 15 pilot, age 47, received an FAA commercial pilot certificate on December 7, 1990, with a rotorcraft-helicopter rating. The pilot's second-class FAA medical certificate was issued on December 27, 2006, with a waiver for defective color vision.¹¹

⁹ Westcor Aviation's current director of operations estimated that, at the time of the accident, the channel 3 pilot had accumulated 14,100 total flight hours, of which 2,400 hours were in AS350-series helicopters, 11,400 hours were in other helicopter models, and 300 hours were in fixed-wing airplanes. (The Safety Board did not find the pilot's logbook.)

¹⁰ The channel 3 accident pilot flew for the station between July 6, 2007, and the date of the accident, but the records of these flights were in the helicopter at the time of the accident and thus were destroyed.

¹¹ The channel 15 pilot's records showed that he received a March 27, 1990, letter from the manager of the FAA's Aeromedical Certification Division that noted, "your eligibility for a third-class medical certificate has been established and made a part of your record in our office ... a Statement of Demonstrated Ability is enclosed to document your eligibility to hold this class of medical certificate despite your failure to entirely meet the physical standards." On December 27, 1990, the pilot received an updated Statement of Demonstrated Ability for a second-class medical certificate. A statement of demonstrated ability does not need to be updated as long as the disability does not change.

The channel 15 pilot began work at U.S. Helicopters (headquartered in Marshville, North Carolina) in October 2005. U.S. Helicopters reported that he had accumulated 8,006 total flight hours, all in rotorcraft; 907 hours of which were in the AS350B2. The pilot had flown 122, 28, and 3 hours in the 90 days, 30 days, and 24 hours, respectively, before the accident. The channel 15 pilot's most recent ground and flight training for the AS350B2 helicopter was completed on December 7, 2006. His last checkride, which also occurred on December 7, 2006, was conducted under Part 135 in the AS350B2.

U.S. Helicopters reported that the channel 15 pilot flew an average of 45 hours per month for the station. The pilot did no other flying for the company. The FAA reported that the pilot had not been involved in any previous accidents or incidents and that no enforcement actions had been taken against him. The company reported that the pilot had not been disciplined for any performance issues.

The channel 15 pilot worked a standard weekday schedule from 0530 to 1430. The pilot was not married, did not have children, and lived alone, and his activities outside of work in the 72 hours before the accident could not be determined.

1.6 Aircraft Information

Both helicopters were Eurocopter AS350B2 models that were equipped with Turbomeca Arriel 1D1 engines. The helicopters had three main rotor blades that were blue-gray on the top and black on the bottom and were color-coded red, blue, and yellow at the blade root. The main rotor blades on the AS350B2 rotate clockwise when viewed from above.

The channel 3 helicopter was equipped with a single ENG monitor that displayed four panels and was mounted near the instrument panel. The top panels showed the station's broadcast and the video being taped by the on-board photographer. The pilot could decide what was shown on the bottom two panels.¹² Figure 1 shows the channel 3 instrument panel; the four-panel monitor appears on the left. The channel 15 helicopter was equipped with a similar monitor that displayed one panel at a time. The pilots were expected to scan the monitor during their normal flying duties.

The channel 3 helicopter had an L-3 Communications SkyWatch SKY497 traffic advisory system on board. The system provided the aural warning "traffic, traffic" over the pilot's headset and displayed other traffic on the helicopter's Garmin GNS 430 navigation unit (shown in the center of figure 1 with the indication "STANDBY" in the display window). The system was capable of tracking up to 30 transponder-equipped aircraft at the same time by interrogating transponders within an 11-nautical mile (nm) radius and computing the responding aircraft's range (± 0.05 nm or 304 feet), relative bearing ($\pm 5^\circ$ to 7°), relative altitude (± 200 feet), and closure rate (to a maximum of 900 knots). The system also predicted collision

¹² The helicopters had outside cameras mounted on their nose and tail, a "talent" camera inside the cockpit that focused on the pilot/reporter, and a tape deck with file footage.

threats, provided a 20- to 30-second warning of aircraft that were on a collision path, and plotted the eight most threatening aircraft locations on the display.



Figure 1. AS350B2 ENG Helicopter Instrument Panel.

Source: KTVK-TV.

The manufacturer's guidance for the traffic advisory system included a warning that stated the following:

Do not attempt evasive maneuvers based solely on traffic information on the display. Information on the display is provided to the flight crew as an aid in visually acquiring traffic; it is not a replacement for Air Traffic Control (ATC) and See & Avoid Techniques.

The system issued an aural alert when aircraft entered a cylinder of airspace surrounding the pilot's aircraft that had a horizontal radius of 0.2 nm (1,216 feet) and a height of ± 600 feet. The manufacturer's guidance stated that, after the system issued the aural alert, the pilot should look outside for other aircraft and should then use normal right-of-way procedures. The guidance also warned pilots not to rely on the aural alert for aircraft information because the alerts

occurred only when the collision threat was first detected. The manual further pointed out that the aural alert might be inhibited.

The channel 3 chief pilot stated that turning on the system was part of the power-up checklist and that the system worked when he flew the helicopter earlier on the day of the accident. The chief pilot also stated that, when “a lot of traffic [was] in close,” the volume on the aural alert would be turned down so that it would not obscure the communications frequency.

The channel 15 helicopter did not have a traffic advisory system on board.

1.7 Meteorological Information

ATIS information “Kilo,” issued at 1155, included the following weather information: winds from 280° at 6 knots gusting to 14 knots; visibility 10 (statute) miles; ceiling broken at 5,500, 15,000, and 25,000 feet; temperature 34° Celsius (C); dew point 19° C; and altimeter setting 29.94 inches of mercury.¹³

According to the U.S. Naval Observatory, the sun’s elevation angle was 71.9° at an azimuth of 139.1° (true heading) at 1245:00 on the day of the accident.

1.8 Aids to Navigation

None.

1.9 Communications

The accident pilots (and the other ENG pilots that were operating in the area at the time of the accident) were using the same air-to-air frequency on one radio to broadcast their helicopter’s position and their intentions. (The police helicopter pilot was using the same air-to-air frequency as well.) The ENG and police helicopter pilots were also monitoring the PHX ATCT frequency on another radio. In addition, the ENG pilots communicated with their station’s news department on a third radio and the station’s photographer via an intercom.

No technical communications problems were reported.

¹³ Section 1.16.2 describes the meteorological conditions near the accident site.

1.10 Airport Information

1.10.1 Air Traffic Control

The accident helicopters were operating in PHX ATCT class B airspace.¹⁴ According to FAA Order 7110.65, *Air Traffic Control*, paragraph 7-9-6, controllers are not required to provide separation to visual flight rules (VFR) helicopters in class B airspace.

The controller who handled the accident flights was at the local control north position. He began working at the PHX ATCT in June 2000 and received training on the Sharp Delta Letter of Agreement (LOA) in April 2002, August 2004, and April 2006.¹⁵ The controller's training records did not indicate training for the Sharp Echo LOA, but the PHX ATCT air traffic manager indicated that the controller had received the training.

The controller stated that he did not see the accident occur because he was watching an airplane taxi for departure but that he did see a smoke plume after being advised of the collision by an ENG helicopter pilot. He was subsequently advised by the pilot of another ENG helicopter that the channel 3 and 15 helicopters had been involved in the collision. The controller then advised the on-duty controller-in-charge about the accident and was relieved from his position per standard procedure.

1.10.2 Sharp Echo Letter of Agreement

The Sharp Echo LOA, "Phoenix Tower and Helicopters Operating in the Phoenix Class B Airspace," became effective on May 15, 2007.¹⁶ Its purpose was to specify responsibilities, define terms, and establish procedures to be used between the PHX ATCT and signatory operators for the control and operation of VFR helicopters within the PHX class B airspace. The LOA stated, "'Sharp Echo' shall be used by pilots on initial contact with Phoenix Tower to indicate their understanding of and participation in this program. The pilot must state ... the current ATIS code." The LOA also stated that Sharp Echo "shall be used by Phoenix Tower as clearance into the Phoenix Class B airspace and/or the pilot's requested routing." In addition, the LOA provided altitude assignments and frequencies for helicopters while in the class B airspace.

1.11 Flight Recorders

The accident helicopters were not required to have a cockpit voice recorder (CVR) or a flight data recorder (FDR) installed.

¹⁴ The collision occurred about 370 feet outside of the horizontal boundary of the airspace.

¹⁵ The Sharp Delta LOA preceded the Sharp Echo LOA.

¹⁶ Phoenix-area ENG helicopter operators provided their pilots with a copy of the Sharp Echo LOA.

1.12 Wreckage and Impact Information

Most of the main wreckage from the channel 3 and 15 helicopters was found in a debris field that was about 2,160 feet long and 560 feet wide. The accident site elevation was 1,100 feet msl.

The channel 3 helicopter's airframe sustained severe mechanical and thermal damage and had fragmented. The cabin was found inverted with the mast imbedded in the ground. The tail boom was broken into several pieces. The forward tail boom section was found about 170 feet west-northwest of the main debris field. The aft tail boom section was found about 260 feet northwest of the main debris field with the tail rotor attached. The piece of the tail boom that formed the aft portion of the left horizontal stabilizer was located about 320 feet north of the main debris field. The tail cone was located about 50 feet to the east of the left horizontal stabilizer piece.

The channel 15 helicopter's airframe also sustained severe mechanical and thermal damage. The main airframe did not fragment, and all of its components were within the main debris field.

Both helicopters' engines sustained severe mechanical and thermal damage. The channel 3 helicopter's engine axial rotor was solidly packed with mud and debris, and the axial compressor blades exhibited gouges and scratches. The engine axial rotor blades on the channel 15 helicopter were bent opposite the direction of rotation (reverse bending). The damage to the engine rotating components on both helicopters was consistent with operation at high power.

An 18-inch outboard segment of the channel 3 helicopter's yellow main rotor blade was found about 1,050 feet southwest of the main debris field. The inboard leading edge of this piece exhibited forward bending mechanical damage in excess of 90°. A 32-inch outboard segment of the channel 15 helicopter's red main rotor blade was found about 1,040 feet southwest of the main debris field and about 180 feet from the yellow blade piece from the channel 3 helicopter. These pieces were found the farthest from the main debris field.

1.13 Medical and Pathological Information

Toxicology tests were performed by the FAA's Civil Aeromedical Institute (CAMI) on tissue specimens from both pilots. The tests detected low levels of ethanol in both pilot's specimens, which were consistent with postmortem ethanol production. The specimens tested negative for a wide range of drugs, including major drugs of abuse (marijuana, cocaine, phencyclidine, amphetamines, and opiates).

1.14 Fire

No evidence or witness statements indicated an in-flight fire. The evidence indicated that the fire damage occurred after the midair collision.

1.15 Survival Aspects

The Maricopa County, Arizona, coroner determined that the cause of death for the ENG pilots and photographers was multiple blunt force injuries.

1.16 Tests and Research

1.16.1 Radar Data Extraction

To determine the accident helicopters' flightpaths based on radar data, the Safety Board imported a file containing all radar data pertinent to the accident (1,200 radar returns) into a Google Earth image. The image that resulted showed 20 minutes of radar data for all of the helicopters operating in the area along with a satellite image of the area over which they were operating. Time and mode C altitude information from the helicopters' transponders,¹⁷ as well as information about the helicopters' initially reported altitudes, were used to verify each helicopter's flightpath.

Radar data showed that the channel 15 helicopter maintained an altitude between 2,000 and 2,200 feet from about 1236:40 to about 1245:46. The helicopter began a right turn about 1245:27, and the rate of turn increased about 1245:50, at which time the helicopter's altitude also increased to 2,300 feet. The last valid radar return associated with channel 15's flightpath occurred about 1245:59 at an altitude of 2,300 feet.

Radar data also showed that the channel 3 helicopter generally maintained an altitude between 1,900 and 2,100 feet from about 1238:18 to about 1243:31.¹⁸ Within that time frame, from about 1241:17 to about 1242:50, the helicopter was at an altitude of 1,900 feet. The helicopter then maintained an altitude of 2,000 feet from about 1243:50 to about 1245:45, at which time the helicopter turned to the right. About 1245:54, the helicopter was at an altitude of 2,100 feet. The last valid radar return associated with channel 3's flightpath occurred about 1246:00 at an altitude of 2,100 feet.

¹⁷ Mode C transponder information provides an airplane's altitude in 100-foot increments. For this accident, this information was provided every 4.5 seconds. All altitudes referenced in this section are based on mode C information.

¹⁸ Three returns during this time frame (occurring about 1242:59, 1243:04, and 1243:13) were at an altitude of 1,800 feet.

1.16.2 Audio/Video Recorder Systems

The accident helicopters were equipped with an on-board system that was capable of transmitting audio and video live to a ground station. The Safety Board developed a transcript of the audio recordings and conducted a video study to estimate the positions of the helicopters.

The audio recordings continuously recorded the pilots' voice and background sounds as captured by their microphones. It is not known whether the photographers on board each helicopter had microphones; their voices, however, were captured by the pilots' microphone but were generally not loud enough to discern. The audio from the pilots' headset was not recorded, so the conversations on the recordings were mostly one sided. The audio recordings indicated that both pilots were talking to several people, including news station personnel, other ENG helicopter pilots, the police helicopter pilot, ATC, and their station's photographer. The transcript of the audio recorded by both systems appears in appendix B.¹⁹

The systems' video cameras were mounted externally. The content of the video recordings was focused on a suspect driving a vehicle that was being pursued by several police vehicles. The camera views were changing frequently because of the cameras' capability to pan, tilt, zoom, and pitch. The video recordings showed that the weather appeared to be generally sunny. Broken or scattered cloud layers could be seen when portions of the sky were visible in the camera views, but these cloud layers were well above the helicopters' operating altitudes. The helicopters did not appear to be in or near clouds at any time, and visibility was unrestricted throughout the recording.

The video study estimated the path of the suspect's vehicle and several locations of the channel 3 and 15 helicopters.²⁰ The locations of the helicopters during the minute that preceded the midair collision could not be calculated at all times or over a regular interval because of the changing camera views. Also, in some instances, only a single reference line could be constructed, which provided a sight line along which the helicopter was most likely located (but the location along that line could not be determined).

A lack of suitable ground references in the camera view precluded any location estimates for the channel 3 helicopter in the final 13 seconds before the collision and for the channel 15 helicopter in the final 10 seconds before the collision. However, the location of the channel 15 helicopter at the moment of the collision could be estimated because ground references had come into the camera view at that precise time. Figure 2 shows the locations of the channel 3 and 15

¹⁹ For the time period until the final 3.5 minutes before the collision, the transcript contains all comments that were considered to be (1) an indication of the accident helicopters' position, (2) coordination between the accident pilots regarding their helicopter's position and their intentions, and (3) callouts about the position of other helicopters operating in the area. All comments heard during the final 3.5 minutes of flight, regardless of their nature, were included in the transcript.

²⁰ The locations of the channel 3 and 15 helicopters were estimated by triangulation or single line-of-sight lines using ground reference features that could be identified in the video recordings and a geographical information system program. Landmarks that were located along a sight line from the helicopter were identified in the video recordings and then plotted in the geographical information system program. Vertical reference lines were overlaid onto the image at locations where easily identifiable landmarks aligned vertically. The extension of these reference lines to the locations where they intersected each other resulted in a triangulation estimate of the cameras' locations.

helicopters in the minute preceding the accident along with some of the radar data (as discussed in section 1.16.1) and the path of the suspect's vehicle.

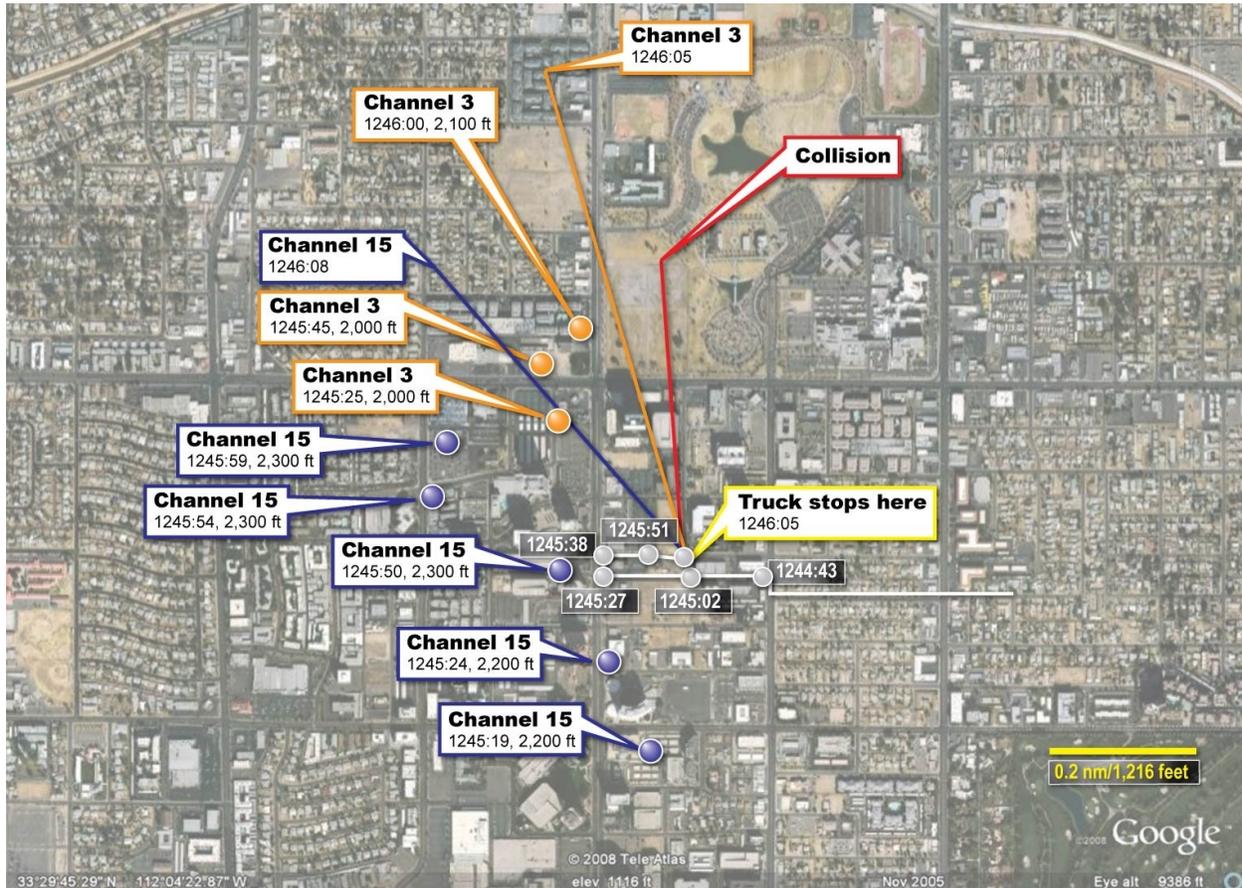


Figure 2. Channel 3 and 15 Helicopter Position Information.

Note: The circles indicate locations where a single helicopter position could be established either with multiple reference lines from the video study or a radar data position. The solid lines indicate a location where only a single reference line could be constructed and the position and altitude of the helicopters along that line could not be determined.

1.17 Organizational and Management Information

1.17.1 Channel 3

Channel 3 (KTVK) owned and operated the accident helicopter and contracted with Westcor Aviation for maintenance on the helicopter.²¹ The channel 3 chief pilot was the only

²¹ Westcor Aviation, located in Scottsdale, was established in 1980. According to its website, the company provides helicopter, charter, and maintenance services.

full-time pilot for the station; the accident pilot was the primary backup pilot. (Two other pilots were also backup pilots for the station.) At the time of the accident, channel 3 assigned its pilots both flying and reporting duties.

The chief pilot reported that he briefed station management directly about safety issues and local ENG pilot meetings. He also stated that station photographers complete an indoctrination course during which they are taught the “see and avoid” concept of flying (because, once in the air, photographers were considered by the station to be part of the crew) and to look for traffic while the pilot is flying. Channel 3 did not have any formal procedures for training its pilots.

Channel 3 changed its operations after the accident. The station now has two full-time pilots and one backup pilot and plans to include other backup pilots for its operations. If an assignment involves filming video only, then one pilot will fly while the photographer films. If an assignment also involves reporting, then two pilots will fly together, one with flying duties and the other with reporting duties, with the photographer filming video.

1.17.2 Channel 15

Channel 15 (KNXV) contracted with U.S. Helicopters to provide a helicopter and pilots and to conduct maintenance. U.S. Helicopters conducted ENG flights under Part 91 pursuant to the aerial work operations exception in 14 CFR 119.1(e)(4)(iii), which states the following:

Except for operations when common carriage is not involved with airplanes having a passenger-seat configuration of 20 seats or more, excluding any required crewmember seat, or a payload capacity of 6,000 pounds or more, this part [air carrier and commercial operator certification] does not apply to ... aerial work operations, including ... aerial photography or survey.

The KNXV helicopter was the only one of the company’s 46 aircraft to operate in the Phoenix area. The accident pilot worked the morning shift (0530 to 1430) at the station, and another company pilot worked the afternoon shift. At the time of the accident, channel 15 assigned its pilots both flying and reporting duties.

U.S. Helicopters was founded in 1979. Its headquarters office is located in Marshville, North Carolina. According to its website, U.S. Helicopters provides full-service, exclusive-use ENG helicopters and other helicopter services, including on-demand charter operations and helicopter maintenance. U.S. Helicopters received, via e-mail, a daily report of channel 15’s flight times and maintenance, and either the company’s director of maintenance or director of operations would follow up, as needed, by telephone with a station pilot.

U.S. Helicopters has a safety office that is part of its headquarters operations. The safety office maintains the company’s safety and operations manuals and reports directly to the company’s chief information officer, who communicates safety information to employees

through e-mails and memos and in person. U.S. Helicopters did not have any formal procedures for training its pilots.

Channel 15 changed its operations after the accident. The pilot no longer has reporting duties along with flying duties, and the photographer videotapes film footage only.

1.18 Additional Information

1.18.1 Witness Information

The Safety Board obtained additional information about this accident from 18 witnesses using contact information provided by the Phoenix police department and from telephone calls made to the Board's communications center and the local FAA flight standards district office (FSDO). The most frequently cited observations in the witness statements were the following:

- The accident helicopters were flying closely together above the police helicopter during the car chase.
- The channel 3 helicopter appeared to be at a higher altitude than the channel 15 helicopter. (Some witnesses could not discern the helicopters' altitudes relative to one another, and others reported that the helicopters were at the same altitude.)
- The channel 3 helicopter appeared to be hovering, and the channel 15 helicopter appeared to be repositioning when it impacted the channel 3 helicopter from below its left side. (Other witnesses reported that both helicopters were maneuvering at the time, yet other witnesses indicated that the channel 15 helicopter was relatively stationary and that the channel 3 helicopter was maneuvering when it impacted the channel 15 helicopter.)
- The helicopters' main rotor blades came together during the collision. (Other witnesses reported that the helicopters' tail sections came together at the time.)
- No abrupt maneuvers, unusual sounds, or fire occurred before the collision.
- After the collision and before descending to the ground, the channel 15 helicopter remained relatively intact, excluding its main rotor blades, and the channel 3 helicopter separated into many pieces.

1.18.2 Federal Aviation Administration Guidance

Advisory Circular (AC) 90-48C, *Pilots' Role in Collision Avoidance*, states that Part 91 flight rules set forth the concept of "see and avoid." This concept requires vigilance at all times by each person operating an aircraft regardless of whether the flight is conducted under

instrument flight rules or VFR. The AC also notes that most midair collisions and reported near midair collisions occur during good VFR weather conditions and daylight hours. The AC further states that pilots should remain constantly alert to all traffic movement within their field of vision and that they should scan the entire visual field outside of their aircraft to ensure that conflicting traffic would be detected.

1.18.3 Group Interview With Phoenix-Area Electronic News Gathering Pilots

After the accident, the Safety Board met with ENG helicopter pilots in the Phoenix area to discuss issues related to the accident flights. The pilots indicated that the following procedures occurred when they received notification of an event:

- The first pilot to arrive on scene establishes a position.
- As additional pilots enter the area, the pilots transmit (on a local frequency) their altitudes and positions to each other.
- ENG helicopters fly 500 feet above police helicopters.
- Pilots wanting to reposition their aircraft transmit the necessary information about this change.
- During live broadcasts, pilots continue to monitor the local frequency and discuss positions.

The ENG helicopter pilots stated their belief that communication between the accident pilots was adequate during the broadcast of the police pursuit. They also stated that, at the time of the accident, all of the operators except one used a combination pilot/reporter; the one exception used a photographer/reporter.

In addition, the ENG pilots stated that they would occasionally lose sight of other helicopters when flying over the city because the helicopters tended to blend in with the desert landscape and vegetation. These pilots suggested that high-visibility main rotor and tail rotor blade paint and light-emitting diode (LED) anticollision lights would help them better discern other helicopters. The accident helicopters were not equipped with LED anticollision lights and did not have high-visibility blade paint on their main rotor blades.²²

²² Channel 15's new ENG helicopter has high-intensity anticollision lights and a high-visibility paint scheme on its main and tail rotor blades.

1.18.4 Postaccident Actions

The channel 3 chief pilot stated that, since the time of the accident, ENG pilots have been having “a lot more” air-to-air conversations. He indicated that the pilots were making more callouts that described their helicopter’s location and acknowledged the position of other helicopters. He also stated that, in a static situation (such as a building fire), no helicopters would change position until all of the pilots responded and that, in a dynamic situation (such as a car chase), the pilots would constantly communicate with one another and confirm each other’s positions. He further indicated that the pilots were providing more distance between each other’s helicopters and were asking the photographers more often to check clearances (separation) with other helicopters.

In August 2008, Helicopter Association International’s (HAI) ENG committee issued a revised draft of the association’s ENG aviation safety manual, which contained updated safety management procedures and guidelines for ENG operations. The revised manual discussed pilot and pilot-reporter duties, maintenance, crewmember training, station management responsibilities, safety guidelines, dispatch and flight management procedures, emergencies, and risk management procedures. HAI anticipated that the manual would be finalized by February 2009.²³ Excerpts from the draft manual include the following:

Radio communications among pilots

As you approach a scene, make an initial radio call no less than 2 miles out announcing your approach, direction, altitude and distance in miles. Radio calls shall be made on the helicopter air to air frequency 123.025 unless local published procedures specify otherwise.

You shall not enter the scene unless both positive communication and visual contact with any other aircraft over the scene have been established. Visual contact and communication shall be maintained at all times.

Operating altitudes

Special procedures are required for participating in a moving scene. Careful attention is required because scenes change from moment to moment and often rapidly. Procedures should be determined in advance during regular meetings of local helicopter crews.

During news events that are moving, the need for wide separation of public service aircraft and media aircraft is crucial.

²³ According to the chairman of the HAI ENG committee, the manual was expected to be forwarded to the HAI Board of Directors by the end of November 2008 for a final vote so that the manual could be adopted before the February 2009 HAI Heli-Expo.

Separation standards

Vertical and horizontal separation between all aircraft in a scene shall be determined by local protocol established by local coordination meetings. To allow for any evasive maneuvering or emergency action, it's recommended all aircraft utilize a minimum separation distance from other aircraft of:

- Minimum recommended horizontal separation of 500 feet (1,000 feet preferred)
- Minimum recommended vertical separation of 200 feet (400 feet preferred)

Pilot responsibilities

The pilot's primary responsibility is to fly the aircraft safely. ALL other duties will be secondary while flying.

Safety, not news, is the primary consideration. Pilot-reporters shall decline station requests for live reports when ATC obligations and safe aircraft operation preclude safely narrating a report personally.

Scene work can increase the possibility of target fixation. All pilots should establish and maintain cockpit routines that reduce the likelihood of target fixation.

In addition, the manual recommended that ENG helicopters be equipped with high-intensity anticollision lights, a traffic advisory system, and high-visibility main and tail rotor blades because of "the special nature of ENG flight and the routine operation of aircraft in close proximity to other aircraft." The manual also recommended that cockpit/flight data recording systems be installed on ENG helicopters and that local coordination meetings be held to discuss pertinent operational issues.²⁴

Finally, in January 2009, the National Broadcast Pilots Association (NBPA) was reorganized so that its full membership would include other ENG industry personnel, including photographers, reporters, aircraft mechanics, and engineers. The new organization is known as the National ENG Helicopter Association.

1.18.5 Previous Electronic News Gathering Accidents

The Safety Board's aviation accident database contained 23 cases that involved helicopters used for ENG operations. However, the circumstances associated with these events

²⁴ Phoenix-area ENG pilots stated that they attend an annual meeting with local law enforcement and U.S. Forest Service personnel to discuss procedures for standardizing operations. Also, the president of the National Broadcast Pilots Association stated that several ENG pilot groups hold meetings with local public use pilots and ATCT personnel to discuss the local operating area procedures, review any problems that may have arisen, and devise ways to mitigate future problems.

involved equipment malfunction/failure, impact with terrain or obstacle, or operational errors that were incidental to the type of operation. One of the events involved a November 1999 nonfatal collision in Seattle, Washington, between a Bell 206B returning from an ENG assignment and a Bell 206L-3 on a Part 91 flight. During postaccident interviews, the Bell 206B pilot stated that he saw the other helicopter at the same time that he felt the impact, and the Bell 206L-3 pilot stated he did not see the other helicopter before or after the collision. A calculated convergence angle between the two aircraft indicated that no visual restrictions would have prevented either pilot from seeing the other aircraft. The Safety Board determined that the probable cause of this accident was the inadequate separation and lookout maintained by both helicopter pilots.²⁵

1.18.6 Aviation Safety Reporting System Reports

The Safety Board reviewed reports related to ENG operations in the National Aeronautics and Space Administration's Aviation Safety Reporting System (ASRS), which is a national repository for reports regarding aviation safety-related issues and events. These reports were submitted voluntarily by pilots since the time of the database's creation in 1988.²⁶ The ASRS database contained 77 reports of events related to ENG operations. Of these 77 reports, 18 involved near midair collisions, 3 involved a critical airborne conflict, and 5 involved a less critical airborne conflict; the remaining reports referenced various topics, with airspace and/or altitude violations commonly cited.

One of the 18 ASRS reports involving a near midair collision, dated March 1997, was submitted by an AS350A ENG helicopter pilot who had been dispatched to cover a breaking news story. Two other ENG helicopters were also on scene. The report stated that all three helicopters set up counterclockwise orbits and agreed on altitudes at which each helicopter would operate (1,400, 1,700, and 2,000 feet). The helicopters operating at 1,400 and 1,700 feet subsequently switched altitudes, and all three helicopters then made a few more orbits. The pilot who submitted the report stated that a near midair collision occurred when the helicopter that should have been operating at 1,700 feet was at an altitude of 2,000 feet and coming straight at him. The pilot made an evasive maneuver and avoided the other helicopter by about 200 to 300 feet horizontally and about 150 feet vertically. In addition, the pilot who submitted this report stated that, with ENG operations, it was not uncommon to have up to five radios operating and to broadcast live at the same time. He also stated that as many as 7 to 10 aircraft might be trying to broadcast from an airspace that is 1,000 feet high and 1/2 mile wide. He further stated that anything that takes the pilot's attention away from the primary job of piloting could cause an incident such as the one he reported.

²⁵ Additional information about this accident, SEA00FA021A/B, can be found on the Safety Board's website at <<http://www.nts.gov/nts/query.asp>>.

²⁶ Because ASRS reports are submitted voluntarily, the existence of reports concerning a specific topic in the ASRS database cannot be used to infer the prevalence of that problem within the National Airspace System.

Another ASRS report involving a near midair collision, dated August 2000, was submitted by an ENG helicopter pilot who was covering the pursuit of a stolen vehicle. The pilot indicated that, as his helicopter began the climb to stay clear of the police helicopters, he also began reporting for his television station. The stolen vehicle involved in the pursuit chase then collided head on with another vehicle, so the pilot began repositioning the helicopter while still reporting the event. At that time, the pilot inadvertently allowed the helicopter's altitude to drop, and a near midair collision with a police helicopter occurred. The pilot did not see the police helicopter, but his photographer noticed that a helicopter had passed close to their position. The pilot then began an immediate climb. The pilot acknowledged that his workload could be "a bit hectic" and that he had let the coverage of the story distract him from his altitude awareness.

1.18.7 Use of Recorded Information

Although neither of the accident helicopters was required to have a CVR or an FDR, the audio/video streams that were actively sent back from each helicopter to its respective news station on the ground were recorded and, along with radar data, provided information for the reconstruction of the accident sequence. With regard to the video, if the camera view happened to include sufficient ground references, a triangulation method (or a line-of-sight method) could be used to estimate a helicopter's actual position or line of position. In the 1 minute preceding the accident, two positions and four lines of position could be estimated for the channel 3 helicopter, and three positions and five lines of position could be estimated for the channel 15 helicopter.²⁷

The audio portion of the stream came from the pilots' microphones, which were continuously active. Examples of information extracted from the audio include position (location) reports, operating altitude, and intentions. The audio also provided pilot confirmations and acknowledgments, as well as conversations between the two accident pilots, even though each side of these conversations was separately recorded. Further, the audio recordings indicated that both pilots were actively reporting when the collision occurred but that only the channel 15 pilot was broadcasting live.

The Safety Board has previously addressed the need for recording information on aircraft such as those involved in this accident. Specifically, on December 22, 2003, the Safety Board issued Safety Recommendations A-03-62, -64, and -65, which asked the FAA to do the following:

Require the installation of a crash-protected image recording system on all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured after January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135

²⁷ For presentation purposes, figure 2 in section 1.16.2 shows, from the video study, one position and one line of position for channel 3, three positions and one line of position for channel 15, and the line of position for both helicopters at the time of the collision. (Figure 2 also shows two radar returns for channel 15 and two radar returns for channel 3.)

and 121 or that are being operated full-time or part-time for commercial or corporate purposes under Part 91. (A-03-62)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a cockpit voice recorder, and that are operating under 14 *Code of Federal Regulations* Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording system by January 1, 2007. (A-03-64)²⁸

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (A-03-65)

On October 11, 2005, the FAA stated that it had been actively working to address these recommendations (as well as Safety Recommendation A-03-63, which was issued along with Safety Recommendations A-03-62, -64, and -65)²⁹ and was collecting data to establish an FAA position on aircraft image recorders. The FAA indicated that the Safety Board's recommendations did not specify what data the image recorder should capture. The FAA stated its belief that the intent of these recommendations was primarily to collect parametric data from the images of the cockpit instrumentation but that an image recorder system had not been manufactured or installed for this specific purpose.

The FAA also stated that it was working with the Safety Board to develop tests of an image recorder system in a simulator and on an FAA Beechcraft King Air airplane. The FAA indicated that images of the flight deck instrumentation would be recorded and analyzed, Board and FAA accident investigators would derive parametric data from these flights, and the derived data would be compared with the actual recorded data to determine the accuracy of the derived data. The FAA further indicated that the tests concluded in June 2005 and that the final report detailing the test findings would be completed by December 2005.

On April 26, 2006, the Safety Board acknowledged that one benefit of an image recording system was the potential to obtain parametric data from images of the cockpit instrumentation but stated that the Board did not agree with the FAA's belief that the intent of Safety

²⁸ Safety Recommendation A-03-64 superseded Safety Recommendation A-99-60, which was issued as a result of the Department of the Interior Cessna 208B accident in Montrose, Colorado. Safety Recommendation A-99-60 asked the FAA to "require, within 5 years of a technical standards order's issuance, the installation of a crash-protective video recording system on all turbine-powered nonexperimental, nonrestricted-category aircraft in 14 *CFR* Part 135 operations that are not currently required to be equipped with a crashworthy flight recorder device."

²⁹ Safety Recommendation A-03-63 asked the FAA to "amend the current regulations for 14 *Code of Federal Regulations* Parts 91, 135, and 121 operations to require all turbine-powered, nonexperimental, nonrestricted-category aircraft that have the capability of seating six or more passengers to be equipped with an approved 2-hour cockpit voice recorder that is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight."

Recommendations A-03-62 through -65 was primarily to collect parametric data. The Board explained that the letter that transmitted these recommendations to the FAA noted that cockpit image recorders “obtain not only audio information like that from CVRs and event data like that from FDRs, but also information about the environment outside the cockpit window.” The Board recognized the value of the FAA’s parametric data study but stated that the unfinished final report was not a valid basis for delaying the recommended actions. The Board indicated that, for the FAA’s actions in response to these recommendations to be acceptable, the FAA must prepare and issue the recommended regulations. As a result, Safety Recommendations A-03-62 through -65 remained classified “Open—Unacceptable Response.”³⁰

Finally, it is important to note that the Safety Board has included “require image recorders” and Safety Recommendation A-03-64 on its Most Wanted List of Transportation Safety Improvements since 2004. (Safety Recommendation A-99-60, which was superseded by Safety Recommendation A-03-64, appeared on the Most Wanted List from 2001 to 2003 under the “Automatic Information Recording Devices” issue area.) In January 2006, the Board prepared a document detailing its observations of and recommendations resulting from the parametric data tests with the FAA.³¹ The Department of Transportation indicated, in its February 2008 report on the status of the recommendations on the Most Wanted List, that the FAA was reviewing the document to determine if an image recorder was an acceptable method for collecting flight data information.

³⁰ Safety Recommendations A-03-64 had previously been classified “Open—Unacceptable Response” on November 9, 2004; Safety Recommendations A-03-62, -63, and -65 had previously been classified “Open—Unacceptable Response” on December 15, 2004.

³¹ As of December 2008, the FAA had not issued its planned final report on the parametric data study.

2. Analysis

2.1 General

The pilots of the channel 3 and 15 helicopters were properly certificated and qualified in accordance with applicable Federal regulations. Both helicopters were properly certified, equipped, and maintained in accordance with Federal regulations. The recovered components showed no evidence of any preimpact structural, engine, or system failures.

Although the reported weather at the time of the accident indicated multiple broken cloud layers in the vicinity of PHX, the video recordings showed that there were few clouds and mostly clear sky in the area of the police pursuit. A prevalent factor in many midair collisions during VMC is sun glare, which prevents a pilot from detecting another aircraft when it is close to the position of the sun in the sky. However, at the time of this accident, the sun's angle was high. Thus, weather was not a factor in this accident, and sun glare would not have interfered with the pilots' ability to detect and track other helicopters over the pursuit scene.

The channel 15 pilot had received a statement of demonstrated ability for his color vision deficiency. Communications recorded during the accident flight indicated that he did not have difficulty discerning objects in the air or on the ground. Also, movement is primarily detected through the use of peripheral vision, which is not affected by color vision deficiencies. Thus, the channel 15 pilot's color vision deficiency was not a factor in this accident.

This analysis discusses the accident sequence, the pilots' joint flying and reporting duties, methods to improve ENG pilots' awareness of other helicopters operating nearby, and the benefits of (1) FAA-led ENG meetings to discuss operational procedures and manage risk, (2) FAA-sponsored ENG best practices guidelines, and (3) flight recorder systems for smaller aircraft.

2.2 Accident Sequence

The channel 3 and 15 helicopters were dispatched to cover a police pursuit of a suspect who had reportedly stolen a pickup truck and backed it into a police car after being pulled over. Three other ENG helicopters were also covering the event, and a police helicopter was operating below the ENG helicopters. Both the channel 3 and 15 helicopters entered the airspace according to the provisions of the Sharp Echo LOA with PHX, except the channel 3 pilot did not state the

current ATIS code during his initial transmissions with the controller.³² However, this omission was not a factor in the accident.

In addition to their flying duties, the channel 3 and 15 pilots were also reporters. Each station had an on-board photographer who was videotaping the event. (Two of the three other stations with ENG helicopters in the area had pilots with joint flying and reporting duties; the other station had a pilot with flying duties and a photographer with videotaping and reporting duties.) The channel 15 broadcast of the event was live, and the channel 3 broadcast was being recorded. The controller was not required to provide radar services to ensure separation, per ATC handbook procedures for VFR helicopters operating in class B airspace. Thus, as part of their flying duties, both pilots were responsible for keeping a safe distance from all of the helicopters operating in the area.

The channel 3 and 15 pilots, as well as the other ENG pilots operating in the area, were expected to communicate position information and intentions with one another using an air-to-air frequency. (The pilots were also expected to monitor the PHX ATCT frequency, which would have provided some general information about other aircraft in the area.) The channel 15 helicopter was the first ENG helicopter to arrive on scene, and its pilot established the helicopter's altitude of 2,000 feet about 1229:03.³³ The channel 3 helicopter arrived on scene about 1238:03, and its pilot announced that the helicopter would be operating at an altitude of 2,000 feet. However, neither pilot recognized each other's intention to operate at the same altitude.³⁴

The audio recordings from the channel 3 and 15 helicopters showed that, about 1241:18 (about 5 minutes before the midair collision), the channel 3 pilot commented that he would be changing position. The channel 15 pilot then stated, "where's three?," "like how far?," and "oh jeez." The channel 15 pilot transmitted, "three. I'm right over you. Fifteen's on top of you." Radar data showed that the channel 3 helicopter had been at an altitude of 1,900 feet and that the channel 15 helicopter had been at an altitude of 2,100 feet.³⁵ The channel 3 pilot then stated to the channel 15 pilot, "OK ... I got you in sight," to which the channel 15 pilot responded, about 3 seconds later, "got you as well." By that time, the channel 15 helicopter's altitude had increased to 2,200 feet. However, these transmissions, which occurred about 4 minutes before the midair

³² The ATC transcript showed that two of the three other ENG helicopters operating in the area also did not state the current ATIS code during their initial transmissions with the controller.

³³ The audio recording from the channel 15 helicopter showed that, about 1238:02, the channel 15 pilot stated, "okay, twenty two hundred." However, this statement was more likely a position acknowledgment rather than a position report. According to the ATC transcript, another ENG pilot had notified the controller that his helicopter would be operating at an altitude of 2,200 feet, and that pilot had also told the controller that he would be communicating with the other ENG pilots that were operating in the area. Radar data showed that the channel 15 helicopter was operating at an altitude of 2,100 feet at that time.

³⁴ In addition, both accident helicopters, as well as one of the other three ENG helicopters operating in the area, were not flying 500 feet over the police helicopter. Thus, these pilots were not adhering to informal ENG procedures for the Phoenix area.

³⁵ The ATC transcript showed that the channel 15 helicopter was, at one point, operating 100 feet above the police helicopter. The channel 15 pilot did not express concern about operating 100 feet above the police helicopter. It is possible, however, that the channel 15 helicopter was not directly above the police helicopter at that time.

collision, were the last times that the channel 3 and 15 pilots coordinated their helicopter's position or their intentions with each other.

The audio recordings showed that the channel 15 and 3 pilots began reporting the event by 1242:42 and about 1245:43, respectively. The video study showed that, between about 1244:43 and about 1246:05, the suspect had traveled on one street, turned right onto a short block, turned right again onto another block, traveled a few hundred yards, and stopped the stolen vehicle. The channel 3 and 15 pilots' broadcasts indicated that the suspect had abandoned the vehicle and was attempting to flee the police while on foot but that the suspect had then acquired another vehicle and drove off.

According to the video study and radar data, both helicopters were moving along similar flightpaths over the ground by about 1245:19. About 1245:25, the channel 3 helicopter appeared to be 0.3 nm ahead of the channel 15 helicopter. The channel 15 helicopter began a slight turn to the right about 1245:27, which was about 15 seconds after the pilot started a live update. The channel 3 helicopter appeared to begin a turn to the right about 1245:45, which was about 2 seconds after the pilot started his report. The channel 15 helicopter's rate of turn then increased farther to the right by about 1245:50, which was about 3 seconds after the pilot started another live update. After completing 90° turns, the helicopters appeared to be closer in proximity than before.

The last valid radar return for the channel 15 helicopter was about 1245:59 at an altitude of 2,300 feet. The last valid radar return for the channel 3 helicopter was about 1 second later at an altitude of 2,100 feet. (Additional radar returns were received through 1246:23, but these returns might not be valid indicators of position because of the proximity of the helicopters at the time.)

The channel 3 and 15 pilots' attention had been focused on the ground immediately before the police announcement about the impending carjacking. The midair collision occurred shortly after the announcement—about 35 seconds after the channel 3 pilot began his only report and about 15 seconds after the channel 15 pilot began his final live update. The Safety Board concludes that the channel 3 and 15 helicopters collided because one or both pilots lost awareness of the other helicopter's position.

Even though the channel 3 and 15 pilots had previously identified the location of the other helicopter, at some point the channel 3 helicopter's altitude increased, the channel 15 helicopter's altitude decreased, or both. The other ENG pilots operating in the area did not see the collision because their attention was also focused on the changing situation on the ground, but, during a postaccident interview, one of the pilots stated that the accident helicopters were initially positioned apart at a reasonable distance but had moved closer together after the police announcement of the carjacking. The Safety Board did not have the information necessary to make any further determination about the helicopters' movements. Thus, the Safety Board concludes that the lack of available information regarding the helicopters' movements and positions precluded investigators from determining precisely the events that transpired before and at the time of the collision.

Examination of the main rotor blade pieces indicated that the yellow blade on the left side of the channel 3 helicopter and the red blade on the right side of the channel 15 helicopter contacted each other about 2 feet from the end of each blade and then separated. The yellow blade was moving forward (advancing) toward the nose of the channel 3 helicopter, and the red blade was moving backward (retreating) from the nose of the channel 15 helicopter, at the time of the collision.

After the outboard section of the channel 3 yellow blade separated, that helicopter's main rotor blades deformed and broke the helicopter's tail boom into several pieces. The helicopter then fragmented in the air and struck the ground in an inverted position. After the outboard section of the channel 15 red blade separated, that helicopter entered a nose-down attitude, which it maintained until impacting the ground.

2.3 Pilot Flying and Reporting Duties

2.3.1 Pilot Workload

The channel 3 and 15 helicopter pilots were experienced in helicopter operations, the AS350B2 helicopter model, ENG operations, and flight operations in the PHX area. As a result, many of the tasks that the pilots were performing during the accident flight (such as flying the helicopter, operating the radios, and initiating communications) were well-learned skills that would have been performed without much cognitive or physical effort. However, the two helicopters collided without either pilot detecting the impending hazard. Thus, even for experienced pilots, the ability to shift attention among competing task demands may break down under high workload conditions and can lead to a narrowing of attention on a specific task.

The channel 3 and 15 helicopter pilots were required to follow a ground target (the reportedly stolen vehicle) while maintaining a safe altitude, position, and track that ensured the helicopters' separation from the ground and other ENG helicopters. Because the pilots were visually tracking a moving ground target (as opposed to a stationary ground target), they needed to continually shift their attention from inside to outside the helicopter. For collision avoidance, the pilots needed to visually scan for the other helicopters operating in the area, identify the helicopters' positions, assess their flightpaths to determine whether the helicopters posed a collision risk, and initiate corrective actions when required.

In addition to flight operations associated with maneuvering their helicopters above the police pursuit, the channel 3 and 15 pilots were also directly supporting their station's ENG operations. The pilots were responsible for reporting, communicating with their station's news department on a dedicated radio, communicating with the station's photographer via an intercom, scanning the monitor that showed the station broadcast and the video leaving the helicopter, and monitoring police radio communications for information about the pursuit. These tasks placed additional demands on the pilots' attention. However, both pilots were experienced in initiating

communications to support ENG operations, and both were experienced in flying and reporting simultaneously.

As they approached the scene, the ENG pilots communicated their locations and intentions to each other on the air-to-air radio frequency. Additional radio communications would have facilitated the pilots' understanding of the location of the other ENG helicopters and expected positions in the future, especially if the communications referenced a helicopter that was not visible to the pilot at the time. However, it would have been difficult for the pilots, while in the process of reporting, to announce position changes or reliably hear such announcements by the other pilots.

Even though the air-to-air frequency was not recorded, the channel 3 and 15 helicopter audio recordings showed that the stations' pilots were not using the frequency to announce their positions and intentions as often as indicated during a postaccident group interview that included the three other ENG pilots who were operating in the area at the time. Also, with one exception, the recordings did not include responses from the channel 3 and 15 pilots to communications from these ENG helicopter pilots.³⁶

It is difficult to determine the extent that the channel 3 and 15 pilots' reporting duties contributed to the breakdown in each pilot's awareness of the other helicopter. The additional tasks of directly observing activities on the ground and providing narration could have affected the pilots' ability to maintain their helicopter's position or track the other helicopter's positions. From about 1245:43 (channel 3) and about 1246:03 (channel 15) to the time of the collision, the pilots were continuously reporting the events as they unfolded, which narrowed the pilots' attention to the ground and away from other tasks, such as maintaining the helicopters' stated position and altitude and scanning the area for potential collision hazards.

Even with the limited evidence to determine the extent that the pilots' ENG-related duties affected their ability to see and avoid the other helicopter, the circumstances of this accident demonstrated that a failure to see and avoid occurred about the time that a critical event of interest to the ENG operations (the carjacking) was taking place on the ground. Although the photographers had experience with the see-and-avoid concept for supporting the pilots in collision avoidance,³⁷ the photographers' primary job was to operate the camera, which was a continual tracking task that required a significant portion of their attention to perform successfully. It is critical for ENG pilots to be vigilant of other aircraft during close-in operations and not to divert their attention to a nonflying-related task or event.

This accident is not the first time that an ENG helicopter pilot failed to maintain position while reporting an event. An August 2000 ASRS report reflected this type of performance degradation during an ENG operation. Specifically, the report indicated that the pilot had been

³⁶ About 1240:19, the channel 15 pilot stated, "I'm off your [aircraft's] nose," to the channel 12 ENG pilot.

³⁷ About 1236:33, the channel 15 pilot had told the station's photographer, "if you could call out where we're at please, don't hesitate to talk." When the channel 15 pilot stated, about 5 minutes before the collision, "where's three?", "like how far?", and "oh jeez," he was most likely discussing the position of the channel 3 helicopter with the channel 15 photographer.

repositioning his helicopter while narrating a stolen vehicle pursuit when he inadvertently allowed the helicopter's altitude to drop near that of a police helicopter, causing a near midair collision. The pilot did not see the police helicopter, but the on-board photographer noticed that a helicopter had passed close to their position. The pilot acknowledged that his workload could be "a bit hectic" and that he had let the coverage of the story distract him from his altitude awareness. In addition, an ENG pilot submitted an ASRS report in March 1997 as a result of a near midair collision that occurred when an ENG helicopter that should have been operating 300 feet below him was instead at his altitude and coming straight at him. The pilot indicated that anything that takes a pilot's attention away from the primary job of piloting, including live broadcasting, could cause an incident such as the one he reported.³⁸

The midair collision in PHX airspace and the near midair collisions described in the two ASRS reports demonstrate the hazards involved in conducting ENG operations with multiple aircraft nearby. The additional workload necessary for a pilot to support ENG operations reduces the time and resources available for the pilot to perform tasks directly related to flight operations, including collision avoidance. Specifically, the pilot has to shift attention visually (from the air to the ground) to obtain the necessary information for maintaining separation from other aircraft as well as the necessary information to be included in a live or recorded report. In this accident, the channel 3 and 15 pilots appeared to quickly focus their attention on an emerging situation on the ground that was of interest to ENG operations; in the process, one or both pilots lost awareness of the other helicopter's location. The Safety Board concludes that the channel 3 and 15 pilots' reporting and visual tracking duties immediately before the collision likely precluded them from recognizing the proximity of their helicopters at that time.

2.3.2 See-and-Avoid Concept

AC 90-48C, *Pilots' Role in Collision Avoidance*, states that Part 91 flight rules set forth the concept of "see and avoid," which requires vigilance at all times by each person operating an aircraft. The AC further states that pilots should remain constantly alert to all traffic movement within their field of vision and that they should scan the entire visual field outside of their aircraft to ensure that conflicting traffic would be detected. However, there are inherent limitations associated with the see-and-avoid concept as the primary method for separation used during high-density traffic operations, including ENG operations.³⁹ These limitations include the pilot's ability to perform systematic scans, competing operational task demands, and blind spots associated with an aircraft structure. After the accident, channels 3 and 15 took steps to mitigate

³⁸ These ASRS reports are discussed in section 1.18.6.

³⁹ These limitations also apply to non-ENG operations. For example, in the November 1999 nonfatal midair collision between a Bell 206L-3 helicopter and a Bell 206B helicopter in Seattle (see section 1.18.5), neither pilot saw the other helicopter before the collision, even though no visual restrictions would have prevented either pilot from seeing the other helicopter. Although an ENG helicopter was involved in the collision, the pilot was not performing any ENG duties at the time. Also, on June 29, 2008, two Bell 407 helicopters collided in midair while approaching the helipad at Flagstaff Medical Center, Flagstaff, Arizona, resulting in seven fatalities. The pilots of these helicopters were supporting emergency medical services operations. (For more information about this ongoing investigation, see DEN08MA116A/B at the Safety Board's website.)

these limitations by modifying their flight operations.⁴⁰ For channel 3, two pilots are now present in the cockpit for reporting assignments—one with flying duties and one with reporting duties. For channel 15, the pilot no longer has reporting duties along with flying duties; the ENG helicopter provides the station with film footage only.

As previously indicated, it can be difficult for pilots to adequately ensure separation from several other aircraft while the pilots are also conducting ENG-related duties. Further, although there were informal procedures that the Phoenix-area ENG pilots were expected to follow regarding communications (announcing positions and intentions on an air-to-air frequency) with other ENG pilots, evidence indicated that these procedures were not rigorously followed on the day of the accident, possibly because of the pilots' additional responsibilities to provide coverage of the ongoing situation on the ground.

The Safety Board notes that, even though most ENG operations are conducted under Part 91, Part 135 operators are required to establish minimum flight crew requirements based on anticipated workload, including collision avoidance activities and communications. The circumstances of this accident demonstrate that Part 91 ENG operators should be held to a similar standard, even though joint flying and reporting duties are not inherently unsafe under some conditions and joint pilot duties are not uncommon (for example, joint flying and briefing duties). The Safety Board concludes that this accident demonstrates the limitations of the see-and-avoid concept for reliably ensuring separation of aircraft during high-density traffic operations, especially when the pilot is conducting other nonflying duties as part of the operation. Therefore, the Safety Board believes that the FAA should require ENG operators to assign reporting responsibilities to someone other than the flying pilot unless it can be determined that the pilot's workload would remain manageable under all conditions.

2.4 Methods for Improved Situational Awareness

2.4.1 Visual Indications

The ENG helicopters were maneuvering over an urban area with a complex terrain pattern (desert landscape and vegetation), which might have made it difficult for the pilots to distinguish between the shape of an airborne object operating below them and the surrounding terrain. In fact, during a postaccident group interview, Phoenix-area ENG pilots stated that they occasionally lose sight of other helicopters when flying over the city because the helicopters tend to blend in with the terrain.

⁴⁰ Channel 5 still uses a pilot/reporter, but the new operator of the station's helicopter does not allow its pilots to look at the talent camera inside the cockpit. Channel 10 still uses a pilot/reporter, but the station's helicopter now has a high-visibility paint scheme and is expected to be equipped with high-intensity anticollision lights (see section 2.4.1). Channel 12 still uses a dedicated pilot.

The Phoenix-area ENG pilots suggested that LED anticollision lights would help them better discern other helicopters. The *Federal Aviation Regulations* address standard anticollision light systems. Specifically, 14 CFR 27.1401, Anticollision Light System, states that such systems are to consist of one or more approved anticollision lights located so that their emitted light will not impair the pilot's vision or detract from the conspicuity of the position lights. These systems are also expected to meet the field of coverage, flashing characteristics, color, light intensity, and minimum effective intensities that are specified in the regulation. Even though the anticollision light system requirements apply only to those rotorcraft that are certificated for night operations, most ENG helicopters have been certificated for these operations. The accident helicopters were both equipped with an anticollision light system that met the requirements of the regulation, and the lights were likely on during the flights (per standard procedures) and were likely visible, even with the daytime VFR conditions at the time.⁴¹

However, other anticollision lights, including the LED anticollision lights mentioned by the Phoenix-area pilots, are brighter than those currently required by 14 CFR 27.1401. Specifically, the regulation requires a minimum effective intensity equivalent to the light emitted by 150 candles (referred to as candela), but there are anticollision lights that emit 400 candela. ENG pilots whose helicopters are equipped with these high-intensity anticollision lights (and who have operated along with other helicopters equipped with these lights) indicated that the lights are more visible to other ENG pilots than the standard anticollision lights.

The Phoenix-area ENG pilots also suggested that high-visibility main rotor and tail rotor blades would help them better discern other helicopters. The *Federal Aviation Regulations* do not address the conspicuity of main rotor and tail rotor blades. CAMI conducted a study to determine the conspicuity on the ground of three paint schemes for airplane propellers and two paint schemes for tail rotor blades.⁴² Three Piper Cherokee 140 airplanes and two Bell B47G helicopters were used for the study. The three propeller paint schemes were black and white stripes placed asymmetrically on opposing blades, a yellow tip design, and a red and white striped design. The two tail rotor blade paint schemes consisted of black and white asymmetrical stripes and a red, white, and black design. The propeller and tail rotor paint schemes that were judged to be the most conspicuous (by 30 volunteer subjects with normal vision, at three different viewing angles, and under bright sunlight conditions) were the ones with black and white asymmetrical stripes because they provided a "flickering" sensation.

The U.S. Forest Service (USFS) acknowledged the importance of helicopter visibility in its December 2005 document detailing requirements for contractors providing helicopters to the USFS for firefighting.⁴³ The USFS requires one or more independently switched white or white

⁴¹ One of the three other ENG pilots operating in the area stated that she thought she saw the channel 15 helicopter with its lights on. This pilot did not provide information about the channel 3 helicopter's lights, likely because the helicopter had entered the airspace after hers and she was focusing on the situation on the ground at the time.

⁴² Civil Aeromedical Institute, Federal Aviation Administration, *Conspicuity Assessment of Selected Propeller and Tail Rotor Paint Schemes*, FAA-AM-78-29 (Oklahoma City, Oklahoma: FAA, 1978).

⁴³ These helicopters, known as type III exclusive-use helicopters, are similar in size to those used for ENG operations.

and red anticollision light(s) mounted on top of the helicopter or in another location that would be visible from above the helicopter.⁴⁴ The USFS also requires high-visibility markings on the helicopters' main rotor blades and provides a listing of acceptable paint schemes, which include blades with alternating white and orange paint and alternating solid black and solid white blades.

Also, helicopter air tour operators recognized that aircraft visibility was essential in helping to avoid collisions during these operations. In January 1996, the operators voluntarily established a safety program for air tour operations. The February 2007 document describing this program, the Tour Operators Program of Safety (better known as TOPS), indicated that high-visibility rotor blades and at least one anticollision light were required to be used at all times (except when the pilot deems it inappropriate for safety reasons).

In addition, in its report on the September 1992 midair collision of two sightseeing helicopters over Niagara Falls, Ontario, Canada, the Transportation Safety Board of Canada (TSB) stated that the cause of the accident was that neither helicopter pilot saw the other helicopter in time to avoid the collision.⁴⁵ In its report, the TSB indicated that two safety measures that had already been implemented as a result of the accident were (1) air tour flights operating in the Niagara Falls area were required to operate with anticollision lights illuminated and (2) all helicopters were to have approved conspicuous paint schemes on the upper surface of their blades.⁴⁶

The channel 3 helicopter's cabin was painted primarily white, and its tail boom was painted red, orange, and yellow. The channel 15 helicopter's cabin was painted black with white stripes, and its tail boom was painted black and yellow. These paint schemes would not have impeded airborne observers from detecting the helicopters. However, the main rotor blades of both helicopters were blue-gray on the top and black on the bottom. (The color coding at the blade root would not be visible to ENG pilots.) Enhanced coloration of the main rotor blades could have increased the conspicuity of these helicopters for airborne observers either looking down on the helicopters (because rotor blades are painted on their top) or in another position in which the top of the blades would be visible. The circular area resulting from the movement of the main rotor blades appears much larger in surface area than the helicopter's fuselage (as viewed from any angle); thus, painting main rotor blades would increase the conspicuity of an entire helicopter. In addition, high-intensity anticollision lights would help pilots detect the presence of other helicopters because these lights could capture a pilot's attention, especially

⁴⁴ The lights are required to meet the applicable requirements of 14 CFR 27.1397, which provides the specifications for the aviation red, green, and white position light colors.

⁴⁵ Transportation Safety Board of Canada, *Mid-Air Collision Between Niagara Helicopters Limited, Bell Helicopter Textron 206B Jetranger, C-GFXX, and Rainbow Helicopters Incorporated, McDonnell Douglas MD369E, N588DB, Niagara Falls, Ontario, Canada, 29 September 1992*, Aviation Occurrence Report A92H0029 (Quebec, Canada: Transportation Safety Board, 1993).

⁴⁶ An official from Transport Canada (TC)—the FAA's counterpart in Canada—indicated that the authorization to conduct flight operations in the Niagara Falls area includes a requirement for alternating bands of contrasting color on helicopter blades. The TC official stated that one Canadian Niagara Falls operator uses black and white on its helicopters' blades and that another uses red and white on its helicopters' blades. The TC official further indicated that, according to the acting operations manager for one of these operators, this equipment was especially effective when looking out for aircraft operating at lower altitudes.

when the flashes occur in the pilot's peripheral vision, and would help under viewing conditions in which blade paint might not be visible.

Just before the time of the collision, the accident pilots and the on-board photographers were likely focusing on the ground because of the events occurring there, including the impending carjacking. However, the Safety Board concludes that a high-visibility paint scheme on the helicopters' main rotor blades or high-visibility anticollision lights could have facilitated the detection of the impending collision risk. Therefore, because of the close-in nature of ENG operations, the Safety Board believes that the FAA should require ENG operators to use high-visibility blade paint schemes and high-visibility anticollision lights on their aircraft.

2.4.2 Cockpit Systems

The channel 3 helicopter had a SkyWatch SKY497 traffic advisory system installed. The system provided an aural warning and displayed targets on the helicopter's Garmin GNS 430 navigation unit. The Safety Board reviewed the SkyWatch system's capabilities and found that the system (1) had an alerting envelope with a horizontal radius of 0.2 nm (1,216 feet) and a height of \pm 600 feet, (2) computed an aircraft's range with 0.05-nm (304 feet) accuracy, and (3) was capable of tracking up to 30 aircraft at the same time. The Board also found that the system was developed for business and general aviation aircraft, including helicopters, but that the system was not specifically designed according to helicopter flight characteristics.⁴⁷

An HAI ENG committee member (who is also an ENG pilot) stated that he has discovered about one-half of threat traffic via a traffic advisory system aural alert. He further stated that the alert provides heading, elevation, and distance information for other aircraft and that, after he receives an aural alert, he immediately scans the area for the traffic.

The channel 3 chief pilot stated that, when helicopters were maneuvering closely to one another, the aural alert "traffic, traffic" would frequently sound over the pilot's headset. Also, any time a helicopter went out of and then reentered the system's 0.2-nm range, the alert would again sound. The chief pilot also stated that, when "a lot of traffic [was] in close," the volume on the aural alert would be turned down so that it would not obscure the communications frequency. Thus, it is possible that the channel 3 pilot had turned down the volume on the aural alert during the accident flight, preventing the pilot from hearing the "traffic, traffic" alert and recognizing the proximity of his helicopter to the channel 15 helicopter. (The channel 3 audio recording was not designed to record sounds over the pilot's headset.)

In addition to aural annunciations, most traffic advisory systems (including SkyWatch) have visual displays of nearby traffic showing an aircraft's relative altitude and an indication of

⁴⁷ The Safety Board reviewed the operating characteristics of six available traffic advisory systems (including SkyWatch) and noted that their range sensitivity and altitude discrimination were best suited for fixed-wing airplanes. Helicopter flight characteristics require closer range dimensions and closer altitude discrimination because helicopters are more maneuverable and operate at slower speeds. Staff is not aware of any current traffic advisory systems that meet these criteria.

its direction of travel, including whether the aircraft is climbing or descending. This additional information can facilitate a pilot's efforts to maintain awareness of and visual contact with nearby aircraft to reduce the likelihood of collision. The Safety Board recognizes that a scan of visual traffic displays could increase a pilot's workload, but the HAI ENG committee member stated that the extra scanning was offset by the additional safety benefit provided by the system. The Board acknowledges the benefits of traffic advisory systems but notes, however, that these systems are not a substitute for the see-and-avoid concept. In fact, the manufacturer of the SkyWatch system issued guidance stating, "information on the display is provided to the flight crew as an aid in visually acquiring traffic; it is not a replacement for ... See & Avoid Techniques."

The channel 3 helicopter's SkyWatch system would have aided the pilot as he entered the scene by indicating the direction of the other helicopters already on scene, including channel 15, and their altitudes. Also, although the alert should have sounded once the channel 15 helicopter was inside the system's 0.2-nm range, the system would have been less useful at that range as a position locator because of the nuisance alerts, so the channel 3 pilot should have been communicating with the channel 15 pilot and verifying the helicopter's location. The channel 15 helicopter did not have a traffic advisory system, and two of the three other ENG helicopters were not equipped with this system. Regardless, all of the ENG pilots were responsible for communicating with each other, paying attention to each helicopter's position for collision avoidance, and not relying solely on a traffic advisory system for position information for helicopters.

The Safety Board concludes that a traffic advisory system would enhance an ENG pilot's capability to detect other aircraft operating in the same area by providing aural annunciations and visual displays of the traffic and that a system designed specifically for helicopters could help eliminate the nuisance warnings that ENG pilots can receive when other aircraft are operating near the system's alerting envelope. Therefore, the Safety Board believes that the FAA should develop standards for helicopter cockpit electronic traffic advisory systems so that pilots can be alerted to the presence of other aircraft operating in the same area regardless of their position. The Safety Board further believes that, once standards for helicopter cockpit electronic traffic advisory systems are developed, as requested in Safety Recommendation A-09-04, the FAA should require ENG operators to install this equipment on their aircraft.

2.5 Electronic News Gathering Conferences

Phoenix-area ENG pilots stated that they attend an annual meeting with local law enforcement and USFS personnel to discuss procedures for standardizing operations. Also, the president of the NBPA stated that several ENG pilot groups hold meetings with local public use pilots and ATCT personnel to discuss the local operating area procedures, review any problems that may have arisen, and devise ways to mitigate future problems. However, these meetings did not involve all ENG-related personnel in the local area and did not have fixed agendas to ensure that all pertinent topics would be discussed. Further, according to an HAI ENG committee member, local ENG meetings are not held in each metropolitan area with ENG operations.

In its report on the Niagara Falls accident, the TSB indicated that interested parties, operators, and regulatory officials from both Canada (Transport Canada [TC]) and the United States (FAA) would review flying operations at Niagara Falls on a semiannual basis. An FAA inspector from the Rochester, New York, FSDO⁴⁸ reported that FAA inspectors, TC officials, and U.S. and Canadian companies with flight operations in the Niagara Falls area participate in annual meetings that are hosted by TC. The FAA inspector indicated that the meetings were beneficial and that they provided a forum to discuss any deviations from the regulations and clarify any misinterpretations of the regulations. According to an official from TC, these annual meetings, which have been held since 1993, are a mandatory requirement of the authorization to conduct flight operations in the Niagara Falls area. He also stated that the meetings “greatly” benefit flight safety because operators can discuss operational and safety issues in a proactive environment. The TC official further stated that, between the annual meetings, TC and the FAA are in “regular contact” to discuss any operational or safety issues.

In its report on the September 2004 Bali Hai Helicopter Tours accident in Kalaheo, Hawaii, the Safety Board discussed that Bali Hai was required to ensure that its tour pilots participated in at least one formal air tour safety meeting annually.⁴⁹ According to the report, the FAA stated that the purpose of the safety meetings was to review Special Federal Aviation Regulation (SFAR) 71 and sightseeing/air tour issues and procedures.⁵⁰ However, the Board concluded that the annual safety meetings were not effective because the Honolulu, Hawaii, FSDO had not ensured that the meetings were focused on safety trends and SFAR 71 procedures; in fact, a FSDO inspector stated that some past meetings had turned into complaint sessions or had strayed onto other topics. As a result, on February 27, 2007, the Board issued Safety Recommendation A-07-22, which asked the FAA to direct the Honolulu FSDO to ensure that annual safety meetings focus on pertinent and timely commercial air tour safety issues, including reviews of Hawaii air tour accidents and SFAR 71 procedures.⁵¹

According to HAI, about 140 ENG helicopters operate daily in the United States. At HAI’s February 2008 Heli-Expo, participants at an ENG helicopter safety roundtable (which included FAA, Safety Board, HAI, NBPA, and ENG operator officials) identified the need for safety meetings to directly discuss pertinent ENG issues. These issues included radio

⁴⁸ The Rochester FSDO provides oversight of U.S. companies with flight operations in the Niagara Falls area.

⁴⁹ 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, DC: NTSB, 2007).

⁵⁰ SFAR 71, “Special Operating Rules for Air Tour Operators in the State of Hawaii,” was replaced on March 15, 2007, by 14 CFR Part 136, Appendix A.

⁵¹ On May 17, 2007, the FAA stated that operations specification (OpSpec) paragraph B048(b)(6), dated March 9, 2007, addressed Safety Recommendation A-07-22 by indicating that at least one formal commercial air tour safety meeting would be held annually. On December 4, 2007, the Safety Board stated that the OpSpec paragraph represented progress in responding to the recommendation but that the FAA still needed to address two important concerns. The Board’s first concern was that, because the OpSpec applies only to Part 135 operators, it was not clear how the FAA would apply this requirement to Part 91 operators (such as Bali Hai). The Board’s second concern was that the FAA needed to evaluate whether the meetings were actually covering the topics on the agenda (which were to include the issues discussed in this recommendation). Pending evaluation of the effectiveness of the required meetings and extension of this requirement to Part 91 commercial air tour operators, Safety Recommendation A-07-22 was classified “Open—Acceptable Response.”

communications among pilots, risk assessment, safety audits, operating altitudes, ATC frequency usage, and separation standards. The circumstances of this accident demonstrate that these and other related issues need the attention of the entire ENG community.

The Safety Board recognizes the necessity for annual meetings of FAA and ENG helicopter personnel to provide a forum for ENG helicopter operators to meet and become familiar with the others' operations, discuss ENG helicopter operational and safety issues, and manage risk by identifying hazards and ways to mitigate them. The Board notes that the importance of some issues, such as the number of ENG helicopters operating in a metropolitan area as well as weather, obstacle, and terrain considerations, may depend on the specific region of operation. It would also be beneficial to hold such conferences by region rather than by state because local news affects specific regions rather than entire states. Further, some regional areas encompass more than one state (for example, the Washington, D.C., Philadelphia, and New York City metropolitan areas), so a statewide conference would not bring together the ENG operators who work in such regions. In addition, some states may only have one metropolitan area with ENG operations, so a statewide conference would not be necessary.

The Safety Board concludes that annual meetings with local ENG helicopter and local FAA personnel would help improve the safety of ENG operations by facilitating a proactive exchange of information among the participants. Therefore, the Safety Board believes that the FAA should host annual ENG helicopter conferences by major metropolitan region to discuss operational and safety issues affecting all ENG operations as well as those issues that pertain to the specific region. The Safety Board further believes that, on the basis of the safety issues identified at the regional conferences discussed in Safety Recommendation A-09-06, the FAA should develop LOAs or amend existing LOAs to specify minimum horizontal and vertical aircraft separation requirements.

2.6 Electronic News Gathering Guidelines

In August 2008, HAI's ENG committee issued a draft ENG aviation safety manual that contained recommended safety management procedures and guidelines for ENG operations. Many of the subjects presented in the ENG manual were also discussed at the ENG helicopter safety roundtable held during HAI's February 2008 Heli-Expo.

The ENG manual stated that, before entering the airspace over a scene and while operating in that airspace, pilots needed to establish and maintain at all times positive communication and visual contact with other aircraft operating in the area. The Safety Board notes that the actions detailed in Safety Recommendations A-09-02 and -05 would enable continuous communication and visual contact, especially when multiple aircraft are operating in the same area.

The manual also stated that careful attention was required for scenes with moving targets because the scene could rapidly change, necessitating sufficient airspace in which to maneuver, and that wide separation between public use helicopters (including law enforcement) and other aircraft operating over such scenes was crucial. In addition, the manual recommended that the

minimum horizontal and vertical separation between ENG aircraft be 500 and 200 feet (or 1,000 feet and 400 feet if possible), respectively. Most importantly, the manual strongly expressed that an ENG pilot's primary responsibility was to fly the aircraft safely and that all other duties would be secondary.

In addition, the manual recommended that ENG helicopters be equipped with high-intensity anticollision lights, a traffic advisory system, and high-visibility main and tail rotor blades because of the proximity in which ENG flights operate. The manual further recommended that cockpit/flight data recording systems be installed on ENG helicopters.

The Safety Board notes that HAI's draft ENG Aviation Safety Manual contains valuable information for ENG pilots, photographers, and other station personnel that was based on practical experiences and that the manual recommends, as part of several different topics, the need for local coordination meetings to discuss pertinent operational issues. Given the number of ENG helicopters that operate each day, it is also important that the FAA take additional actions to promote ENG flight safety. Safety Recommendation A-09-06 addresses the need for the FAA to host local ENG conferences, but the FAA also needs to issue ENG guidance because HAI's manual may not reach all ENG operators, including those that operate fixed-wing airplanes. The Safety Board concludes that best practice guidelines would provide ENG pilots with practical knowledge to apply during these operations. Therefore, the Safety Board believes that the FAA should incorporate pertinent information from HAI's ENG Aviation Safety Manual into an AC detailing best practices for ENG operations.

2.7 Flight Recorder Systems for Smaller Aircraft

ATC radar data were available to the Safety Board to determine the altitudes and flightpaths of the accident helicopters. However, one limitation with this information was that both helicopters (as well as the other three ENG helicopters operating in the area) were using the same transponder beacon code,⁵² which impeded efforts to distinguish individual helicopters. Another limitation was that the mode C information provided by some radar returns could have possibly been distorted because of the proximity with which the helicopters were operating at the time.

Although the Safety Board was able to use the audio/video streams that were recorded for both helicopters, the amount of useful information for the investigation was limited. For example, each helicopter's position, or line of position, could only be determined at locations where the camera view was in a favorable position (showing sufficient ground references) and detailed geographical information system data existed. Also, the audio/video streams could not be used to estimate altitude information for either helicopter and did not include parametric data related to the engines and other systems. In addition, the audio was recorded only from the pilots' microphones; audio from their headsets was not recorded. As a result, only one-sided

⁵² All of the ENG helicopters used the same beacon code because it signified operation according to the provisions of the Sharp Echo LOA.

conversations were available. These conversations were difficult to understand in context because the pilots could have been talking to a pilot of another ENG helicopter, the law enforcement pilot, news station personnel, or the on-board photographer, among others.

The Safety Board notes that the accident helicopters were not required to have a CVR or an FDR installed but that they would have been subject to the requirements for a cockpit image recorder that were included in Safety Recommendation A-03-64 (see section 1.18.7, where Safety Recommendations A-03-62 and -65 are also discussed) if the FAA had implemented this recommendation.

On October 11, 2005, the FAA stated that it had been actively working to address these recommendations. The FAA further stated its belief that the intent of these recommendations was primarily to collect parametric data from the images of the cockpit instrumentation but that an image recorder system had not been manufactured or installed for this specific purpose. The FAA also stated that parametric data tests of an image recorder system in a simulator and on an FAA Beechcraft King Air airplane concluded in June 2005 and that the final report detailing the test findings would be completed by December 2005.

On April 26, 2006, the Safety Board acknowledged that one benefit of an image recording system is the potential to obtain parametric data from images of the cockpit instrumentation but stated that the Board did not agree with the FAA's belief that the intent of these recommendations was primarily to collect parametric data. The Board explained that cockpit image recorders obtain audio information (like CVRs) and event data (like FDRs) but also obtain information about the environment outside the cockpit window. The Board recognized the value of the FAA's parametric data study but indicated that, for the FAA's actions in response to these recommendations to be acceptable, the FAA must prepare and issue the recommended regulations. As a result, Safety Recommendations A-03-62, -64, and -65 remained classified "Open—Unacceptable Response."

The Safety Board notes that government and industry representatives have been participating since 2007 in a European Organization for Civil Aviation Equipment (EUROCAE) working group to develop a flight recorder specification titled, "Minimum Operational Performance Specification for Lightweight Flight Recorder Systems" (ED-155). (Both the Board and the FAA are members of this working group.) When finalized, ED-155 is expected to address recent improvements in technology by establishing the minimum performance requirements for flight recorder systems that could be used on board smaller aircraft (such as the accident helicopter models). This specification targets a more affordable flight recorder option for smaller aircraft than traditional CVRs or FDRs and addresses the recording of audio, image, and parametric information. As currently written, ED-155 identifies parameters that should be recorded according to the type of aircraft (that is, airplane or helicopter). Also, ED-155 accommodates variations in aircraft complexity by identifying parameters that should always be recorded and parameters that should be recorded if an information source for the parameter is used by aircraft systems and/or the flight crew to operate the aircraft. ED-155 is expected to be issued by June 2009.

It is also important to note that Bell Helicopter Textron and American Eurocopter have been developing digital imaging recorders as FAA “nonrequired safety-enhancing equipment hardware.” According to the safety department managers at Bell Helicopter Textron and American Eurocopter, the recorders (which are not required under Parts 27, 29, 91, or 135) are expected to provide digital imaging of the cockpit and its instruments at a sampling rate of between one and eight frames per second. The recorders are also expected to record ambient cockpit noise and flight data.

Both companies have developed prototype recorders that contain internal global positioning system receivers and inertial sensing electronics. Although these recorders are not being designed to meet the crash-protection requirements stipulated in the FAA’s current technical standard orders (TSO) for CVRs and FDRs,⁵³ the safety department managers indicated that the recorders would have a level of crash protection that meets many of the industry criteria stipulated in the December 2004 RTCA, Inc., document DO-160E, “Environmental Conditions and Test Procedures for Airborne Equipment,” including moisture tolerance, temperature extremes, vibration, and electromagnetic interference. The companies expected to deliver and install these recorders on new-production helicopters in early 2009. The companies also expected to make kits available for retrofitting older helicopters with the recorders.

If recorder systems that captured cockpit audio, images, and parametric data had been installed on the accident helicopters, the recorders would have enabled Safety Board investigators to determine additional information about the accident scenario, including the helicopters’ precise locations, altitudes, headings, airspeeds, engine performance, and other systems information. It is also possible that recorded images could have shown the proximity of one helicopter to another and any obstruction that might have prevented a pilot from seeing another helicopter. The Safety Board concludes that recorder systems that captured cockpit audio, images, and parametric data would have significantly aided investigators in determining the circumstances that led to this accident.

With the anticipated completion of EUROCAE specification ED-155 and the proactive development of digital imaging recorders by Bell Helicopter Textron and American Eurocopter, technology will soon be in place for the implementation of flight recorder systems for smaller aircraft that are not currently equipped with a CVR or an FDR. (It is important to note the Safety Board’s position that such flight recorder systems should never take the place of a crash-protected CVR, per TSO-C123B, for those aircraft so equipped.) These developments in incorporating data recording, as well as audio and image recording, into more affordable flight recorder systems for smaller aircraft are significant. The technology to record flight data in an affordable flight recording system for smaller aircraft was not available at the time that the Safety Board issued its previous image recorder recommendations. As a result of the development of this more advanced technology, and because the FAA has not taken timely

⁵³ TSO-C123B, “Cockpit Voice Recorder Equipment,” dated June 1, 2006, contains the minimum performance standards that CVR equipment must meet. TSO-C124B, “Flight Data Recorder System,” dated April 1, 2007, contains similar information for FDR equipment.

action with regard to the Board's image recorder recommendations,⁵⁴ the Safety Board classifies Safety Recommendations A-03-62, -64, and -65 "Closed—Unacceptable Action/Superseded."

The Safety Board believes that the FAA should require the installation of a crash-resistant flight recorder system on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with an FDR and are operating under 14 CFR Parts 91, 121, or 135. The crash-resistant flight recorder system should record cockpit audio (if a CVR is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in EUROCAE document ED-155, "Minimum Operational Performance Specification for Lightweight Flight Recorder Systems," when the document is finalized and issued. (This safety recommendation supersedes A-03-62).

The Safety Board also believes that the FAA should require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a CVR and are operating under 14 CFR Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio, a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in EUROCAE document ED-155, "Minimum Operational Performance Specification for Lightweight Flight Recorder Systems," when the document is finalized and issued. (This safety recommendation supersedes A-03-64).

In addition, the Safety Board believes that the FAA should require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with an FDR and are operating under 14 CFR Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio (if a CVR is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in EUROCAE document ED-155, "Minimum Operational Performance Specification for Lightweight Flight Recorder Systems," when the document is finalized and issued. (This safety recommendation supersedes A-03-65).

⁵⁴ The initial image recorder recommendation, A-99-60, was issued on February 8, 2000. The recommendation was classified "Open—Unacceptable Response" because the FAA could not commit to the timeframe proposed by the Safety Board. Instead, the FAA wanted to refer the recommendation to an industry committee, but that committee had no immediate plans to address the use of image recorders in the near term. Safety Recommendation A-99-60 was superseded by Safety Recommendation A-03-64 so that the recommendation could be expanded to include Parts 91 and 121 in addition to Part 135. However, Safety Recommendation A-03-64 was also classified "Open—Unacceptable Response" because the FAA had not prepared and issued the recommended regulation. In addition, the FAA's report on image recorder system tests, conducted in response to Safety Recommendations A-03-62 through -65, was expected in December 2005 but has not yet been issued.

3. Conclusions

3.1 Findings

1. The pilots of the channel 3 and 15 helicopters were properly certificated and qualified in accordance with applicable Federal regulations.
2. Both helicopters were properly certified, equipped, and maintained in accordance with Federal regulations.
3. The recovered components showed no evidence of any preimpact structural, engine, or system failures.
4. Weather was not a factor in this accident, and sun glare would not have interfered with the pilots' ability to detect and track other helicopters over the pursuit scene.
5. The channel 15 pilot's color vision deficiency was not a factor in this accident.
6. The channel 3 and 15 helicopters collided because one or both pilots lost awareness of the other helicopter's position.
7. The lack of available information regarding the helicopters' movements and positions precluded investigators from determining precisely the events that transpired before and at the time of the collision.
8. The channel 3 and 15 pilots' reporting and visual tracking duties immediately before the collision likely precluded them from recognizing the proximity of their helicopters at that time.
9. This accident demonstrates the limitations of the see-and-avoid concept for reliably ensuring separation of aircraft during high-density traffic operations, especially when the pilot is conducting other nonflying duties as part of the operation.
10. A high-visibility paint scheme on the helicopters' main rotor blades or high-visibility anticollision lights could have facilitated the detection of the impending collision risk.
11. A traffic advisory system would enhance an electronic news gathering (ENG) pilot's capability to detect other aircraft operating in the same area by providing aural annunciations and visual displays of the traffic, and a system designed specifically for helicopters could help eliminate the nuisance warnings that ENG pilots can receive when other aircraft are operating near the system's alerting envelope.

12. Annual meetings with local electronic news gathering (ENG) helicopter and local Federal Aviation Administration personnel would help improve the safety of ENG operations by facilitating a proactive exchange of information among the participants.
13. Best practice guidelines would provide electronic news gathering pilots with practical knowledge to apply during these operations.
14. Recorder systems that captured cockpit audio, images, and parametric data would have significantly aided investigators in determining the circumstances that led to this accident.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was both pilots' failure to see and avoid the other helicopter. Contributing to this failure was the pilots' responsibility to perform reporting and visual tracking duties to support their station's electronic news gathering (ENG) operation. Contributing to the accident was the lack of formal procedures for Phoenix-area ENG pilots to follow regarding the conduct of these operations.

4. Recommendations

4.1 New Recommendations

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

Require electronic news gathering operators to assign reporting responsibilities to someone other than the flying pilot unless it can be determined that the pilot's workload would remain manageable under all conditions. (A-09-02)

Require electronic news gathering operators to use high-visibility blade paint schemes and high-visibility anticollision lights on their aircraft. (A-09-03)

Develop standards for helicopter cockpit electronic traffic advisory systems so that pilots can be alerted to the presence of other aircraft operating in the same area regardless of their position. (A-09-04)

Once standards for helicopter cockpit electronic traffic advisory systems are developed, as requested in Safety Recommendation A-09-04, require electronic news gathering operators to install this equipment on their aircraft. (A-09-05)

Host annual electronic news gathering (ENG) helicopter conferences by major metropolitan region to discuss operational and safety issues affecting all ENG operations as well as those issues that pertain to the specific region. (A-09-06)

On the basis of the safety issues identified at the regional conferences discussed in Safety Recommendation A-09-06, develop letters of agreement (LOAs) or amend existing LOAs to specify minimum horizontal and vertical aircraft separation requirements. (A-09-07)

Incorporate pertinent information from Helicopter Association International's ENG [electronic news gathering] Aviation Safety Manual into an advisory circular detailing best practices for ENG operations. (A-09-08)

Require the installation of a crash-resistant flight recorder system on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135. The crash-resistant flight recorder system should record cockpit audio (if a cockpit voice recorder is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document

ED-155, “Minimum Operational Performance Specification for Lightweight Flight Recorder Systems,” when the document is finalized and issued. (A-09-09) (Supersedes Safety Recommendation A-03-62)

Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio, a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document ED-155, “Minimum Operational Performance Specification for Lightweight Flight Recorder Systems,” when the document is finalized and issued. (A-09-10) (Supersedes Safety Recommendation A-03-64)

Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio (if a cockpit voice recorder is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document ED-155, “Minimum Operational Performance Specification for Lightweight Flight Recorder Systems,” when the document is finalized and issued. (A-09-11) (Supersedes Safety Recommendation A-03-65)

4.2 Previously Issued Recommendations Classified in This Report

The following safety recommendations are classified “Closed—Unacceptable Action/Superseded” in section 2.7 of this report:

Require the installation of a crash-protected image recording system on all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured after January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being operated full-time or part-time for commercial or corporate purposes under Part 91. (A-03-62) (Superseded by Safety Recommendation A-09-09)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a cockpit voice recorder, and that are operating under 14 *Code of Federal Regulations* Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording

system by January 1, 2007. (A-03-64) (Superseded by Safety Recommendation A-09-10)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (A-03-65) (Superseded by Safety Recommendation A-09-11)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

MARK V. ROSENKER
Acting Chairman

ROBERT L. SUMWALT
Member

DEBORAH A. P. HERSMAN
Member

STEVEN R. CHEALANDER
Member

KATHRYN O'LEARY HIGGINS
Member

Adopted: January 28, 2009

5. Appendixes

Appendix A

Investigation and Hearing

Investigation

The National Transportation Safety Board was notified of this accident on July 27, 2007. Investigators from the Safety Board's Western Pacific Region arrived on scene about 2300 on the day of the accident. Staff from Board headquarters arrived on scene the next morning. Accompanying the team in Phoenix, Arizona, was Board Member Steven Chealander.

The following investigative teams were formed: Operations, Airworthiness, and Air Traffic Control. Also, a specialist was assigned to evaluate the helicopters' audio and video systems at the Safety Board's laboratory in Washington, D.C.

Parties to the investigation were the Federal Aviation Administration, the National Air Traffic Controllers Association, KTVK-TV, and U.S. Helicopters. In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, the Safety Board's counterpart agency in France, the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA), participated in the investigation as the representative of the State of Design and Manufacture (Airframe and Powerplants). Eurocopter and Turbomeca participated in the investigation as technical advisors to the BEA, as provided in Annex 13.

Public Hearing

No public hearing was held for this accident.

Appendix B

Audio Recordings

The following is a transcript of the audio recordings from the audio/video system installed on a Eurocopter AS350B2 electronic news gathering (ENG) helicopter, N215TV (channel 15), and a Eurocopter AS350B2 ENG helicopter, N613TV (channel 3), which were involved in a midair collision over Phoenix, Arizona, on July 27, 2007:

LEGEND

CH15	voice or sound heard from the N215TV recording
CH3	voice or sound heard from the N613TV recording
TWR	radio transmission from the Phoenix Air Traffic Control Tower.
*	Unintelligible word
@	Non-Pertinent word
&	Third party personal name (see note 5 below)
#	Expletive
-, - - -	Break in continuity or interruption in comment
()	Questionable insertion
[]	Editorial insertion
...	Pause

Note 1: Times expressed in this report and transcript are Mountain Standard Time, based on the clock used for the ATC transcript of voice communications.

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed. (in this transcript only one incoming radio transmission was observed).

Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

Note 5: Personal names of 3rd parties not involved in the conversation are generally not transcribed.

Note 6: All references to 'left' 'right' 'forward' or 'aft' are referenced as if seated in the pilot's operating seat.

Audio from N215TV (TV Channel 15) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:26:50 CH15	[start of recording]
12:32:11 CH15	ok my mic is on too...[first comment recorded from pilot's microphone]
12:36:33 CH15	Rick if you could call out where we're at please, don't hesitate to talk.

Audio from N613TV (TV Channel 3) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:36:03 CH3	[start of recording]
12:36:41 CH3	Phoenix tower, Helicopter TV3.
12:36:50 CH3	TV3 is west of Piestewa Peak, sharp echo for the North Bravo, Going where the other helicopters are over there.
12:37:00 TWR	three helicopters on site, and Newshawk Five about a mile ahead of you.
12:37:03 CH3	got Newshawk Five in sight, got a couple of others in sight as well, thanks TV three.

Audio from N215TV (TV Channel 15) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:38:02 CH15	okay, twenty two hundred.

12:40:19 CH15	Lenny I'm off your nose.
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12:41:02 CH15	yeah, I'll just kinda park it right here.
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Audio from N613TV (TV Channel 3) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:37:53 CH3	copy, we'll be on scene in less than a minute.

12:38:03 CH3	TV3's comin in, we got five, we got four in sight up high, we're comin in at two thousand.
-----------------	--

12:38:19 CH3	OK, I've got firebird over the golf course, twelve o'clock.
-----------------	---

12:38:33 CH3	see firebird there? ... ok, got him?
-----------------	--------------------------------------

12:41:18 CH3	OK, I'm gonna move.
-----------------	---------------------

Audio from N215TV (TV Channel 15) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:41:22 CH15	where's three?
12:41:24 CH15	like how far?
12:41:26 CH15	oh. jeez.
12:41:30 CH15	three. I'm right over you. fifteen's over top of you.
12:41:33 CH15	you-you're- I'm over the top of you.
12:42:28 CH15	got you as well.

Audio from N613TV (TV Channel 3) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:41:30 CH3	Who you over the top of?
12:41:34 CH3	OK, thanks. I'm at two thousand.
12:42:25 CH3	OK, Craig, I got you in sight.

Audio from N215TV (TV Channel 15) Recording

TIME and SOURCE

CONTENT

12:42:42
CH15 ok now he's southbound about ni- 8 or 9th street, seventh, eighth, 'bout ninth street. ninth street and uh Wellington. [all speech is transcribed from this time forward]

12:42:52
CH15 * * looks like he may clip another car...nope, didn't clip it. Almost.

12:43:02
CH15 I am.... yeah that's correct.

Audio from N613TV (TV Channel 3) Recording

TIME and SOURCE

CONTENT

12:42:46
CH3 this is Scott go ahead, I gotcha.
[all speech is transcribed from this time forward]

12:42:51
CH3 OK, let her know its Scott Bowerbank.

12:42:56
CH3 I can't hear the scanner, our scanner's not working.

12:43:02
CH3 nope, I sure don't.

12:43:05
CH3 feel free to talk in my ear when you know a road.

Audio from N215TV (TV Channel 15) Recording

TIME and
SOURCE

CONTENT

12:43:22
CH15

oh man this is a wild chase actually this uh some kinda uh construction type uh truck with some uh tanks on the back of it we're in the area of Indian School and seventh street this guy keeps goin in a circle here in the area here uh right now he's uh up on the curb right around Minnezona he's been on the sidewalk he's uh hit several cars here, basically what happened here when this first started, uh apparently the police pulled this vehicle over the uh truck then backed into the police car and uh and then took off and then uh we been on this pursuit ever since. police have used stop sticks uh both tires in the back we believe have been blown out * weaving all over the side streets you can see right now as that's happening here live on ABC fifteen, uh now he's up on the sidewalk again he's headin down towards the downtown area what a wild chase.

Audio from N613TV (TV Channel 3) Recording

TIME and
SOURCE

CONTENT

12:43:20
CH3

if you keep your mic hot with the uh police traffic, that would help me.

12:43:31
CH3

we're gonna miss this if you don't come here.

Audio from N215TV (TV Channel 15) Recording

TIME and
SOURCE CONTENT

Audio from N613TV (TV Channel 3) Recording

12:43:44
CH3 OK seventh- he's coming back to seventh street. ... oh
 * oh, come on.

12:43:50
CH3 OK, I'm gonna back up.

12:44:01
CH3 can you zoom in on him?... looks like he's gonna hit *
 hit a wall? uh.

12:44:06
CH3 [photojournalist voice heard in background as if
 talking to a 3rd party] I can't believe they're not
 blowing off this # # show. tell * * tell 'em to blow of
 this # # (recipe) show... no, just do it.

12:44:21
CH3 all right.

Audio from N215TV (TV Channel 15) Recording

TIME and SOURCE

CONTENT

12:44:22

CH15

uh well basically the firebird helicopter is over on top of this thing right now and there are several police cars behind him I'd say at least ten or fifteen. they're staying back a good distance maybe a couple ah blocks or so but they are definitely keeping an eye on this guy now he's back northbound along uh seventh street here and he's going to be approaching Indian School and and this guy obviously has no regard for anybody or anything that is in his way. he does not care as I said before he sideswiped several vehicles uh very uncontrollable because of the uh tires being blown out, Rebecca.

Audio from N613TV (TV Channel 3) Recording

TIME and SOURCE

CONTENT

12:44:29

CH3

he's gonna hit a car here so go uh stay wide with it.

12:44:34

CH3

ok. he missed it.... almost got that white truck.

12:44:42

CH3

ok. sounds good.

12:44:50

CH3

animation and up to me. gotcha. they're trying to do it, Jim. standby, he's gonna get stuck on this construction up here.

Audio from N215TV (TV Channel 15) Recording

TIME and
SOURCE

CONTENT

12:45:12
CH15

ohhh, I'm gonna say at least a block behind him now we're entering the uh central uh area of the downtown north downtown Phoenix area as we approach uh where they're building the uh new uh train track rails there and uh its just kind of a slow chase right now uh he can't maneuver this uh vehicle very well uh he just actually went through some barricades as you're seeing this and again this is all happening live right now this is all uh northbound along Central just south Indian School now he's * eastbound and he just hit some more barricades. absolutely unbelievable this guy doesn't care what he hits.

Audio from N613TV (TV Channel 3) Recording

TIME and
SOURCE

CONTENT

12:45:04
CH3

all right, if you don't come now, its probably going to end here, so.

12:45:23
CH3

if you could keep that mic hot on uh, at the desk on the scanner traffic that would help me cause I can't hear.

Audio from N215TV (TV Channel 15) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:45:47 CH15	no. have no idea all I know is uh what firebird reported to me that apparently, the police pulled this vehicle over and uh the vehicle then backed into the cruiser there were no injuries to the police and just simply took off and that's how this uh all ensued.
12:46:03 CH15	now he's going into a parking lot, now he's stopped. we'll see what happens here. he has stopped, this may be the end of this thing. ..ok he's out, ok now it's a foot chase. Now he's in another vehicle. ok ok doors open police ok. oh jee-
12:46:18 CH15	[sound similar to transmission gear noise decreases in frequency]
12:46:18 CH15	[collision]

Audio from N613TV (TV Channel 3) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:45:43 CH3	Hi Scott Bowerbank up in News Chopper Three. we're following a police chase that's been going on for about the last thirty minutes here, it's this white truck flatbed truck you see here with the tank, there's about two dozen police cars from the Phoenix police department along with the Phoenix firebird police helicopter following this guy, its unknown at this point what he's wanted for. it all started about thirty minutes ago at seventh street and Mcdowell, he did try to ram a police car, and uh we understand - well he's pulled over right now he's about to get out and uh looks like he's starting to run, he's got several units of Phoenix police on his tail right here and uh (Jim stays with him) looks like he's gonna try and take another vehicle here, we'll see if they'll block him in there. looks like they've got him blocked in there but he did get * -
12:46:18 CH3	[collision. End of CH3 recording]

Audio from N215TV (TV Channel 15) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
12:46:19 CH15	[sound similar to aural warning horn begins and continues to end of recording]
12:46:24 CH15	[sound of screaming]
12:46:29 CH15	[interference, possibly from another helicopter's video transmission. noisy video of the (new) truck driving. The start of this interference may be end of CH15 recording]
12:46:35 CH15	[end of 'interference' video, end of recording]

Audio from N613TV (TV Channel 3) Recording

<u>TIME and SOURCE</u>	<u>CONTENT</u>
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