

Crash Following Encounter with Instrument Meteorological  
Conditions After Departure from Remote Landing Site  
Alaska Department of Public Safety  
Eurocopter AS350 B3, N911AA  
Talkeetna, Alaska  
March 30, 2013



**Accident Report**

NTSB/AAR-14/03  
PB2014-108877



**National  
Transportation  
Safety Board**

# Aircraft Accident Report

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

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**Abstract:** This report discusses the March 30, 2013, accident involving a Eurocopter AS350 B3 helicopter, N911AA, operated by the Alaska Department of Public Safety, which impacted terrain while maneuvering during a search and rescue flight near Talkeetna, Alaska. The airline transport pilot, an Alaska state trooper serving as a flight observer for the pilot, and a stranded snowmobiler who had requested rescue were killed, and the helicopter was destroyed by impact and postcrash fire. Safety issues include inadequate pilot decision-making and risk management; lack of organizational policies and procedures to ensure proper risk management; inadequate pilot training, particularly for night vision goggle use and inadvertent instrument meteorological condition encounters; inadequate dispatch and flight following; lack of a tactical flight officer program; punitive safety culture; lack of management support for safety programs; and attitude indicator limitations. Safety recommendations are addressed to the Federal Aviation Administration, the state of Alaska, 44 additional states, the Commonwealth of Puerto Rico, and the District of Columbia.

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For more detailed background information on this report, visit <http://www.nts.gov/investigations/dms.html> and search for NTSB accident ID ANC13GA036. Recent publications are available in their entirety on the Internet at <http://www.nts.gov>. Other information about available publications also may be obtained from the website or by contacting:

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## Abbreviations

<b>AAWU</b>	Alaska Aviation Weather Unit
<b>agl</b>	above ground level
<b>ALEA</b>	Airborne Law Enforcement Association
<b>AMPA</b>	Air Medical Physicians Association
<b>AMRG</b>	Alaska Mountain Rescue Group
<b>ANC</b>	Ted Stevens Anchorage International Airport
<b>ASOS</b>	automated surface observing system
<b>AST</b>	Alaska State Troopers
<b>AWT</b>	Alaska Wildlife Troopers
<b>CDI</b>	course deviation indicator
<b>CFR</b>	<i>Code of Federal Regulations</i>
<b>DPS</b>	Department of Public Safety
<b>ELT</b>	emergency locator transmitter
<b>EMS</b>	emergency medical services
<b>FA</b>	area forecast
<b>FAA</b>	Federal Aviation Administration
<b>FLI</b>	flight limit indicator
<b>FLIR</b>	forward-looking infrared
<b>fpm</b>	feet per minute
<b>FSS</b>	flight service station
<b>HEMS</b>	helicopter emergency medical services
<b>HSI</b>	horizontal situation indicator
<b>IFR</b>	instrument flight rules
<b>IMC</b>	instrument meteorological conditions
<b>in Hg</b>	inches of mercury
<b>METAR</b>	meteorological aerodrome report
<b>min</b>	Minutes



<b>msl</b>	mean sea level
<b>NMSP</b>	New Mexico State Police
<b>NTSB</b>	National Transportation Safety Board
<b>NVG</b>	night vision goggles
<b>NWS</b>	National Weather Service
<b>OCC</b>	operations control centers
<b>PAQ</b>	Palmer Municipal Airport
<b>PED</b>	portable electronic device
<b>PIC</b>	pilot-in-command
<b>RCC</b>	Alaska Air National Guard Rescue Coordination Center
<b>SAR</b>	search and rescue
<b>SFAR</b>	special federal aviation regulation
<b>SMS</b>	safety management system
<b>TAF</b>	terminal aerodrome forecast
<b>TFO</b>	tactical flight officer
<b>TKA</b>	Talkeetna Airport
<b>TSO</b>	technical standard order
<b>VFR</b>	visual flight rules

## Executive Summary

On March 30, 2013, at 2320 Alaska daylight time, a Eurocopter AS350 B3 helicopter, N911AA, impacted terrain while maneuvering during a search and rescue (SAR) flight near Talkeetna, Alaska. The airline transport pilot, an Alaska state trooper serving as a flight observer for the pilot, and a stranded snowmobiler who had requested rescue were killed, and the helicopter was destroyed by impact and postcrash fire. The helicopter was registered to and operated by the Alaska Department of Public Safety (DPS) as a public aircraft operations flight under 14 *Code of Federal Regulations* Part 91. Instrument meteorological conditions (IMC) prevailed in the area at the time of the accident. The flight originated at 2313 from a frozen pond near the snowmobiler's rescue location and was destined for an off-airport location about 16 mi south.

After picking up the stranded, hypothermic snowmobiler at a remote rescue location in dark night conditions, the pilot, who was wearing night vision goggles (NVG) during the flight, encountered IMC in snow showers within a few minutes of departure. Although the pilot was highly experienced with SAR missions, he was flying a helicopter that was not equipped or certified for flight under instrument flight rules (IFR). The pilot was not IFR current, had very little helicopter IFR experience, and had no recent inadvertent IMC training. Therefore, conducting the flight under IFR was not an option, and conducting the night flight under visual flight rules in the vicinity of forecast IFR conditions presented high risks. After the helicopter encountered IMC, the pilot became spatially disoriented and lost control of the helicopter.

At the time the pilot was notified of the mission and decided to accept it, sufficient weather information was available for him to have determined that the weather and low lighting conditions presented a high risk. The pilot was known to be highly motivated to accomplish SAR missions and had successfully completed SAR missions in high-risk weather situations in the past.

The investigation also identified that the Alaska DPS lacked organizational policies and procedures to ensure that operational risk was appropriately managed both before and during the mission. Such policies and procedures include formal pilot weather minimums, preflight risk assessment forms, and secondary assessment by another qualified person trained in helicopter flight operations. These risk management strategies could have encouraged the pilot to take steps to mitigate weather-related risks, decline the mission, or stay on the ground in the helicopter after rescuing the snowmobiler. The investigation also found that the Alaska DPS lacked support for a tactical flight officer program, which led to the unavailability of a trained observer on the day of the accident who could have helped mitigate risk.

Any organization that wishes to actively manage safety as part of an effective safety management system must continuously strive to discover, understand, and mitigate the risks involved in its operations. Doing so requires the active engagement of front-line personnel in the reporting of operational risks and their participation in the development of effective risk mitigation strategies. This cannot occur if a focus of the organization's approach to dealing with safety-related events is to punish those whose actions or inactions contributed to the event.

Although front-line personnel may, on rare occasions, be involved in intentional misdeeds, the majority of accidents and incidents involve unintentional errors made by well-intentioned personnel who are doing their best to manage competing performance and safety goals. An organizational safety culture that encourages the adoption of an overly punitive approach to investigating safety-related events tends to discourage the open sharing of safety-related information and to degrade the organization's ability to adapt to operational risks.

The Alaska DPS safety culture, which seemed to overemphasize the culpability of the pilot in his past accident and events, appears to have had this effect. The pilot had adopted a defensive posture with respect to the organization, and he was largely setting his own operational limitations and making safety-related operational decisions in a vacuum, masking potential risks, such as the risk posed by his operation of helicopter NVG flights at night in low IFR conditions. This had a deleterious effect on the organization's efforts to manage the overall safety of its SAR operations. The investigation found that Alaska DPS had a punitive safety culture that impeded the free flow of safety-related information and impaired the organization's ability to address underlying safety deficiencies relevant to this accident.

The National Transportation Safety Board (NTSB) determines that the probable cause of this accident was the pilot's decision to continue flight under visual flight rules into deteriorating weather conditions, which resulted in the pilot's spatial disorientation and loss of control. Also causal was the Alaska Department of Public Safety's punitive culture and inadequate safety management, which prevented the organization from identifying and correcting latent deficiencies in risk management and pilot training. Contributing to the accident was the pilot's exceptionally high motivation to complete search and rescue missions, which increased his risk tolerance and adversely affected his decision-making.

It is important to note that the investigation was significantly aided by information recovered from the helicopter's onboard image and data recorder, which provided valuable insight about the accident flight that helped investigators identify safety issues that would not have been otherwise detectable. Images captured by the recorder provided information about where the pilot's attention was directed, his interaction with the helicopter controls and systems, and the status of cockpit instruments and system indicator lights, including those that provided information about the helicopter's position, engine operation, and systems. Information provided by the onboard recorder provided critical information early in the investigation that enabled investigators to make conclusive determinations about what happened during the accident flight and to more precisely focus the safety investigation on the issues that need to be addressed to prevent future accidents. For example, the available images allowed the investigation to determine that the pilot caged the attitude indicator in flight. This discovery resulted in the development of important safety recommendations related to attitude indicator limitations.

Although the recording device on board the accident helicopter was not required and was not a crash-protected system, the NTSB has a long history of recommending that the Federal Aviation Administration (FAA) require image recording devices on board certain aircraft. Some of these safety recommendations, which were either closed or superseded after the FAA indicated that it would not act upon them, date as far back as 1999. The NTSB notes that, had the FAA required all turbine-powered, nonexperimental, nonrestricted-category aircraft operated under Parts 91, 135, and 121 to be equipped with crash-protected image recording system by

January 1, 2007 (as the NTSB had recommended in 2003), 466 aircraft involved in accidents would have had image recording systems; in 55 of these accidents, the probable cause statements contained some element of uncertainty, such as an undetermined cause or factor.

As a result of this investigation, the NTSB makes 3 safety recommendations to the FAA and 7 safety recommendations to the state of Alaska, 44 additional states, the Commonwealth of Puerto Rico, and the District of Columbia that conduct law enforcement public aircraft operations.

# 1. Factual Information

## 1.1 History of the Flight

On March 30, 2013, at 2320 Alaska daylight time, a Eurocopter AS350 B3 helicopter,<sup>1</sup> N911AA, impacted terrain while maneuvering during a search and rescue (SAR) flight near Talkeetna, Alaska. The airline transport pilot, an Alaska state trooper serving as a flight observer for the pilot, and a stranded snowmobiler who had requested rescue were killed, and the helicopter was destroyed by impact and postcrash fire. The helicopter was registered to and operated by the Alaska Department of Public Safety (DPS) as a public aircraft operations<sup>2</sup> flight under 14 *Code of Federal Regulations* (CFR) Part 91. Instrument meteorological conditions (IMC) prevailed in the area at the time of the accident. The flight originated at 2313 from a frozen pond near the snowmobiler's rescue location and was destined for an off-airport location about 16 mi south.

### 1.1.1 Mission Coordination

At 1935, the snowmobiler used his cell phone to call 911 to request rescue after his snowmobile became stuck in a ditch under the Intertie (a major power transmission line) between Larson Lake and Talkeetna. According to the MatCom<sup>3</sup> dispatcher who handled the call, the snowmobiler reported that he bruised his ribs but was more concerned about developing hypothermia if not rescued soon. After receiving notification from MatCom, the trooper on duty at the Alaska State Troopers (AST) Talkeetna post tried to coordinate a ground rescue mission.<sup>4</sup> The trooper found that no local Alaska Wildlife Troopers (AWT) units were on duty and that other local resources (residents with snowmobiles and SAR experience) did not want to participate because of the distance involved and the deteriorating weather, which included rain and poor snow conditions on the ground. After the trooper's attempts to coordinate a ground rescue were unsuccessful, at 2009, he telephoned the AST on-duty SAR coordinator,<sup>5</sup> and they agreed that it would be appropriate to use the Alaska DPS's primary SAR helicopter to retrieve the snowmobiler.

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<sup>1</sup> Eurocopter is now known as Airbus Helicopters, a wholly owned subsidiary of the Airbus Group, which is headquartered in France.

<sup>2</sup> The term "public aircraft" refers to a subset of government aircraft operations that, as such, are not subject to some of the regulatory requirements that apply to civil aircraft. Because public aircraft operators (like the Alaska DPS) are exempted from certain aviation safety regulations, government organizations conducting public aircraft operations supervise their own flight operations without oversight from the Federal Aviation Administration.

<sup>3</sup> MatCom, a public safety dispatch center located in Wasilla, Alaska, is a division of the Wasilla Police Department.

<sup>4</sup> The Alaska DPS has two major divisions, the AST and the Alaska Wildlife Troopers (AWT). The AST is charged with statewide law enforcement, prevention of crime, pursuit and apprehension of offenders, service of civil and criminal process, prisoner transport, central communications, and SAR. The AWT is charged with enforcing fish and game regulations; AWT troopers also enforce criminal laws and participate in SAR operations.

<sup>5</sup> According to the Alaska DPS SAR protocol, the SAR coordinator handled all requests for the use of the accident helicopter. If the SAR coordinator approved, then the coordinator would notify the pilot, who would evaluate the weather and determine if the mission was acceptable.

According to records from the pilot's portable electronic device (PED),<sup>6</sup> at 2019, he received an incoming call from the SAR coordinator. The SAR coordinator stated that he relayed details of the situation to the pilot, and the pilot said he would check the weather. The pilot's spouse recalled that, immediately after the pilot received the call, he went upstairs to check the weather. The pilot called the SAR coordinator soon after and said he would accept the mission.<sup>7</sup> The pilot's spouse recalled that she asked her husband about the weather, and he said that it was "good." The pilot then drove to Ted Stevens Anchorage International Airport (ANC), Anchorage, Alaska, where the helicopter was based.

At 2051, the pilot called a fixed-base operator and asked for help towing the helicopter out of its hangar. Two line service technicians drove a tug across the airport to the hangar, arriving about 2100. They towed the helicopter out of the hangar and watched as the pilot performed a walk-around inspection, went through cockpit checks, and started the engine. They estimated that the helicopter's rotors were turning about 10 or 15 minutes (min) after they disconnected the tug, and they watched the helicopter depart shortly thereafter.

### 1.1.2 Outbound Flight to Remote Rescue Location

At 2117, the pilot radioed the MatCom dispatcher that he had departed ANC, and, at 2142, he reported to the dispatcher that he was landing at "Sunshine," a landing zone near the AST Talkeetna post, to pick up the trooper/flight observer. At 2154, the pilot radioed the dispatcher that he had spotted the snowmobiler and would land nearby and walk to his location.

GPS data<sup>8</sup> showed that the helicopter departed Sunshine and proceeded north until it reached the Intertie. As shown in figure 1, the helicopter continued north along the Intertie for about 0.6 mi at an altitude of about 1,100 to 1,200 ft mean sea level (msl), made a right 360° turn over the Intertie, and landed immediately west of it on a frozen, snow-covered pond at 2156. The flight duration was about 11 min, and the landing site pond was about 16 mi north of Sunshine. The landing site elevation was about 460 ft above msl. Hand-written coordinates on the pilot's kneeboard that was recovered from the wreckage indicate that the snowmobiler's location was about 0.2 mi from the landing site.

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<sup>6</sup> Records recovered from the pilot's PED, which was an Apple iPhone 4, included call and text message log information for the 3 days leading up to the accident and six photographs of the helicopter's cockpit, which were dated July 18, 2012.

<sup>7</sup> The pilot's PED records did not show a second call with the SAR coordinator; however, it is possible that the pilot used his home phone.

<sup>8</sup> The helicopter was equipped with a Garmin GPSMAP 296 portable GPS unit capable of storing flight route information. References in this report to the helicopter's position (at specific times), altitude, and groundspeed are based on information retrieved from the unit's nonvolatile memory.



**Figure 1.** End of GPS flight track from Sunshine to landing site with flight track shown in orange.

At 2159, the trooper radioed the dispatcher that they were walking to the snowmobiler's location. At 2209, he asked the dispatcher, who had cell phone contact with the snowmobiler, to have the snowmobiler stand up so that he would be easier to spot in the deep snow, but the dispatcher advised that the snowmobiler was too weak to stand. At 2220, the pilot and the trooper reached the snowmobiler.

The pilot and trooper did not report to the dispatcher how they assisted the snowmobiler or transported him to the helicopter. However, the snowmobile was later found parked on the frozen pond (not under the Intertie) near two parallel linear marks in the snow with dimensions that corresponded to the helicopter's landing skids (see figure 2).



**Figure 2.** Aerial photograph of helicopter landing site. (Red arrows point to marks consistent with helicopter's landing skids. Green arrow points to the snowmobile.)

### 1.1.3 Accident Flight

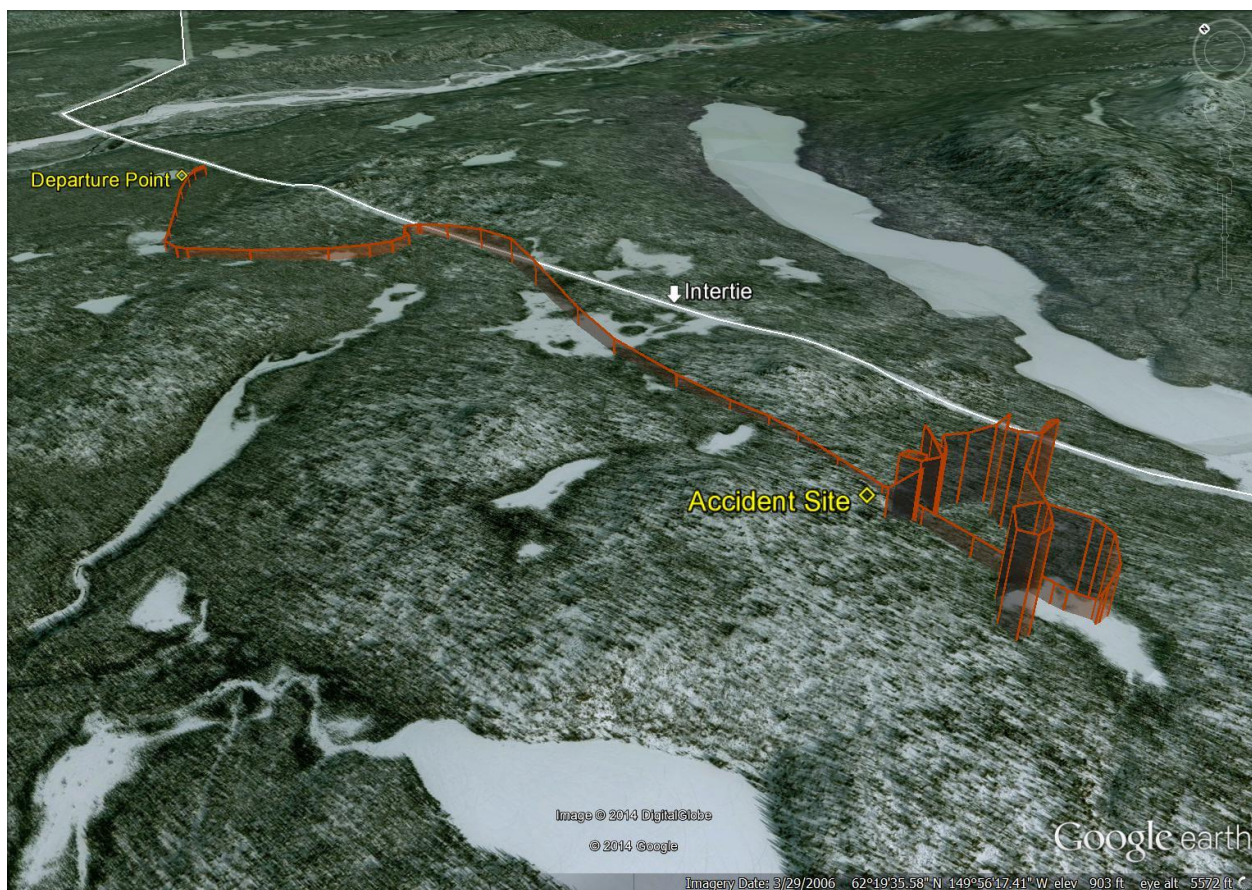
As shown in figure 3, GPS data for the accident flight (which lasted about 7 min) showed that the helicopter departed the frozen pond about 2313. It climbed to about 700 ft msl (about 250 ft above ground level [agl]) and accelerated to about 60 knots. The helicopter flew southwest and then southeast, circumnavigating a 1,000-ft msl hill at altitudes of 700-800 ft msl (about 150-200 ft agl, depending on terrain elevation), and then it slowed to about 20 knots as it approached the Intertie. About 2315, the helicopter turned right and headed south along the Intertie for about 30 seconds at altitudes of about 900-1,100 ft msl (about 200-300 ft agl) and a speed of 60 knots. Before the helicopter reached an area where the Intertie crossed over another 1,000-foot msl hill (which was one of several in a cluster of low-lying hills directly ahead of the helicopter's flightpath), the helicopter turned right and deviated toward a slight gap in the hills at a speed of 70 knots.

At 2316, the flight observer radioed the dispatcher that the helicopter was en route back to Sunshine, and he requested that an ambulance meet the flight to receive the hypothermic snowmobiler. No further radio communications were received from the flight.



At 2317:14, the helicopter was flying about 1,000 ft msl over 900-ft terrain in the middle of the cluster of low-lying hills and had slowed to 23 knots.<sup>9</sup> At 2317:31, the helicopter was about 1,100 ft msl and 44 knots. At 2317:49, the helicopter was at 1,060 msl (about 200 ft agl) and 16 knots.

At 2317:59, the helicopter began to climb and turn left rapidly with little forward airspeed. According to images recovered from the helicopter's onboard Appareo Systems Vision 1000 recorder (see section 1.5), at 2318:40, as the helicopter completed about a 360° turn, the pilot caged the attitude indicator.<sup>10</sup> Caging an attitude indicator sets it to display a level flight attitude (0° pitch and 0° roll). This action is meant to be performed only when an aircraft is in a level flight attitude, such as on the ground or in straight-and-level, unaccelerated flight. After this, the helicopter entered a series of erratic turns, climbs, and descents. The GPS data for the accident flight ended at 2320:17, and the last position recorded placed the helicopter about 3 mi south of the takeoff point and 13 mi north of Sunshine.



**Figure 3.** GPS-derived flight track of the accident flight (shown in orange).

<sup>9</sup> The presence of many tall trees in the area meant that obstacle clearance was much less than 100 ft.

<sup>10</sup> The attitude indicator, also known as an artificial horizon, displays a visual representation of the helicopter's pitch and roll relative to the Earth's horizon.

At 0039 on March 31, 2013 (about 1.5 hours after being notified to meet the helicopter), emergency medical services (EMS) personnel awaiting the helicopter's arrival at Sunshine contacted a MatCom dispatcher to request the helicopter's estimated time of arrival. The dispatcher's attempts to locate the helicopter via radio and phone and by contacting personnel at Sunshine and the Talkeetna flight service station (FSS) were unsuccessful. The dispatcher had only limited information from Alaska DPS about the helicopter, and DPS personnel did not perform any flight tracking. (For more information about dispatch and DPS activities to locate the helicopter, see section 1.8.5.) No signals were received from the helicopter's 406-MHz emergency locator transmitter (ELT). At 0217, the Alaska Air National Guard Rescue Coordination Center (RCC) advised that the National Guard helicopters could not fly for 3 hours (due to crew rest requirements, however, the weather was also adverse), and, at 0230, the decision was made to search for the helicopter using snowmobiles. About 0700, after the weather improved, a 210<sup>th</sup> Air National Guard Rescue Squadron Sikorsky HH-60 Pave Hawk helicopter departed from Anchorage to join the search. The wreckage was located by the National Guard helicopter crew about 0930 on March 31, 2013 (see figure 4). The accident site was about 200 ft north of the last recorded GPS position at an elevation of about 940 ft.



**Figure 4.** Aerial view of the accident site with helicopter wreckage circled in red.

## 1.2 Personnel Information

### 1.2.1 Pilot

The pilot, age 55, held a commercial pilot certificate with ratings for helicopters, single-engine and multiengine land airplanes, and single-engine sea airplanes, and he was instrument-rated for helicopters and airplanes. He also held a flight instructor certificate for helicopters and single-engine land airplanes and an airline transport pilot certificate with a rating for multiengine land airplanes. The pilot's most recent Federal Aviation Administration (FAA) second-class medical certificate was dated August 23, 2012, with the limitation, "Must wear corrective lenses [and] possess glasses for near/intermediate vision." The pilot also held an airframe and powerplant mechanic's certificate.

Based on available records,<sup>11</sup> the pilot had accumulated about 10,693 total flight hours, of which about 8,452 hours were in helicopters. His logbooks showed a total of 247.1 hours simulated instrument time and 141.3 hours of actual instrument time, primarily in airplanes and all logged before 2001. The logbooks documented 38.3 hours of instrument flight in helicopters, of which 0.5 hour was actual instrument time. The most recent instrument helicopter flight was logged in 1986.

#### 1.2.1.1 Training and Performance at Alaska DPS

Alaska DPS hired the pilot in December 2000 to be the primary pilot for the accident helicopter. He had flown a total of 3,415 flight hours for Alaska DPS, which included 1,738 hours flown during SAR missions. He flew 242 hours in the year before the accident, of which 239 hours were in the accident helicopter. The pilot flew 23 hours in the 90 days before the accident, with 8 hours flown in the last 30 days. His most recent flight in the accident helicopter before the day of the accident took place on March 17, 2013. That flight was a SAR mission to retrieve an injured hiker.

The pilot's most recent Alaska DPS check flight took place on March 18, 2013. The check flight was conducted in a Robinson R-44 by an independent instructor and included a flight review in accordance with 14 CFR 61.56 and the special awareness training required by Special Federal Aviation Regulation (SFAR) 73<sup>12</sup> to act as pilot-in-command (PIC) of a Robinson R-44. On November 20, 2012, the pilot completed an AS350 B3 pilot recurrent training course at the American Eurocopter training center in Grand Prairie, Texas. According to

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<sup>11</sup> Total flight times were derived from the pilot's logbooks (which contained no recent entries) and DPS records. For more information about the pilot's flight experience, see the Operations/Human Performance Factual Report contained in the public docket for this accident.

<sup>12</sup> SFAR 73 imposes training requirements (in addition to those contained in Part 61) that are specific to the Robinson R-22 and R-44 model helicopters. The rule requires special awareness training covering energy management, mast bumping, low rotor rpm (blade stall), low G hazards, and rotor rpm decay.

the training record, the pilot received a total of 1.5 hours of flight training, which included normal and emergency procedures. The training did not include any instrument flight.<sup>13</sup>

The pilot's logbooks did not reference night vision goggle (NVG)<sup>14</sup> flight time, and Alaska DPS did not maintain pilot NVG flight time records.<sup>15</sup> Log sheets for the helicopter showed that the pilot flew 16.2, 13.2, and 2.2 hours using NVGs within the 6 months, 90 days, and 30 days before the accident, respectively. His most recent flight using NVGs was on March 15, 2013.

The pilot's performance evaluation report for 2009 listed as a goal for 2010, "attend a commercial initial NVG course to update his training in the NVG environment." A quotation dated October 13, 2009, for an NVG course including 8 hours of ground school and 5 hours of flight training to be given by Aviation Specialties Unlimited of Boise, Idaho, was found in the pilot's office. However, the pilot's performance evaluation report for 2010 stated that "it was decided not to send [the pilot] to a commercial initial NVG course due to the cost of the course."

The pilot had previous military helicopter flying experience, and one of the Alaska DPS pilots who provided the pilot with his NVG training at DPS reported that the pilot had previous NVG experience in the military. Investigators could find no record that the pilot received formal NVG training in the military. According to the pilot's Alaska DPS training records, he completed NVG training on December 18, 2003, and was authorized to use NVGs in accordance with "the department NVG and policy manual." According to the records, the NVG training included 6 hours of ground school and 4.4 hours of flight training, which was provided by other Alaska DPS pilots. The records specify that during one of the NVG training flights, inadvertent IMC operations were performed and that, during another flight, blowing snow takeoffs were performed. There were no records found indicating that any subsequent recurrent NVG or instrument training in helicopters was provided. Alaska DPS provided the pilot with instrument flight training in a Cessna 208 airplane at a FlightSafety training center in 2001.

In the "Weather Restrictions" section of the pilot's Alaska DPS Flight Authorizations/Limitations form dated December 18, 2003, the box for "VFR [visual flight rules] Flight" was checked with no restrictions noted, and the box for "Night Flight" was checked with the restriction "[NVG] use w/ 500' ceiling and 2 miles visibility." This was the most recently completed copy of this form found in the pilot's records.

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<sup>13</sup> None of the pilot's previous training at American Eurocopter included instrument flight. He received training there in 2002, 2005, 2006, 2008, 2009, 2010, and 2011.

<sup>14</sup> NVGs are used during night operations to provide a brighter visual scene, allowing the user to more easily see external references. NVG limitations include a reduced field of view, reduced image resolution, and the presence of digital noise. Also, low lighting conditions can result in lower contrast images that are more difficult to interpret and may cause a tendency to fly lower in an effort to maintain an acceptable image. The use of NVGs in low light conditions also requires high levels of gain, which worsens digital noise and can lead to "scintillation." Further, the presence of meteorological obscurants, like rain and snow, has the potential to further degrade NVG image quality.

<sup>15</sup> DPS required that the pilot maintain a record showing that he met the NVG operating experience required by 14 CFR 61.57. This requirement was satisfied by the pilot completing a form titled "State of Alaska Department of Public Safety NVG Operating Experience...on an AS350B3 (Astar)." Copies of completed forms dating back to December 7, 2010, were located in the pilot's personnel file. The most recent form was dated March 15, 2013.

Review of the pilot's Alaska DPS personnel file revealed that he had received ratings of "outstanding" or "high acceptable" on his yearly performance evaluations since joining the agency.<sup>16</sup>

The pilot had been commended numerous times by state officials, including the governor. Most recently, in 2011, the pilot received an honorable mention for the Governor's Denali Peak Performance Award in the category of Crisis Responder. Also, in 2008, the pilot and the on-duty SAR coordinator (who was a sergeant stationed in Girdwood, Alaska, at the time) received the Governor's Denali Peak Performance Award in the category of Exceptional Performance Team and a Commendation for Meritorious Service for saving the life of a kayaker on July 29, 2007. According to the commendation, the kayaker became caught in a bore tide,<sup>17</sup> and the pilot flew the helicopter steady close to the turbulent water's surface while the sergeant leaned out of the helicopter and pulled the kayaker from the water. The pilot's personnel file also contained numerous letters and e-mails of appreciation from people the pilot had rescued and their families. For example, one of three people who had become stranded on a gravel bar with two airplanes due to rising water sent an e-mail dated September 27, 2012, to the pilot's supervisor that stated, in part, the following:

I wanted to tell you thank you for rescuing us during the flooding...Our situation was pretty grim. We were surrounded by rising waters with no way to get out... . Your pilot who was only asked to do a weather check pushed on through to get us out of that situation.... The weather wasn't all that great when he flew in and got us back.

### 1.2.1.2 Work/Sleep/Wake History

The pilot's spouse said that the pilot was a morning person who woke every day at 0530 but sometimes went back to sleep until about 0800 on weekend mornings. He normally left for work between 0600 and 0615 Monday through Friday. He typically went to bed early in the evening (about 2100 on weeknights and 2130 on Friday and Saturday nights) so that he would be rested if called to fly a mission. He had no difficulty falling asleep at night.

The pilot's spouse said that the pilot had not recently experienced any significant negative life events, and she reported no recent changes in his daily habits. He normally ate breakfast at a fast food restaurant on the way to work, ate lunch at home about 1100, ate dinner at home between 1700 and 1800, and sometimes ate a late evening snack. He visited a gym for cardiovascular exercise and strength training 3 or 4 days a week, normally in the afternoon.

Based on the pilot's spouse's recollections of his schedule and a review of his PED activity, the pilot's estimated potential sleep time for the 3 nights before the accident is summarized in table 1.

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<sup>16</sup> The rating levels were unacceptable, low acceptable, mid acceptable, high acceptable, and outstanding. There was no performance evaluation report for the rating period January 16, 2008, to January 15, 2009, in the pilot's personnel file.

<sup>17</sup> A bore tide is a wave or series of waves formed by a rush of seawater as the incoming tide from a wide bay is funneled into a shallow and narrowing inlet.

**Table 1.** Pilot's estimated potential sleep.

Date	Went to Bed	Awoke	Potential Sleep
March 27-28	2100	0530	8.5 hours
March 28-29	2100	0530	8.5 hours
March 29-30	2200	0800 to 0900	10 to 11 hours

### 1.2.1.3 Previous Accident

The pilot was involved in a previous accident in the helicopter on April 21, 2006. According to the National Transportation Safety Board (NTSB) report for the accident, the pilot stated that, just after takeoff, as the helicopter transitioned from a hover to forward flight, blowing snow from the helicopter's main rotor momentarily reduced his visibility, and he lost all visual reference with the surface. He elected to abort the takeoff while he was attempting to regain a visual reference, and the helicopter's tail rotor guard and vertical stabilizer struck the surface of the lake. The NTSB determined that the probable cause of the accident was "the pilot's failure to maintain adequate altitude/clearance from terrain during an aborted takeoff in whiteout conditions, which resulted in an in-flight collision with terrain. A factor associated with the accident was whiteout conditions."<sup>18</sup>

As a result of the accident, the FAA requested that the pilot undergo a commercial pilot reexamination given by an FAA inspector in accordance with 49 *United States Code* 44709(a). The pilot successfully completed the reexamination on May 15, 2006, in a Robinson R-44 helicopter. There were no records of any other certificate actions in the pilot's FAA records. Also as a result of the accident, DPS required the pilot to undergo training on takeoffs in blowing snow conditions with one of the department's senior pilots. Alaska DPS conducted an internal investigation of the accident and other events<sup>19</sup> involving the pilot. (For more information, see section 1.8.3.1.)

### 1.2.1.4 Schedule and Compensation

The pilot's work schedule was Monday through Friday, 0700 to 1530, with an hour lunch break from 1200 to 1300. According to his wife and colleagues, he was always on call except when he took leave for a special family occasion or to use a few days of leave that he would otherwise have to forfeit.<sup>20</sup> An examination of the pilot's time sheet for the period of March 16-31, 2013, indicated that he was on "standby" every day during that period. According to the pilot's wife and colleagues, the pilot sometimes went off call temporarily when he exceeded flight or duty time limits and needed to rest.

<sup>18</sup> The NTSB report for this accident, [ANC06TA047](http://www.ntsb.gov/ANC06TA047), can be accessed from the NTSB web site at [www.ntsb.gov](http://www.ntsb.gov).

<sup>19</sup> The events, each of which did not meet the criteria to be classified as an accident, were not investigated by the NTSB or the FAA.

<sup>20</sup> The pilot was required to use a minimum of 5 days of vacation time or forfeit it at the end of the year.

The pilot's last day off was Saturday, March 9, 2013, and his last extended time off was a week-long family vacation in January 2013. Alaska DPS records indicated that, before the accident, the pilot had not done any flying since he completed a flight review on March 18, 2013, and had not worked outside of his normal office hours since Sunday, March 17, 2013.

The pilot was paid for his work on an hourly basis and was expected to work at least 40 hours per week. He received additional compensation (premium pay) for additional hours worked (overtime), for working in the evenings or at night (swing shift or graveyard shift pay differentials), for working on a holiday, and for being on call outside of normal work hours (standby pay). DPS records indicated that, for calendar year 2012, about 37% of the pilot's total earnings consisted of premium pay.

### **1.2.1.5 Colleagues' and Others' Perceptions**

#### **1.2.1.5.1 Proficiency**

The aircraft section commander, who was a nonhelicopter-rated pilot and had flown with the pilot, said that the pilot had a "high level of proficiency" and was "always very professional." He characterized him as a "by the book" pilot.

The relief pilot for the accident helicopter, who had flown with the pilot numerous times (most recently in November 2012), said that the pilot was the "best helicopter pilot" he had ever flown with. He described the pilot as "a sound professional."

An Alaska Mountain Rescue Group (AMRG) observer who often flew with the pilot described him as an excellent pilot who he "completely trusted." (The Alaska DPS's use of flight observers is further described in section 1.8.4).

The former relief pilot, who had provided the pilot with his NVG training in 2003 and had most recently flown with the pilot in December 2010, rated the pilot's skill level as "average."

#### **1.2.1.5.2 Attitude Regarding Weather Risks**

The aircraft section commander said that he knew the pilot was aware of weather-related safety issues because when he talked with the pilot about his SAR missions, the pilot always discussed the conditions he encountered and how he compensated for them. He said that the pilot did not display hazardous attitudes and that he did not consider him to be a "risk-taker." He recalled a discussion he had with the pilot about the risks involved in some of the SAR missions the pilot conducted, including flying in bad weather and at night, and he said that the pilot told him, "I told them when I took this job that I would do this, and that's what I am going to do." The aircraft section commander expressed the opinion that the pilot knew what the risks were and felt a self-imposed obligation to conduct SAR missions in difficult conditions.

The relief pilot had received helicopter flight instruction from the pilot and had flown missions with him. The relief pilot said that the pilot was "extremely safe" and that for "everything [the pilot] did, he had a backup plan." The relief pilot recalled that, on one occasion, he expressed concern to the pilot about the weather conditions for a particular mission, and the

pilot had encouraged him to decline it. He recalled that the pilot had repeatedly told him not to “fight” or “push” the weather.

The AMRG observer said that the pilot did not take risks flying in bad weather and that he had been on missions with the pilot numerous times where they had to turn around because the weather was too bad to continue. He said that, after the pilot’s 2006 accident, the pilot was “extra careful” because he wanted to avoid another accident or incident. The pilot had previously briefed him that, if they ever encountered zero-visibility conditions, he would climb and transition to instrument flight rules (IFR) flight while the observer monitored the cockpit display for terrain conflicts. The pilot told the observer he would then continue the flight under IFR until they reached the nearest airport or exited the bad weather. The observer told investigators the pilot had never been forced to execute this plan during the 300-plus missions they had conducted together because, aside from momentary whiteouts during takeoff or landing, they had never encountered zero-visibility conditions in flight.

The recently retired aircraft section supervisor, who was a nonhelicopter-rated pilot and left the Alaska DPS about 3 weeks before the accident, characterized the pilot as a “very careful pilot.” She said that although she had never flown with the pilot, she knew this because she had seen him in the office checking the weather before accepting a mission, and she had also received notifications that the helicopter had been assigned to a SAR mission but was on hold because of poor weather conditions such as low ceilings or freezing rain.

#### **1.2.1.5.3 Pilot’s Motivational Factors**

The pilot’s spouse stated that the pilot enjoyed flying the helicopter and was highly motivated about flying-related tasks. She said that he was very close to his family and found it rewarding to rescue people and bring them back safely to their families.

Describing the September 2012 mission that the pilot performed to rescue three people from two airplanes that had become stranded on a gravel bar by rising water,<sup>21</sup> the aircraft section commander stated that a 210th Air National Guard Rescue Squadron crew attempted to reach the location in a Sikorsky HH-60 Pave Hawk helicopter but had to turn back when they were unable to cross a mountain pass due to poor weather conditions. The pilot stayed up all night and continued to check the weather until he saw a “weather window on the radar” that he thought would allow him to reach the location. About 0300, the pilot launched, and, by using a different route that avoided the mountain pass where the Air National Guard crew was forced to turn back, he reached the location and rescued the three people. The aircraft section commander said that this mission demonstrated how “motivated and driven” the pilot was to perform rescues.

#### **1.2.1.5.4 Attitude Regarding Overtime**

The recently retired aircraft section supervisor said that the pilot considered overtime “an expected part of his job.” Also, the aircraft section commander said that it was difficult to get the pilot to take time off. He said that any time he talked to the pilot about adjusting his schedule or bringing in another pilot to share the standby duty, the pilot would complain that this was going to take away from his overtime pay.

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<sup>21</sup> One of the individuals who was rescued wrote an e-mail commending the pilot.



The major who was the AWT deputy director said that he had recently become aware of the number of days the pilot was on standby and that his concern about this prompted him to discuss it with the aircraft section commander. He said that if a pilot were paid a salary rather than hourly pay, this might be beneficial because it would remove the incentive to work more hours to make more money.

The relief pilot said that the pilot wanted to be on standby because he wanted the overtime. The relief pilot said that he had offered to cover for the pilot if he needed a break and that he had done so when the pilot wanted time off, such as when he went on vacation or got sick. He said that the pilot had expressed to him that he was afraid that he would be replaced if other pilots were allowed to fly more of the helicopter's missions.

The relief pilot recalled that, on Thursday, March 28, the pilot had visited him at Alaska DPS headquarters between 0700 and 1200. During the conversation, he discussed a proposed change with the pilot regarding the pilot scheduling for the helicopter. The AWT deputy director had proposed that the relief pilot serve as the primary pilot for the helicopter 2 days a week. The AWT deputy director said that he made this decision when he realized that the pilot was continuously on call. The purpose of the change was to allow the pilot to have some time off duty each week. The relief pilot said that the pilot was upset about this scheduling change.

### **1.2.2 Flight Observer**

The trooper who served as a flight observer held a commercial pilot certificate with ratings for single-engine land, multiengine land, single-engine sea, and instrument airplanes. He was issued an FAA second-class medical certificate on August 20, 2012, with no limitations. He owned a Piper PA-18 Super Cub airplane, which he flew on his days off.

According to the flight observer's spouse, the flight observer had previously accompanied the pilot on several missions and enjoyed flying with him. According to the pilot's mission records, the flight observer most recently accompanied him on a March 15, 2013, SAR mission. The flight observer received no Alaska DPS training for using NVGs or assisting with helicopter flight tasks, such as operating some of the helicopter's navigational equipment.

### **1.3 Helicopter Information**

The accident helicopter, pictured in figure 5, was a Eurocopter AS350 B3 model powered by a single Turbomeca Arriel 2B turboshaft engine with a single three-bladed main rotor system using a conventional two-bladed tail rotor for antitorque and heading control. The helicopter had four large doors, two located on either side of the helicopter, for access to the cockpit and passenger seating area. For the SAR mission, the left seat controls had been removed, and the

seating capacity was for a pilot and six passengers. The helicopter was not certified for IFR flight operations.<sup>22</sup>



**Figure 5.** Preaccident photograph of the helicopter.

The helicopter was equipped with a Garmin GNS 430 GPS mounted in the center of the instrument panel; a Garmin GPSMAP 296, which was mounted on the lower right side of the instrument panel; an Avalex Technologies™ mapping flight display system that had various map display capabilities; and a forward-looking infrared (FLIR) system.<sup>23</sup> The Garmin 430 unit could be connected to the horizontal situation indicator (HSI) such that the course deviation indicator (CDI) could be used for additional course guidance. The Garmin 296 unit was capable of showing color-coded terrain elevation information and terrain alerts if selected by the pilot. The helicopter had an AIM 1200 attitude indicator that was limited to indicating  $\pm 25^\circ$  of pitch (that

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<sup>22</sup> None of the Alaska DPS helicopters were IFR-certified. Helicopters that are certified for IFR operations are typically more stable than VFR-only helicopters because the certification requirements are often met through the use of stabilization and/or automatic flight control systems. According to chapter 10-1-1 in the FAA *Aeronautical Information Manual*, the systems typically fall into categories that include aerodynamic surfaces that impart some capability or control capability not found in the basic VFR configuration, stability augmentation systems, attitude retention systems, and/or autopilot systems, among others.

<sup>23</sup> The FLIR system was not operational at the time of the accident. The external components had been removed.

is, if the helicopter's pitch exceeded the limitation, the pitch indicator would stop at the limit and remain there until the helicopter's pitch no longer exceeded the limit).<sup>24</sup>

Modifications included high skid landing gear; inflatable skid floats; snow shoes; a 406-MHz ELT; an Appareo Systems Vision 1000 cockpit image, audio, and data recorder;<sup>25</sup> and a lighting system that was compatible with the flight crew's use of NVGs.

The helicopter also carried survival equipment and rescue gear. Aircraft section personnel estimated the weight of this equipment at 275 lbs. The AMRG volunteer who frequently flew with the pilot said that the survival equipment included two sleeping bags, a tent, a trauma kit, food, a satellite phone, a personal locator beacon, and snowshoes.

### 1.3.1 Maintenance

Alaska DPS had operated and maintained the helicopter for about 10 years since acquiring it new. A review of the helicopter logbooks revealed that, at the time of the departure from ANC, the helicopter had accumulated 2,518.8 hours and 5,179 landings, and the engine had accumulated 2,476.7 hours.

The last inspection that was performed on the helicopter was a 150-hour inspection on March 17, 2013, and the helicopter had accumulated 2,518.8 hours at that time. A certified repair station mechanic at the AST hangar performed the inspection. The helicopter was approved for return-to-service and released for flight. The last 100-hour inspection was performed on October 1, 2012, by the same mechanic who performed the last 150-hour inspection, and the helicopter had accumulated 2,466.4 flight hours at that time.

A review of the helicopter logbook for the last 30 days revealed that all maintenance write-ups had been cleared; there were no open or deferred items. All maintenance was listed as accomplished in accordance with Eurocopter's maintenance procedures, and the helicopter was returned to service.

Witnesses reported that the pilot kept the turn-and-bank indicator disabled by pulling its circuit breaker. No one was certain of the pilot's reason for doing this. The AMRG observer said that the turn-and-bank indicator worked but that there was "a problem with it." Another of the pilot's colleagues thought that the pilot disabled the instrument when it was not needed to extend its life by reducing wear. The most recent maintenance record related to the turn-and-bank

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<sup>24</sup> The operating manual for the AIM 1200 did not include information about its pitch and bank indicating range limits. The manufacturer provided this information during the investigation. The AIM 1200 attitude indicator's pitch indication range met the requirements of the FAA's technical standard order (TSO) for bank and pitch instruments, TSO-C4c. TSO-C4c states that bank and pitch instruments manufactured for installation on civil aircraft after April 1, 1959, shall meet the standards set forth in the Society of Automotive Engineers' Aeronautical Standard AS-396B, dated July 15, 1958. AS-396B states, under the heading "Indicating Range," that "the range of indication in pitch shall be at least plus or minus 25 degrees. The range of indication in bank shall be at least plus or minus 100 degrees." Under the heading "Operating Range," AS-396B states that "the instrument shall be operable following maneuvers of 360 degrees in bank and 360 degrees in pitch."

<sup>25</sup> The recorder installation was accomplished as a modification under an FAA supplemental type certificate. Airbus, which is the current type certificate holder for the AS350 models, equips all new AS350 helicopters with Appareo units.

indicator was from 2004. The record stated, “T&B makes noise in headset. Removed T&B to facilitate testing, not able to duplicate problem. Note: T&B is powered from avionics [bus].” The helicopter was signed off and returned to service on November 3, 2004, and no other records or maintenance write-ups regarding the turn-and-bank indicator were found.

A review of the maintenance records revealed incident and inspection findings that included an April 21, 2006, hard-landing accident; a May 13, 2009, main rotor overspeed<sup>26</sup> event; a March 23, 2011, tail rotor pitch change link replacement (due to a suspected crack); and an April 15, 2011, overtorque<sup>27</sup> event.

### 1.3.2 Pilot’s Concerns about Maintenance

A friend of the pilot, who worked for the aviation section as a mechanic from 1988 to 2009, said that during a conversation with the pilot on March 22, 2013, the pilot said that he was “disgusted” with the quality of the maintenance being done on the helicopter. In particular, the pilot expressed his concern that some hoses had not been replaced within the specified time. Another friend of the pilot, who worked for the aviation section as a mechanic from 2004 to 2007, said that the pilot “didn’t have any confidence in the department as far as their ability to properly maintain the helicopter.” According to some of the pilot’s colleagues, the pilot did not have a very good relationship with the helicopter’s lead mechanic and often disagreed with the mechanic about how the maintenance should be performed and how long it should take.

The lead mechanic for the helicopter said that the pilot disliked not being in charge of the helicopter’s maintenance. The mechanic said that he and the pilot did not get along well for several years, but the relationship recently improved. He attributed the improvement, in part, to a complaint that he made to the FAA about the pilot. (The complaint, discussed in section 1.8.3.3, resulted in Alaska DPS disciplinary action against the pilot.) He also attributed the improvement to an agreement in which the pilot was allowed to be responsible for the maintenance recordkeeping for the helicopter.

## 1.4 Meteorological Information

There is no record of the pilot obtaining a weather briefing by calling FSS or accessing the direct user access terminal service.<sup>28</sup> It is unknown what weather information sources the pilot may have accessed before deciding to accept the mission. A former Alaska DPS relief pilot said that the most relevant weather information for the search area that he would have checked were the area forecast (FA) for Cook Inlet and Susitna Valley and the meteorological aerodrome

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<sup>26</sup> Overspeed is a condition in which an engine or rotor system operates at a speed (rpm) greater than the maximum allowable.

<sup>27</sup> Overtorque is a condition in which an engine produces more torque (power) than the maximum allowable.

<sup>28</sup> According to chapter 7-1-4 of the *Aeronautical Information Manual*, an FSS is the primary source for obtaining preflight briefings and inflight weather information. Flight service specialists are authorized to translate and interpret available forecasts and reports directly into terms describing the weather conditions expected along a pilot’s flight route and destination. These include, but are not limited to, reported weather conditions summarized from all available sources (such as meteorological aerodrome reports [METAR], special METARs, and pilot reports), the en route forecast for the proposed route, and the destination forecast for the estimated time of arrival.

reports (METARs) and terminal aerodrome forecast (TAF) for the Talkeetna Airport (TKA) and ANC (the departure airport). TKA was located 5 nautical mi west of the search area (and about 4 mi west of the accident site) at an airport elevation of 358 ft.

The current and former relief pilots for the accident helicopter both said that they typically obtained weather information from the National Weather Service (NWS) Alaska Aviation Weather Unit (AAWU) website<sup>29</sup> and followed up with a call to FSS to speak to a briefer only if they had a concern about the weather. The current relief pilot said that the accident pilot also used the AAWU website. The AAWU website displays links to various weather information products for pilots, including FAs, METARs, and TAFs. Its default homepage displays a map of Alaska with any AIRMET<sup>30</sup> advisory areas highlighted in yellow and SIGMET<sup>31</sup> advisory areas highlighted in red. Hovering the cursor over these highlighted areas produces a popup window displaying the text of an advisory.

#### 1.4.1 Weather Information Available Before Departure

At the time that the pilot received the call about the mission (at 2019), the TAF for TKA issued at 2008 (valid for the 20-hour period beginning at 2000) forecasted a calm wind, visibility greater than 6 mi, light rain, a broken ceiling at 1,000 ft agl, broken clouds at 1,800 ft agl, and overcast skies at 2,800 ft agl. The FA issued at 1745 forecasted scattered clouds at 2,000 ft, scattered to broken clouds at 6,000 ft, broken to scattered clouds at 12,000 ft, and cloud tops to flight level 180.<sup>32</sup> A widely scattered area of broken ceilings at 2,000 ft with light rain showers was forecast. The forecast included isolated light rain and snow showers with visibility down to 4 mi at times. The FA contained no forecasted turbulence, icing, or IFR conditions, and there were no AIRMETs for IFR conditions.<sup>33</sup>

The NWS Office in Anchorage, Alaska, issued the updated Zone Forecast Product at 2015. The information about the search area and accident area had not been updated since 1600, and it forecasted cloudy skies with scattered snow showers. Rain was forecasted to mix with snow during the evening hours with light winds.

The observed weather conditions at TKA reported in the 1953 METAR were wind calm, 10 mi visibility, light rain, a broken ceiling at 1,000 ft agl, broken clouds at 1,800 ft agl, overcast skies at 2,800 ft agl, temperature of 2° C, dew point temperature of 1° C, and an altimeter setting of 30.20 in of mercury (in Hg).

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<sup>29</sup> The AAWU website can be accessed at <http://aawu.arh.noaa.gov>.

<sup>30</sup> An AIRMET is an advisory that includes significant weather phenomena that contain details about IFR, extensive mountain obscuration, turbulence, strong surface winds, icing, and freezing levels. AIRMETs describe conditions at intensities lower than those that require the issuance of a SIGMET.

<sup>31</sup> A SIGMET is an advisory that advises of nonconvective weather that is potentially hazardous to all aircraft. These phenomena include severe icing not associated with thunderstorms, severe or extreme clear air turbulence not associated with thunderstorms, dust storms or sand storms lowering surface visibilities to below 3 mi, volcanic ash, and, in Alaska and Hawaii, tornadoes, lines of thunderstorms, embedded thunderstorms, and hail greater than or equal to 3/4-in diameter.

<sup>32</sup> A flight level is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the international standard pressure datum of 29.92 in of mercury, the average sea-level pressure.

<sup>33</sup> The criteria for IFR conditions are a ceiling below 1,000 ft agl and/or less than 3 mi visibility.

A review of weather radar imagery available at the time that the pilot received the call about the mission showed scattered showers around the Palmer Municipal Airport (PAQ) in Palmer, Alaska (PAQ is located 50 mi south-southeast of the accident site at an elevation of 242 ft), and the Wasilla Airport in Wasilla, Alaska. The imagery depicted these showers as moving northward (toward TKA).

#### **1.4.2 Weather and Lighting Conditions at Accident Site and Time**

The accident occurred at 2320. Observed weather conditions at TKA reported in the 2253 METAR were wind calm, 6 mi visibility, light rain and mist, few clouds at 500 ft agl, a broken ceiling at 1,500 ft agl, overcast skies at 2,400 ft agl, temperature of 1° C, dew point temperature of 1° C, and an altimeter setting of 30.22 in Hg. The observed weather conditions at TKA reported in the 2312 METAR were wind calm, 7 mi visibility, light snow, a broken ceiling at 900 ft agl, broken skies at 1,300 ft agl, overcast skies at 2,400 ft agl, temperature of 1° C, dew point temperature of 1° C, and an altimeter setting of 30.22 in Hg. The remarks stated that unknown precipitation began at 2310 and ended at 2312 and that snow began at 2312.

The NWS Surface Analysis Chart for 0100 on March 31, 2013, depicted a stationary front north of the Alaska Range that stretched west to east into northwest Canada. The station models around the accident site depicted temperature-dew point spreads of 4° F or less, light and variable winds, cloudy skies, and light snow.

A review of weather radar imagery showed a line of echoes extending from PAQ to TKA around the time of the accident. The imagery depicted this line of showers as moving northward from PAQ (which had earlier surface reports of precipitation) through TKA and the accident site around the time of the accident.

A witness, who regularly makes “go/no-go” decisions for SAR operations for the National Park Service, was located 3 mi west of the accident site. He reported that the clouds began lowering around 2020, with light rain mixed with sleet at times, and about 10 mi visibility. He was located inside until 2300, when he walked to his vehicle and noticed that it was raining with a temperature of 34° F reported on his vehicle. This witness began driving home in the rain when it began to snow so heavily that he had to turn off his bright lights so that he could see. He continued to drive and arrived at his home, located about 5 mi southwest of the accident site, about 2315, and the heavy snow continued. Two witnesses 10 mi southwest of Larson Lake reported a mix of rain and sleet with the temperature around freezing when the accident helicopter flew overhead around 2130. One of those witnesses reported a changeover to snow between 2130 and 2300 with the snow coming down like a “son of a gun.” This witness reported 4 in of new snow at 1,700 ft the next morning. A witness 2 mi northeast of Larson Lake reported light freezing drizzle and rain around 2200 with 1 in of fresh “crusted up” snow around their property the next morning.

Sunset was at 2043, the end of civil twilight was at 2130, and moonrise occurred the following morning at 0104. According to the FAA, night VFR lighting conditions can be classified as “high level” or “low level.” Low-level lighting conditions are present when clouds cover at least 5/8 of the sky, the moon is below the horizon, or the moon is less than 50% illuminated, and little significant cultural or reflected cultural lighting is present.

The TAF for TKA issued at 2137 (valid for the 24-hour period beginning at 2200) forecasted a calm wind, visibility greater than 6 mi, a broken ceiling at 900 ft agl, broken clouds at 4,500 ft agl, and overcast skies at 6,000 ft agl. These forecasted IFR conditions were not referenced in an AIRMET or an updated FA. (Typically, TAFs and FAs are consistent with each other with regard to references to IFR conditions. During other accident investigations, the NTSB noticed inconsistencies among other weather information products and issued safety recommendations to address these issues. These recommendations are discussed in section 1.9.3.)

## 1.5 Cockpit Image, Audio, and Data Recorder

The helicopter's Appareo Systems Vision 1000 cockpit imaging and flight data monitoring device was mounted on the cockpit ceiling. The self-contained unit is designed to record cockpit images and two-track audio, and it has a GPS receiver for satellite-based time, position, altitude, and groundspeed information. It also has a self-contained real-time inertial measuring unit that provides three-axis accelerations as well as aircraft pitch, roll, and yaw data.<sup>34</sup> The unit recovered from the accident helicopter showed damage on the exterior case and power connector (see figure 6). The removable memory card was undamaged, and its data were downloaded. Recovered data included about 2 hours of image and audio data and about 100 hours of parametric data.

Review of the data revealed that no external audio source (such as the helicopter's intercom or radios) was connected to audio track "one" for recording (which is an optional audio link referred to by Appareo as the "ICS," or "Intercom System"). Audio track "two" recorded sound from the unit's internal microphone, which captured only loud helicopter engine/transmission sounds and no intelligible voices. Review of the data also revealed that the unit's internal attitude data were subject to inaccuracies.<sup>35</sup> The recorded images captured a view of the cockpit from behind the pilot looking forward. Some navigation and system instruments and displays, the helicopter's master caution warning panel, a partial view out the cockpit windscreen, and some of the pilot's left arm and head motions (the pilot was seated in the right seat) were visible at times.

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<sup>34</sup> The helicopter was not required to be equipped with a cockpit voice recorder or flight data recorder. The optional device was not required to comply with TSO C197, "Information Collection and Monitoring Systems."

<sup>35</sup> The investigation found that the unit was not properly configured when it was installed. The Appareo Systems Vision 1000 installation instructions (revision dated October 22, 2010) did not contain instructions for configuring the unit; configuration instructions were contained in a separate publication. Appareo has since issued revised installation instructions (dated October 29, 2013) that contain a section dedicated to configuring the unit.



**Figure 6.** Appareo Vision 1000 unit from the accident helicopter.

Images from the flight from ANC to the remote rescue location (via the Sunshine site) showed that, before departure from ANC, the pilot adjusted the Avalex display brightness down, changed the type of map it displayed from a street map to a topographic map, and changed the map orientation from “north up” to “track up.” The imagery showed that the helicopter’s turn-and-bank indicator was not operating during the outbound flight from ANC or during the accident flight. During the flight from ANC to the Sunshine site, the pilot raised, lowered, and adjusted his NVGs several times. He lowered them before landing and used them during landing at the Sunshine site. The pilot did not shut down the helicopter while at the Sunshine site. The flight observer, who did not use NVGs, boarded and sat in the left seat, and the flight departed. The pilot used the NVGs during liftoff from the Sunshine site and during landing at the remote rescue location.



Images for the accident flight showed that, before takeoff from the frozen pond, the pilot turned on the “lip light”<sup>36</sup> attached to his helmet and kept it on during the entire flight. The light cast an area of illumination about 1 ft in diameter that moved when the pilot moved his head. The light at times illuminated parts of the helicopter’s instrument panel and flight controls. The pilot also made inputs to the Garmin 296 unit, which displayed a track-up map and a magenta course line that extended to the southwest, consistent with a direct route to Sunshine. The Avalex display powered up and displayed a north-up street map. As the helicopter lifted off from the frozen pond, no blowing snow was visible and, once the helicopter left the ground, no outside lights or ground references were seen by the Appareo unit for the remainder of the flight. The helicopter’s master caution warning panel and engine instruments (including the first limit indicator [FLI], which displays engine power information) are visible at times. No warning or caution lights from the helicopter’s master caution warning panel and no abnormal engine instrument readings appear.

Table 2 summarizes some of the navigational instrument readings and other information obtained from reviewing the imagery from the accident flight. Some pitch indications on the attitude indicator are approximate. Pitch indications higher than about 17° could not be accurately measured due to a combination of low image resolution, the dark night condition, shadows, and the construction of the instrument.

**Table 2.** Summary of select information from Appareo images.

Time	Altimeter (barometric)	Airspeed indicator	Comments
2310:19			Start of engine
2310:44			Avalex display is powering up
2310:54			Garmin entry screen is acknowledged
2310:57			Pilot selecting entry on Garmin 296
2312:11			Garmin 296 display changes to track heading screen
2312:45			Avalex display unit comes up in street map mode - north up orientation
2312:47	400 ft	0 kts	Attitude indicator shows 0° pitch, 0° roll, aircraft level line set at 0° pitch, vertical speed is 0 ft per min (fpm), turn indicator is at zero (where it remains for the entire flight)
2313:00			Helicopter is lifting off surface, no blowing snow, only light is from red position light, once aircraft leaves ground, no outside lights or ground references are seen during remainder of flight
2313:08			Garmin 296 display is showing a magenta course line about 30° to the right of the helicopter’s heading of 180°
2313:16			Pilot with NVG in down position

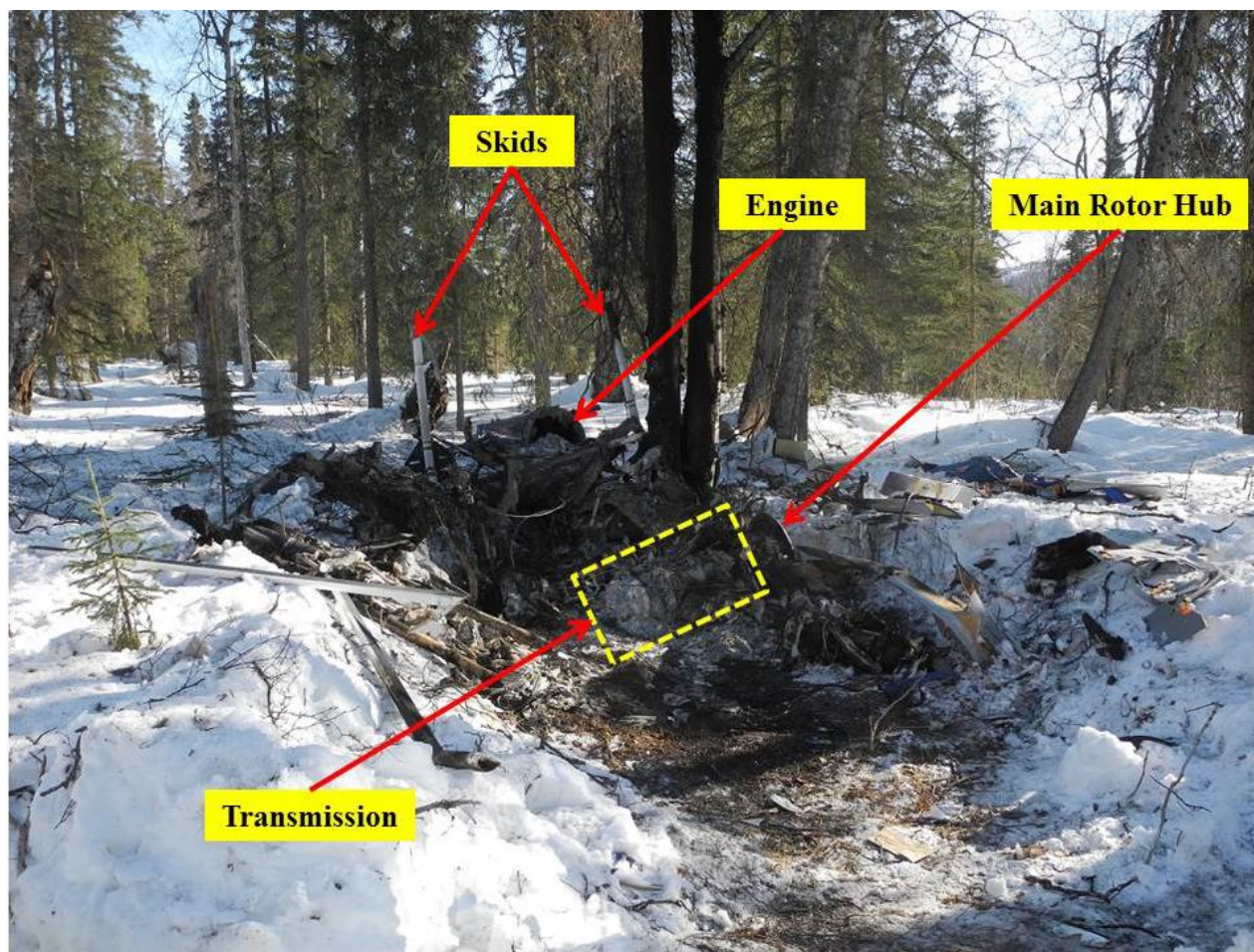
<sup>36</sup> The pilot’s lip light consisted of a row of several LED bulbs embedded in plastic and attached to the pilot’s boom microphone with a button on the back of the unit that the pilot could toggle on or off with his mouth. According to other DPS helicopter pilots, the lip light helps a pilot see cockpit instrumentation and controls. When using NVGs, the pilot could look through the NVG binoculars to see outside and could look below them to view the cockpit instruments.

Time	Altimeter (barometric)	Airspeed indicator	Comments
2314:40			Helicopter starts left turn off of GPS track, 500 fpm climb, 20° left roll, 300 ft radio altimeter
2315:17	800 ft	20 kts	7° right roll, 150 ft radio altimeter
2317:23	1,050 ft	40 kts	Level attitude, 300 fpm climb, 200 ft radio altimeter, on Garmin 296 course
2317:29			Two fingers from left seat observer are seen in front of Avalex screen (no buttons were pushed), 2.5° left roll, 0° pitch
2317:56			0° roll, 0° pitch, 15 knots indicated airspeed, 950 fpm climb, 450 ft radio altimeter, 9.5 FLI, 1,250 ft altimeter, Garmin 296 course line not visible
2318:02		10 kts	2.5° left roll, 5° up pitch, 1,400 ft altimeter, 1,000 fpm climb, 600-700 ft radio altimeter, 9.1 FLI
2318:07	1,410 ft	0 kts	Pilot's left hand is visible adjusting CDI indicator, nav red flag is visible, 1,100 fpm climb, 2.5° right roll, 5° up pitch
2318:12	1,510 ft	0 kts	0° roll, 7.5° up pitch, 1,200 fpm climb, 550 ft radio altimeter, 10 FLI, T4 (turbine outlet/exhaust gas temperature) yellow underline, torque underline in yellow
2318:17	1,620 ft	0 kts	7.5° right roll, 10° up pitch, 900 ft radio altimeter, 1,200 fpm climb, 10 FLI, T4 yellow underline, torque underline in yellow
2318:20	1,700 ft	0 kts	5° right roll, 12.5° up pitch, 1,000 fpm climb, 10 FLI, 900 ft radio altimeter, Garmin 296 course line back in view
2318:21		0 kts	5° right roll, 12.5° up pitch, 900 fpm climb, 7.8 FLI
2318:24			Left seat observer pointing at Avalex display, 15° right roll, 12.5° up pitch
2318:27			12.5° right roll, 17.5° up pitch
2318:28			Pitch exceeds 17.5° from this time until 2318:40.
2318:40		0 kts	Pilot cages the attitude indicator, 0° pitch, 0° roll, 800 fpm climb, 9 FLI
2318:43	1,800 ft		0° pitch, 20° left roll, 0 fpm vertical speed, 9.5 FLI
2319:06	1,790 ft	0 kts	85° right roll, 0° pitch, 500 fpm climb, 8 FLI,
2319:33	1,550 ft	0 kts	0° pitch, 30° right roll, 800 ft radio altimeter, 200 fpm descent, 7 FLI
2319:35	1,500 ft	0 kts	85° right roll, 0 fpm vertical speed, 7.5 FLI
2319:43			Attitude indicator tumbled
2319:48	1,500 ft	0 kts	30° left roll, 10° up pitch, 7 FLI, 0 fpm vertical speed, 600 ft radio altimeter
2319:48	1,500 ft	0 kts	30° right roll, 10° up pitch, 0 fpm vertical speed, 500 ft radio altimeter, 7.3 FLI, no warning/caution lights
2320:02			End of recording

## 1.6 Wreckage and Impact Information

The helicopter was found on snow-covered, wooded terrain (see figure 7). The helicopter was destroyed by impact forces and postcrash fire, and the ELT showed impact and fire damage. The initial ground impact site was about 3 ft before the beginning of the wreckage debris field, and the debris path measured about 75 ft long on a magnetic heading of 029°, which was also the flightpath direction (in-line with the tree damage). A tree near the initial impact site exhibited strikes with about a 60° angle (relative to the horizon and along the flightpath direction). The tree branch ends were smooth and even.

The entire helicopter was accounted for at the crash site. The helicopter came to rest inverted with the landing gear and tailboom forward of the main debris area. Fragments outside the main debris crater were not fire damaged and had no soot streaks. The center section of the fuselage was largely missing, with the main transmission case predominately consumed by fire. The main transmission gears showed evidence of postcrash fire and did not exhibit missing gear teeth, galled areas, or other evidence of mechanical malfunction.



**Figure 7.** Accident site showing main wreckage.

Fragments of the cyclic, collective, and yaw controls were found loose in the debris. Continuity could not be established due to the breaks in the system and missing portions of the push-pull tubes; however, some breaks were matched and examined for evidence of malfunction or failure. None was found. The breaks were examined and exhibited characteristics consistent with overload fractures and melting. The damage to the flight control system was consistent with ground impact and exposure to postimpact fire. The red, yellow, and blue main rotor blade hub ends remained attached to the hub. The main rotor blades were broken, mostly thermally consumed, and the spars were bent and twisted.

The tailboom was separated from the fuselage near the forward bulkhead, and the tail rotor driveshaft was fractured at the junction of the tailboom and fuselage. Tail rotor control and drive continuity were established from the tailboom separation at the fuselage to the flange of the tail rotor gearbox drive coupling.

The engine was found upside down covered by the engine deck and in the proper orientation to the tailboom (also upside down). The rear engine mount was broken away from the engine, and the front engine mount was still connected to the coupling tube. The transmission shaft was inside the coupling tube, and the engine side flexible coupling group was relatively undamaged with the transmission side showing rotation and tension splaying. The tail rotor drive flexible coupling displayed rotational splaying. The freewheel shaft functionality was verified to be correct.

The reduction gearbox was removed in the field for inspection of the input pinion slippage mark. The slippage mark was offset in the torqueing (tightening direction) about 0.10 in, which is consistent with significant power at the time the main rotor system struck the ground and stopped.

## **1.7 Medical and Pathological Information**

Autopsy reports provided by the State of Alaska Medical Examiner's Office concluded that the cause of death for each occupant was "blunt force and thermal injuries sustained during a helicopter crash."

The FAA's Civil Aerospace Medical Institute performed toxicology testing on samples from the pilot. The report indicated that no ethanol or drugs were detected in the samples tested.

## **1.8 Organizational and Management Information**

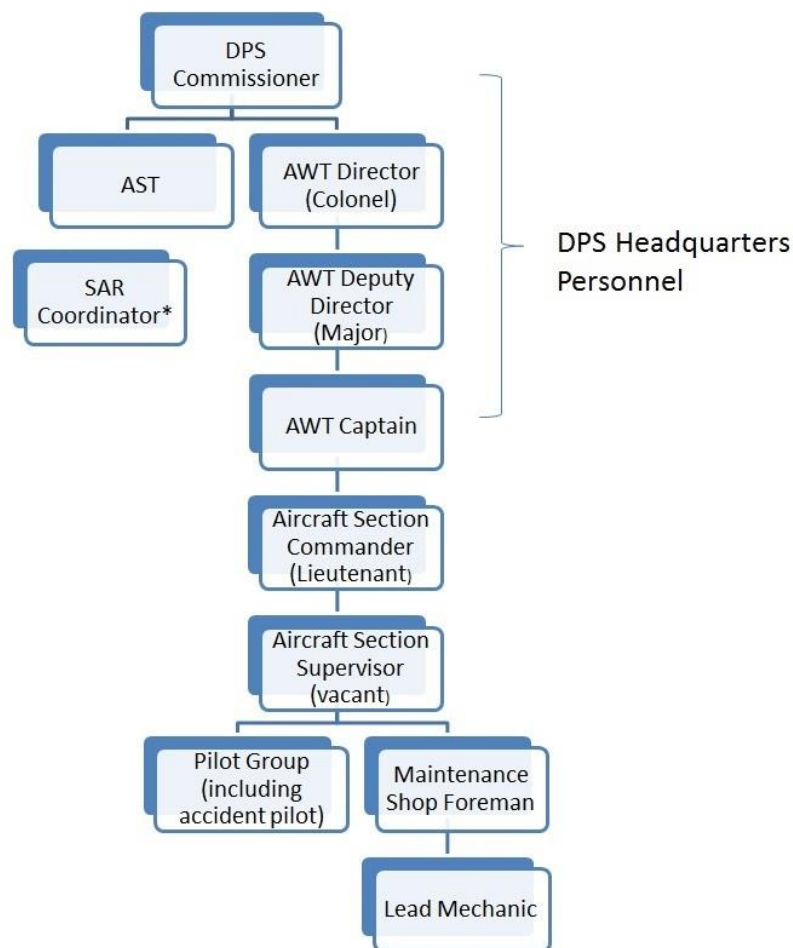
### **1.8.1 General**

The Alaska DPS aircraft section is a specialized unit of AWT responsible for maintaining the department-owned aircraft fleet and for providing training to all department pilots, the majority of whom are commissioned troopers. At the time of the accident, the DPS fleet included 38 airplanes and 4 helicopters (3 Robinson R-44s and the accident helicopter), and the aircraft section had an assigned staff of 13 people consisting of 6 mechanics, 3 pilots, 2 administrative assistants, the aircraft section supervisor, and the aircraft section commander. All aircraft section

staff members had offices in the aircraft section’s hangar located in Anchorage. The aircraft section supervisor’s position was vacant due to the March 8, 2013, retirement of the person who held that job.

Each of the department’s aircraft is assigned to a particular AST or AWT section, and it is considered to be an asset of that section, not of the aircraft section. The aircraft section directly employs civilian pilots (such as the accident pilot) whose primary job functions are to operate aircraft and provide flight training. When a trooper is designated as a pilot, their pilot duties are performed in addition to their regular trooper duties, and that trooper remains assigned to their detachment and is supervised by the detachment chain of command.

Figure 8 illustrates the chain of command structure that was in place at the time of the accident, based on interviews with DPS personnel.



**Figure 8.** Chain of command structure in place at the time of the accident. (\*Note: Although the SAR coordinator is part of the AST, the AST chain of command personnel are omitted because they are not discussed in this report.)

The aircraft section commander (lieutenant) said that the captain and major were not pilots and that the AWT director was a pilot. He said that “generally he was able to go directly”

to the AWT director, who made “a lot of the ultimate decisions.” He said that his position had been created by the AWT director in August 2011 and that his function was to act as a liaison between the aircraft section supervisor, who was a civilian, and the commissioned troopers. He provided direction to the aircraft section supervisor who “ran the business” and oversaw the aircraft section mechanics and administrative staff. Before the aircraft section commander joined the aircraft section, the aircraft section supervisor would ask the AWT director for guidance “when troopers in the field had questions about needing maintenance or an airplane or something”; after the aircraft section commander came on board, he responded to troopers’ questions instead of the aircraft section supervisor asking the AWT director. Since the aircraft section supervisor retired, the aircraft section commander had been filling that position as well as his own. He said that he was planning to retire on September 27, 2013.

The recently retired aircraft section supervisor, who held the position from August 24, 2009, to March 8, 2013, said that she initially reported to the captain, then she reported to the AWT director, and beginning in 2012 she reported to the aircraft section commander. She said that she supervised the maintenance shop foreman, three pilots, and the administrative assistant; the maintenance shop foreman supervised five mechanics, and the administrative assistant supervised the office assistant. The recently retired aircraft section supervisor explained that she was listed as the pilot’s supervisor, but “in reality” he was supervised by the AST SAR coordinator, and she was not involved in any of his flights. The SAR coordinator contacted the pilot directly regarding SAR missions. The aircraft section supervisor was responsible for approving the pilot’s time cards and writing his performance appraisals, and she was involved if he needed to purchase equipment for the helicopter.

According to the department’s aircraft operations manual, the aircraft section supervisor is responsible for the content and currency of the manual. The recently retired aircraft section supervisor stated that her position “[did]n’t have any authority.” She explained that some of the position’s duties are specified in the department’s aircraft operations manual, but that, in reality, headquarters would direct or make the decisions. She said that if she made decisions the aircraft section staff did not like, they would just bypass her to consult headquarters.

According to NTSB records, the Alaska DPS had 18 previous accidents that occurred between July 1, 1999, and June 30, 2012. One accident was fatal, one resulted in a minor injury, and 16 involved substantial aircraft damage but resulted in no injuries.

## **1.8.2 Aircraft Section Policies and Procedures**

### **1.8.2.1 Operational Control and Go/No-Go Decisions**

The Alaska DPS aircraft operations manual did not include requirements for anyone other than the pilot to be involved in flight planning, risk analysis, and decision-making responsibilities. The manual chapter titled “Pilot Responsibility and Authority” stated, in part, “in preparation for every flight, pilots will evaluate aircraft performance, route of flight information, and weather conditions in the context of their own abilities and experience and base mission decisions on a totality of the information available to them.” Further, this section stated

that “the PIC is responsible for the safe operation of the aircraft and is the ultimate decision maker with regard to the conduct of the flight.”

The aircraft section commander said that the “ultimate responsibility” to go or not to go on a flight rested with the pilot. He said that he had told the pilots during seminars and other discussions, “if you don’t feel like going, for whatever your reasons, maybe it’s below minimums for weather, or other conditions...then don’t go on the flight.” He said that during his 25-year career with DPS he had never seen any supervisor push back if a pilot decided not to go on a flight. The relief pilot and a former relief pilot for the accident helicopter reported that they did not feel pressed to fly, but two other former DPS personnel recalled one instance in 2009 in which a pilot was pressured to fly.<sup>37</sup>

The aircraft section commander said that the pilot did not normally call him when he launched on a SAR mission and that many times, if a launch occurred on the weekend, he would not know until the following Monday when he came to work that there had been a flight. He said that the pilot did not need to obtain his permission to fly because he did not have control over the helicopter. He explained that the helicopter was an AST asset and that the “go-to person” for requesting it was the AST SAR coordinator.

The AST SAR coordinator explained that his job was to act as a central point of contact for everything having to do with the resources that a trooper needed to conduct a SAR operation, including aircraft, equipment, and volunteers. He said that, at the time of the accident, he and two other people were taking turns as the on-call SAR coordinator after hours and on weekends and holidays and that he was not on call the night of the accident. His normal procedure when he received a request for assistance from a trooper was to evaluate whether sending the helicopter would be the best tool for the job. If that was the case, he would call a pilot and ask him to evaluate the weather, the location, and other factors to determine whether he could go or not. He said that he relied on the pilots to determine whether or not they could safely accept the mission and that “there was absolutely no pressure whatsoever” on pilots to accept a mission.

### **1.8.2.2 Flight and Duty Time Policies**

The Alaska DPS aircraft operations manual stated that, for a single pilot, the maximum duty period was limited to 12 hours, the maximum flight time within the duty period was limited to 8 hours, and the rest period was 10 hours. During emergencies, which included SAR operations, an extension of the maximum duty period to 15 hours, the maximum flight time within the duty period to 10 hours, and the rest period to 12 hours was allowed with “the approval of a DPS supervisor who is or has been a pilot and who can assess the need as well as the pilot’s personal condition at the time.”

The recently retired aircraft section supervisor said that the pilots tracked their own time and that they were “very good” about tracking it. When she first started, the accident pilot called her a couple of times to let her know that he was going to exceed his duty time limit but then he

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<sup>37</sup> Two former Alaska DPS personnel described an event in 2009 in which the AWT director pressured a fixed-wing pilot to accept a flight in weather conditions that the pilot felt were potentially unsafe. The pilot completed the flight without incident.

stopped, and she believed he was instead calling the colonel (AWT director). The AWT director recalled that the pilot called him “a couple of times” to ask for an extension of his maximum flight or duty time, as permitted by the Alaska DPS aircraft operations manual.

The aircraft section commander was unfamiliar with the details of the section’s flight and duty time policy. When asked whether the AST SAR coordinator monitored the accident pilot’s flight and duty time, he said “no” and added that “we leave almost all of that up to the pilot to know to follow.” He said that the pilot was familiar with the policy because he had brought the limits to his attention on several occasions. He said the pilot was “quite aware of the policy,” and he followed it.

### **1.8.2.3 Preflight Risk Assessment and Weather Minimums**

The Alaska DPS aircraft operations manual did not include a preflight risk assessment procedure. The recently retired aircraft section supervisor said that she was in the initial stages of developing a risk assessment procedure for the section when she retired. She had obtained a form that looked like it could be modified to meet their needs, and she had discussed with the aircraft section commander trying it out with the aircraft section pilots. She stated that the accident pilot had vigorously objected to the proposed implementation of this procedure because he thought that only the SAR pilot should be able to turn down a SAR mission.

The manual did not specify any weather minimums for the operation of DPS aircraft other than the applicable FAA requirements. The aircraft section commander said that pilots’ minimums depended on their experience. Alaska DPS policy indicated that any change had to be approved in writing by the aircraft section supervisor. The most recent Alaska DPS Flight Authorizations/Limitations form for the pilot was completed in 2003, shortly after he was hired. As discussed in section 1.2.1.1, it stated that the pilot’s night VFR NVG weather minimums were a 500-ft ceiling and 2-mi visibility. The aircraft section commander stated, however, that by the time of the accident, the pilot was expected only to comply with FAA weather minimums, which did not require any minimum visibility or cloud clearance below 1,200 ft agl in class G airspace.<sup>38</sup> However, there was no record of this change in the pilot’s file. The recently retired aircraft section supervisor said the same but also stated that the pilot used his own personal weather minimums. In a 2009 e-mail, the pilot wrote a colleague that his personal minimums for NVG operations at night were a 200-ft ceiling and 5-mi visibility.<sup>39</sup>

### **1.8.2.4 Safety Program**

The recently retired aircraft section supervisor told investigators that the AWT captain in the aircraft section’s chain of command asked her to get DPS involved in the Medallion

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<sup>38</sup> Title 14 CFR 91.155 specifies that, within 1,200 ft of the surface, “A helicopter may be operated clear of clouds if operated at a speed that allows the pilot adequate opportunity to see any air traffic or obstruction in time to avoid a collision.”

<sup>39</sup> In the same e-mail, the pilot wrote, “Please note 7.06 NVG Operational Limitations, dated 3/12/07, gives no specific limitation other than slowing down for the weather condition during the flight. In addition, you must have sufficient ambient light (lums) to continue with flight.”



Foundation,<sup>40</sup> and, beginning in 2010, she worked to develop Alaska DPS's safety management system (SMS).<sup>41</sup> This effort included the development of a hazard reporting system, safety committee, and other safety mechanisms that enabled DPS to earn one of the Medallion Foundation's five stars, the safety star.<sup>42</sup> To pass the Medallion Foundation audit for the safety star, Alaska DPS was required to have various safety policy components in place, including procedures for safety reporting, hazard identification, risk assessment, safety committees, and internal safety auditing. The hazard reporting system was designed to allow employees in all departments to report accidents, incidents, and injuries and to make suggestions or voice concerns. The reporting system was to be nonpunitive with an anonymous reporting option, and reported hazards were to be evaluated for risk by a formal safety committee that met on a regular schedule to use the information to make safety improvements.

In addition, the program was required to have a full or part-time safety manager with the authority necessary to run the program and a direct report to a high-level manager who was held accountable for safety performance. Interviews with DPS personnel indicated that all of these elements were in place when the organization passed its initial Medallion Foundation audit in January 2012 and followup audit in July 2012.

However, the recently retired aircraft section supervisor stated that the safety program lacked high-level Alaska DPS support and, as a result, there was a lack of Alaska DPS pilot confidence and participation in the program. She said that she had only received "a couple" of pilot reports involving aircraft operations and that most of the reported issues had involved safety hazards located in or near the aircraft hangar. In addition, she stated that the section did not have enough money for training and that, in 2012, headquarters canceled the annual 3-day pilot safety seminar because of a lack of funds. She said that she thought that it was important to have the seminar every year because it was the only time when about 40 trooper pilots were brought together from their stations around the state to receive information about safety issues.

Further, in 2012, her chain of command changed such that instead of reporting to the colonel who was the AWT director (a high-ranking manager), she reported to the lieutenant who

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<sup>40</sup> The Medallion Foundation was formed by the Alaska Air Carriers Association in 2001 as a nonprofit organization for the purposes of improving pilot safety awareness and reducing air carrier insurance rates. The organization's stated mission is to reduce aviation accidents by fostering a proactive safety culture and promoting higher safety standards through one-on-one mentoring, research, education, training, auditing, and advocacy.

<sup>41</sup> According to International Civil Aviation Organization and FAA guidance materials, a comprehensive SMS program should contain four major components: safety policy, safety risk management, safety assurance, and safety promotion. Safety policy defines the policies, procedures, resources, and organizational structures that provide a foundation for the program's functional elements. Safety risk management is a formal system for identifying hazards and managing related risks. Safety assurance is a process for evaluating the effectiveness of existing risk controls. Safety promotion involves the promotion of safety as a core value and the development of an organizational culture that is conducive to safety management.

<sup>42</sup> The Medallion Foundation describes its Five Star/Shield Program for aircraft operators as "a step-by-step approach to building an [SMS] by providing program and process guidelines, specific training classes, one-on-one company mentoring and auditing to determine if the applicant meets the specific program requirements." To earn the safety star, an operator is required to have implemented a safety program with commitment from top management that includes a nonpunitive and anonymous safety reporting system, an emergency response plan, a safety committee, and a viable safety information collection and distribution system. (See the Medallion Foundation website at <http://medallionfoundation.org>.)

served as the aircraft section commander, a lower-ranking new position. She said that this change undermined her influence as safety manager and that trooper pilots and middle managers felt comfortable ignoring the safety policies that she had attempted to put in place. When she made a decision staff disagreed with, they would just go around her and appeal directly to headquarters. She said that she decided to leave the organization after an AST supervisor directed a pilot to fly an airplane that had been repaired by someone other than a qualified mechanic.

She said that she assumed that the aircraft section commander would take over as the manager of the safety program when she left. However, the aircraft section commander said that he was not well versed in the former aircraft section supervisor's activities in her role as safety manager, and that, since she left, he had not "been able to keep up with all that stuff." A safety policy statement posted in the main hangar that was signed by the AWT director stated, "A safety manager who is experienced in safety programs will be appointed and will have the responsibility and authority to manage the Alaska DPS aviation safety program. The safety manager should be contacted in regards to any questions or recommendations."

Three months after the aircraft section supervisor retired, no safety manager had been formally appointed, and no safety committee meetings had been held. The AWT director said that he realized that the civilian aircraft section supervisor ran the aircraft section safety program, but, when she retired in March 2013, he delayed selecting her replacement because he was retiring in May 2013 and wanted to allow his replacement to select the new aircraft section supervisor to help facilitate any necessary operational changes.

### **1.8.3 Response to Pilot's Previous Accident and Events**

#### **1.8.3.1 Accident in 2006**

Following the pilot's accident in 2006, the AWT director appointed an Aircraft Accident Review Board that conducted an internal investigation separate from the NTSB's. The review board, which consisted of an AWT captain, the aircraft section supervisor, the former relief pilot for the helicopter, and another AWT helicopter pilot (who later became the relief pilot), met on April 28, 2006. A memorandum dated May 2, 2006, that documented the review board's investigation included the following "aggravating factors," among others:

- The pilot was aware of the blowing snow, low visibility condition before takeoff.
- The pilot depended on a visual reference by using the edge of the lake.
- The pilot did not execute an instrument takeoff when confronted with a blowing snow condition and choose to hover and use a reference point.
- The pilot had worked for 18 days straight without a day off.

The memorandum stated:

The direct cause of the incident was the pilot's loss of visual reference with the ground while taking off. ...The loss of visual reference was a direct result of blowing snow caused from the rotor downwash as power was applied during takeoff. The pilot's landing site selection; positioning of the helicopter on landing;

choice of VFR departure vs. an IFR instrument departure under the existing weather conditions when linked together led to this incident. Based upon the evidence presented it is this board's determination that the incident was a result of pilot error.

Under the heading "Recommendations," the memorandum stated, in part, that "an instrument departure under the weather conditions and night operations would have been prudent." Also, it stated that "[t]he intent of this board is not to provide any disciplinary action on the employee, [the pilot], but rather to suggest avenues for him to return to flight status for the Department."

On May 2, 2006, the pilot successfully completed an Alaska DPS postaccident evaluation check flight in a Robinson R-44. The check airman was one of the Alaska DPS pilots who had given the pilot his initial NVG training in 2003.<sup>43</sup> On the form used to document the check flight, the flight time was listed as 0.3 hour, and the remarks section of the form stated, "although no blowing snow conditions were present, techniques used for blowing snow operations were discussed and evaluated. Recommend continued status as PIC." As noted in section 1.2.1.3, the pilot also successfully completed the FAA-requested checkride on May 15, 2006.

A memorandum dated August 29, 2006, with the subject, "Memorandum of Warning," addressed to the pilot from the highest ranking member of the Aircraft Accident Review Board, discussed the board's findings. The memorandum stated, in part, that "the cause of the incident was due to pilot error. Specifically your momentary distraction within the cockpit from your instruments during the departure and the inability to transition from instrument to VFR flight resulted in a momentary loss of aircraft control."

Further, the memorandum stated that "the damage to the aircraft was significant," and "the cost and impact on the department being without its search and rescue helicopter...was also significant." The memorandum stated, "...[you] are hereby warned. Any future occurrence of a similar incident may result in more severe disciplinary action." The memorandum also noted that "the fact that you took responsibility for the accident and showed great remorse weighs heavily in how the department views this incident."

The pilot's performance evaluation report dated January 23, 2007, included the following statement with regard to the accident:

Although the accident caused damage to the helicopter which has since been repaired, no one was injured and both the Aircraft Section and [the pilot] learned some very valuable lessons. His cooperation during the investigation allowed the Alaska DPS to make significant changes to the aircraft operations manual and address in the open the challenges that fatigue places upon flight crew during extreme operational demand periods. The [manual] now provides clear guidance for all flight crews on duty day and flight duty limitations aimed at making aircraft section flight operations safer.

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<sup>43</sup> The check airman was also one of the members of the Aircraft Accident Review Board.

### 1.8.3.2 Engine and Rotor Overspeed Event in 2009

The pilot was landing the accident helicopter at ANC on May 13, 2009, when an engine and rotor overspeed occurred.<sup>44</sup> The former relief pilot suspected that the pilot had initiated the event by moving the collective in an aggressive manner, and the AWT director requested that an AST captain investigate the event. According to the report of the investigation prepared by the AST captain, the pilot stated that he was attempting to land the helicopter on its ground cart when the helicopter bounced slightly, and the pilot increased collective pitch to lift the helicopter off the cart. The pilot told the AST captain that he did not move the collective in an aggressive manner when landing on the cart.

The engine was removed and sent to Turbomeca for overspeed inspection and repair. The Turbomeca report of the inspection indicated that the fuel metering needle had frozen in position, and its findings noted corrosion contamination on the metering needle assembly and other components, as well as wear on other components. The Turbomeca report concluded that it was “probable that a combination of the findings observed led to the reported event.”

The “Conclusion” section of the Alaska DPS investigation report stated, in part, “the final cause of the overspeed, based on the available information, is inconclusive.” According to the Alaska DPS report, on the day of the incident, the pilot started work at 0800, had been on duty for 12 hours when the event occurred, and had flown the helicopter 5.8 hours that day.

When interviewed by NTSB investigators, the AWT director recalled the overspeed event and said that “ultimately it wasn’t determined that it was pilot error or a mechanical issue. It was unclear.” The AWT director also said that another event involving the pilot occurred around the same time as the overspeed event. In the other event, the pilot was flying a Robinson R-44 helicopter, and the tail rotor “may or may not” have struck water during a water landing.<sup>45</sup> The AWT director said that the pilot denied that a water strike occurred. The AWT director also mentioned the pilot’s 2006 accident and said that when the pilot was asked about any of these events, “it was never his fault.” He said that there was nothing he could do to “take sanctions” against the pilot without some reliable information to refute the pilot’s statements. The combination of the overspeed and the R-44 events prompted the AWT director to ask the aircraft section supervisor to research onboard monitoring equipment that could be installed in the accident helicopter to monitor the pilot’s actions. Once the AWT director learned of the Appareo system, he had it purchased and installed.

The AMRG observer stated that the pilot was “always worried” about losing his job. He said that the pilot told him he thought he was going to be fired after the 2006 accident and that he was being blamed for damaging the helicopter after the 2009 overspeed event. The pilot’s spouse stated that the pilot “fought tooth and nail” to be exonerated of the event. According to the lead mechanic and others, the pilot felt that everybody in the organization was against him.

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<sup>44</sup> This event was not investigated by the NTSB.

<sup>45</sup> According to the Alaska DPS maintenance shop foreman, the Robinson R-44 sustained damage on the tail rotor assembly that a manufacturer’s technical representative stated was consistent with a water strike. Inspection of the tail rotor assembly by a manufacturer’s technical representative following a flight by the pilot indicated that the damage could have resulted from a water strike.

### 1.8.3.3 Overtorque Event in 2011

The pilot was conducting an external load operation in the accident helicopter at Lake George, Alaska, about 1630 Alaska daylight time on April 15, 2011, when an overtorque condition occurred.<sup>46</sup> In a written statement dated May 9, 2011, the pilot said that the purpose of the flight was to recover a Piper PA-18 from a frozen lake using a sling and long-line. The pilot's statement said that, while the airplane was suspended beneath the helicopter, wind buffeted the helicopter, which led him "to use more pedal, which robbed additional power from the main rotor causing a momentary settling." The pilot said that he reacted to the settling by increasing collective and that this induced an overtorque event. After the pilot finished moving the airplane, he checked the vehicle and engine multifunction display and found that it had recorded an overtorque spike of 107% for 1 second. He performed an inspection of the rotor head and transmission support arms, found no damage, and signed off the inspection on the helicopter's log sheet for the day.

The pilot did not inform the helicopter's lead mechanic or the aircraft section supervisor about the event. Maintenance personnel later saw the pilot's signoff on the inspection sheet, and the lead mechanic reported the discrepancy to the FAA, which sent inspectors to examine the maintenance records.<sup>47</sup> Although the AWT asked the aircraft section to review the Appareo data for the overtorque event, section staff discovered that the data card was not formatted and that no data had been recorded during the flight.

A memorandum dated May 5, 2011, from the aircraft section supervisor to the pilot addressed the overtorque incident stating, in part, the following:

The over-torque condition necessitated a manufacturer-required inspection of the aircraft. You hold [an FAA] airframe & powerplant license and conducted this inspection yourself. After you inspected the aircraft, you failed to ensure that the incident was properly reported. ....

It was not until 04/27/11, that Aircraft Section maintenance staff was made aware of the over-torque due to the discovery of the over-torque inspection documentation in the aircraft logbook by an FAA inspector, and not until 04/28/2011, that I, as your immediate supervisor, was notified.

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<sup>46</sup> This event was not investigated by the NTSB.

<sup>47</sup> FAA Program Tracking and Reporting System records for the helicopter indicated that on April 18, 2011, the Anchorage Flight Standards District Office received an anonymous complaint via a safety hotline that a pilot was performing maintenance on the helicopter without writing up the discrepancies. (The helicopter's lead mechanic told investigators that he made the anonymous complaint.) The FAA inspection determined that the pilot was qualified to perform and sign off the inspection.

The memorandum continued with a discussion of the pilot's handling of a discrepancy with the helicopter's tail rotor pitch change links that he had found during a visual inspection on March 23, 2011. It then stated the following:

As your immediate supervisor, it's my expectation that you will notify me of any condition which occurs to the aircraft that can affect the flight status of that aircraft. By not notifying me as soon as practical that the over-torque condition occurred or that there was a problem with the tail rotor pitch links, you did not follow the appropriate...policy as outlined in Chapter 3.04(E)."<sup>48]</sup>

You are also expected to notify the Aircraft Section shop foreman, either directly or through me, of any problems or concerns regarding the DPS aircraft that you fly.

The memorandum concluded by stating, "this letter is intended to be instructional in nature, correct this type of behavior, and for you to follow the appropriate course of action with respect to our rules and procedures in the future."

#### **1.8.4 Use of Flight Observers**

The primary Alaska DPS SAR coordinator stated that the use of trained volunteer observers was up to the pilots and based on their personal relationships with members of the volunteer SAR community. Current and former relief pilots for the helicopter said that they liked to have a trained observer in the left seat to operate the Garmin 430 and Avalex display for them, especially when flying at night using NVGs. When the accident pilot used a trained observer, he relied mostly on one particular individual from the AMRG; however, this AMRG observer was out of town on the day of the accident. The AMRG observer estimated that he had flown over 300 SAR missions with the pilot, with the most recent flight in February 2013. Both the AMRG observer and the Alaska DPS on-duty SAR coordinator said that, if the AMRG observer had been available, he likely would have accompanied the pilot during the mission to rescue the snowmobiler. The AMRG observer was trained in the use of NVGs.

The AMRG observer said that, if he had been on the helicopter during the accident mission, he would have operated the Garmin 430 and Avalex displays for the pilot and performed other tasks, including setting up navigational courses and selecting radio frequencies. In addition, he said he would have been wearing NVGs and assisted the pilot by calling out terrain and obstacles. He was also familiar with the pilot's practice of disabling the turn-and-bank indicator (which was located on his side of the center pedestal), and he knew how to reset the circuit breaker to enable the instrument to function. The AMRG observer said that operating the Garmin 430 and Avalex display required significant training and familiarization.

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<sup>48</sup> Chapter 3.04(E) of the Alaska DPS aircraft operations manual stated, "All mishaps involving a DPS aircraft including any accident, incident, injury or ground damage associated with an aircraft in any way shall be immediately reported verbally to the Aircraft Supervisor and the direct supervisor of the pilot responsible for the aircraft followed as soon as possible by an email synopsis of the event."

A former Alaska State Trooper who served as the state SAR coordinator from 2004-07 and 2010-11 said that the pilot had, with his approval, developed a tactical flight officer (TFO)<sup>49</sup> training program. This training program was designed to familiarize volunteer TFOs with the Avalex display, FLIR, spotlight, and the use of NVGs. The pilot planned to train six to eight volunteer TFOs in the hangar during his normal duty hours so that a TFO would always be available for helicopter SAR missions. However, after the former SAR coordinator left that role in 2011, there was little management support for the TFO training program. Many missions require law enforcement personnel, but the helicopter had a limited payload. Alaska DPS management decided that, in many cases, it would be more appropriate to have the pilot pick up an on-duty state trooper rather than fly with a SAR volunteer. Commissioned troopers generally did not have the same level of training in helicopter operations as volunteer TFOs. The former SAR coordinator stated that he believed that the Alaska DPS management did not adequately consider the impact of this change on operational safety.

The former relief pilot for the helicopter said that the aircraft section had attempted to train some troopers in the use of helicopter equipment but that those trained officers were often unavailable for SAR missions due to scheduling conflicts. The current aircraft section commander said that he had never met any of the volunteer observers, including the AMRG observer who routinely flew with the accident pilot, and was not familiar with the training they had received.

### **1.8.5 Use of MatCom Dispatch Services**

The Alaska DPS contracts with MatCom for dispatch services. The MatCom dispatch center for the geographic area that includes Talkeetna is located in Wasilla, Alaska. The Alaska DPS did not perform any flight tracking or flight-following, and no one was aware that the accident helicopter was overdue until the EMS personnel waiting at Sunshine contacted MatCom dispatch to inquire about its estimated time of arrival.

Interviews with MatCom personnel revealed that dispatchers had clear guidance, training, and defined responsibilities and duties for AST ground vehicle operations and could provide very specific status and location information for every ground vehicle at any time. MatCom dispatchers had no aircraft-specific training and were not provided any specific flight plan information for the accident flight.<sup>50</sup>

After EMS personnel inquired about the helicopter at 0039 on March 31, 2013, the MatCom dispatcher attempted to locate it by radio and phone and by contacting personnel at Sunshine and the Talkeetna FSS. The dispatcher was unable to provide the FSS personnel the registration number of the helicopter (the dispatcher knew it only as "Helo-1"). At 0052, the dispatcher received a call from a sergeant asking for contact information for the on-duty SAR

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<sup>49</sup> TFOs are typically law enforcement personnel trained to conduct a wide array of flight operation support duties with a responsibility for assisting with flight safety. TFOs often assist with equipment operation (including systems used for aviation navigation, mapping, recording, and tracking) and collision avoidance and serve in a tactical decision-making capacity.

<sup>50</sup> When the pilot departed on the previous flight from ANC to Sunshine, he told the MatCom dispatcher that he had 2 hours 37 min of fuel on board and that his estimated time en route was 27 min. The pilot did not provide the dispatcher with such information for the accident flight.

coordinator for Alaska DPS; the sergeant told the dispatcher to stand by on contacting cell phone providers to initiate “accident circumstance” procedures for locating the cell phones of the helicopter occupants until the sergeant could talk with the SAR coordinator.

At 0109, the SAR coordinator called dispatch for contact information for the aircraft section commander (so that he could obtain the helicopter’s satellite telephone number) and asked for the coordinates for the snowmobiler’s location. At 0110, the dispatcher called a cell phone provider to attempt to obtain coordinates from the pilot’s, flight observer’s, and snowmobiler’s cell phones.

Over the course of the next several hours, the MatCom dispatch center changed shifts three times from the start of the initial search and rescue call to the time in which the accident site was located, and some difficulties with the transfer of information over multiple shifts occurred.

### **1.8.6 Alaska DPS Changes Since This Accident**

On August 7, 2014, representatives from the Alaska DPS met with NTSB investigators to discuss the safety improvements the department has made since the accident. Among these was the establishment of a new safety officer position, which incorporates a clear chain of command to the AWT director, captain, and lieutenant for any safety-related program issues. The safety officer, who is a pilot with aviation safety experience, is a dedicated full-time employee located at the Alaska DPS aviation section headquarters in Anchorage. Also, a third-party maintenance audit was completed in August 2014, an operations audit began in August 2014, and a training audit is to follow. All audits include a safety component that is being included in the safety program.

Table 3 summarizes the department’s improvements as of the date of this report. Many of these improvements are consistent with safety issues identified in completed NTSB investigations of accidents involving another law enforcement SAR helicopter, helicopter emergency medical services (HEMS) operators, and public operators of EMS helicopters and the safety recommendations that were issued as a result of those investigations. (See sections 1.9.1 through 1.9.3.)



**Table 3.** Summary of Alaska DPS safety improvements since the accident.

Flight Operations	All active AS350 helicopter pilots have attended inadvertent IMC training from a commercial vendor <sup>51</sup> and will receive inadvertent IMC training from a department check airman at least every 90 days. Airplane pilots received the training annually.
	NVG operations are suspended until a formal NVG training program for pilots is implemented.
	Pilots are adhering to standard operating procedures that specify that the maximum duty day for a single-pilot crew is 12 hours with 8 flight hours maximum and 10 hours rest. Exceptions during emergencies require approval.
	Formal TFO program being developed; SAR aircraft availability reduced to meet current staffing level.
	Night SAR operations are no longer being conducted. Situations involving loss of life or limb are evaluated case by case with regard to weather minimums.
	Pilots are required to adhere to personal and department weather minimums. Satellite phones issued for communications at remote sites.
Operational Control	Safety officer reviews Appareo data monthly.
	Clear chain of command established for personnel in a pilot's chain of command. Nonaviation supervisors do not participate in mission go/no-go decision-making.
	Formal risk assessments are used for all helicopter missions and are under development for remote airplane operations.
	For flight-tracking, Spidertracks has been installed in about 34 of the 42 aircraft (plans are to equip all aircraft). Flight-following is being performed by the RCC, MatCom, and authorized supervisors.
Organizational Culture	Formal chain of command to AWT director, captain, and lieutenant established and enforced.
	Safety officer periodically audits pilot flight and duty time limits and is authorized to communicate directly with aircraft section commander or director of public safety about safety-related findings.
	Created a safety manager position that is a required part of the safety/management team.
	Statewide pilot safety seminar planned for November 18-20, 2014.
	SMS is being developed with plans to include "just culture." <sup>52</sup>
	Third-party maintenance audit completed in August 2014. An operations audit began in August 2014, and a training audit is to follow.
Maintenance	Appareo system installation now includes use of the wire link to the aircraft intercom system to record voice audio.
	Department reviewing options to meet recommendations from third-party audit to address maintenance turnaround times, staffing, and aircraft availability.
	New responsibilities and roles are being established to ensure maintenance oversight.

<sup>51</sup> Alaska DPS personnel stated to NTSB investigators during the August 2014 meeting that the pilots had questions about the effectiveness of the training they received.

<sup>52</sup> Just culture has been described as "an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information" (Reason 1997), and "a culture in which front line operators or others are not punished for actions, omissions, or decisions taken by them that are commensurate with their experience and training but where gross negligence, willful violations, and destructive acts are not tolerated" (Chapter 1, Article 2 [k] of European Union regulation No. 691/2010).

## 1.9 Previously Issued Safety Recommendations

### 1.9.1 Airborne Law Enforcement Association Safety Policies Guidance

The Airborne Law Enforcement Association (ALEA) was founded in 1968 as a nonprofit association composed of local, state, and other public aircraft operators engaged in law enforcement activities. The organization's stated mission is to support, promote, and advance the safe and effective use of aircraft by governmental agencies through training, networking, advocacy, and educational programs.

On June 9, 2009, an Agusta S.p.A. A-109E helicopter operated by the New Mexico State Police (NMSP) impacted terrain during a VFR flight into IMC during a SAR mission near Santa Fe, New Mexico (NTSB 2011). As a result of the investigation, the NTSB issued several safety recommendations, including Safety Recommendations A-11-57 to the ALEA, A-11-53 to the state of New Mexico, A-11-60 to the National Association of State Aviation Officials, and A-11-64 to the International Association of Chiefs of Police.

To the ALEA: Revise your accreditation standards to require that all pilots receive training in methods for safely exiting inadvertently encountered instrument meteorological conditions for all aircraft categories in which they operate. (A-11-57, classified "Closed—Acceptable Action")

In response to this recommendation, the Airborne Law Enforcement Accreditation Commission revised Sections 04.03.01 and 04.03.02, "Pilot in Command Initial and Recurrent Training," of its accreditation standards to require pilot training in inadvertent encounters with IMC during initial pilot training and at least annually during pilot recurrent training for both fixed and rotary wing aircraft.

To the state of New Mexico: Require the New Mexico Department of Public Safety to bring its aviation section policies and operations into conformance with industry standards, such as those established by the Airborne Law Enforcement Association. (A-11-53, classified "Closed—Acceptable Action")

To the National Association of State Aviation Officials: Encourage your members to conduct an independent review and evaluation of their policies and procedures and make changes as needed to align those policies and procedures with safety standards, procedures, and guidelines, such as those outlined in Airborne Law Enforcement Association guidance. (A-11-60, classified "Closed—Acceptable Action")

To the International Association of Chiefs of Police: Encourage your members to conduct an independent review and evaluation of their policies and procedures and make changes as needed to align those policies and procedures with safety standards, procedures, and guidelines, such as those outlined in Airborne Law Enforcement Association guidance. (A-11-64, classified "Closed—Acceptable Action")

In response to these safety recommendations, each of the addressees performed actions that were responsive to the recommendations and satisfied their intent.

### **1.9.2 HEMS Operations**

HEMS operations, like SAR operations conducted by law enforcement departments, involve missions that require a high level of urgency to protect human life and are unpredictable in terms of when, where, and in what weather conditions they occur. Because of these mission similarities, many of the risks inherent in HEMS operations affect SAR operations as well. An NTSB safety study identified that pressure to complete a mission, weather, nighttime flight, spatial disorientation, and inadequate pilot training and experience were common risk factors for HEMS operations (NTSB 1988). A study by the Air Medical Physicians Association (AMPA) acknowledged these risks and cited additional risks such as unprepared landing sites, complacency, and situational stress.

Safely operating in such a high-risk environment calls for systematic evaluation and management of those risks. According to AMPA, an effective flight risk evaluation program acknowledges and identifies threats, evaluates and prioritizes risks, considers the probability that a risk will materialize, and mitigates loss. In a 2006 special investigation report, the NTSB found that, in both the HEMS and airplane EMS environment, conducting a flight risk evaluation requires the pilot and possibly another person (a manager, a flight dispatcher, or another flight crewmember) to assess the situation without being influenced by the sense of urgency that can come with an initial call requesting services (NTSB 2006).

#### **1.9.2.1 Pilot Training on Inadvertent IMC Encounters**

As a result of an NTSB public hearing on the safety of HEMS flights that revealed that most HEMS pilots did not have adequate training to recognize the conditions that indicate when they are encountering IMC, how to effectively avoid IMC encounters, and how to escape safely should they encounter IMC, the NTSB issued Safety Recommendation A-09-87 to the FAA and A-09-97 to the 40 public operators of HEMS flights.

Develop criteria for scenario-based helicopter emergency medical services (HEMS) pilot training that includes inadvertent flight into instrument meteorological conditions and hazards unique to HEMS operations, and determine how frequently this training is required to ensure proficiency. (A-09-87, classified “Closed—Unacceptable Action”)

Conduct scenario-based training, including the use of simulators and flight training devices, for helicopter emergency medical services (HEMS) pilots, to include inadvertent flight into instrument meteorological conditions and hazards unique to HEMS operations, and conduct this training frequently enough to ensure proficiency. (A-09-97)

In response to Safety Recommendation A-09-87, on February 21, 2014, the FAA published a final rule, “Helicopter Air Ambulance, Commercial Helicopter, and Part 91

Helicopter Operations,” which revised Section 135.293 to include the following new pilot testing requirements<sup>53</sup> (among others):

(a)(9) ... For rotorcraft pilots, procedures for aircraft handling in flat-light, whiteout, and brownout conditions, including methods for recognizing and avoiding those conditions....

(c) Each competency check given in a rotorcraft must include a demonstration of the pilot’s ability to maneuver the rotorcraft solely by reference to instruments. The check must determine the pilot’s ability to safely maneuver the rotorcraft into visual meteorological conditions following an inadvertent encounter with instrument meteorological conditions. For competency checks in non-IFR-certified rotorcraft, the pilot must perform such maneuvers as are appropriate to the rotorcraft’s installed equipment, the certificate holder’s operations specifications, and the operating environment. ...

(h) Rotorcraft pilots must be tested on the subjects in paragraph (a)(9) of this section when taking a written or oral knowledge test after April 22, 2015. Rotorcraft pilots must be checked on the maneuvers and procedures in paragraph (c) of this section when taking a competency check after April 22, 2015.

However, the FAA’s revisions to the regulation did not include criteria for scenario-based training to address hazards unique to helicopter air ambulance operations, such as interfacility helicopter air ambulance flights or remote helispot landings or takeoffs. As a result, on September 11, 2014, the NTSB classified Safety Recommendation A-09-87 “Closed—Unacceptable Action.”

Since Safety Recommendation A-09-97 was issued, many of the public HEMS operators now provide the training discussed in the recommendation to their pilots, as well as other flight crew, such as paramedics and flight nurses, involved in their HEMS flights. In recognition of this training being provided to more than just HEMS pilots, Safety Recommendation A-09-97 is classified “Closed—Exceeds Recommended Action” to 15 of the 40 public HEMS to which it was issued.

### 1.9.2.2 Preflight Risk Assessment

The NTSB has issued several recommendations regarding formal preflight risk assessment procedures and the involvement of another qualified helicopter pilot when making launch decisions for HEMS missions. As a result of the 2006 special investigation on EMS safety, Safety Recommendations A-06-13 and -14 were issued to the FAA. Safety Recommendation A-06-13 addressed the importance of flight risk evaluation programs and asked the FAA to do the following:

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<sup>53</sup> The final rule’s original effective date was April 22, 2014. On April 21, 2014, the FAA amended the final rule to change the effective date to April 22, 2015, for certain sections, including 135.293 (a)(9) and (c).

Require all emergency medical services (EMS) operators to develop and implement flight risk evaluation programs that include training all employees involved in the operation, procedures that support the systematic evaluation of flight risks, and consultation with others trained in EMS flight operations if the risks reach a predefined level. (A-06-13, classified “Open—Acceptable Response”)

On August 1, 2005, the FAA published Notice 8000.301, “Operational Risk Assessment Programs for Helicopter Emergency Medical Services,” which provided guidance to FAA inspectors on promoting risk assessment, risk management tools, and training for HEMS operations. The notice contained a formalized risk assessment matrix, which could be used by HEMS crews when making decisions to launch or to continue a mission. When Safety Recommendation A-06-13 was issued, the NTSB was aware of the notice but was not confident that the new guidance would be widely adopted by EMS operators because most HEMS operators examined during the 2006 special investigation did not have a decision-making or a risk evaluation program in place as suggested by FAA guidance issued in 1991. FAA notices are, by design, temporary documents that expire after 1 year.

On January 28, 2006, the FAA published Safety Alert for Operators 06001, “Helicopter Emergency Medical Services Operations,” which included the information from the notice. On May 1, 2008, the FAA incorporated the risk assessment information into FAA Order 8900.1, “Flight Standards Information Management System.”<sup>54</sup> On February 21, 2014, the FAA published a final rule titled “Helicopter Air Ambulance, Commercial Helicopter, and Part 91 Helicopter Operations,” which amended FAA regulations in Section 135.617 to require that all helicopter air ambulance operators establish and document, in their operations manual, an FAA-approved preflight risk analysis that includes management approval in situations where a predetermined risk level is exceeded. The FAA incorporated guidance for developing risk assessment matrix tools to determine risk level (such as “low,” “medium,” “serious,” and “high”) for use in go/no-go decision-making into Section 5 of FAA Order 8900.1.

Safety Recommendation A-06-14 addressed the importance of formalized dispatch and flight-following procedures. The NTSB recommended that the FAA do the following:

Require emergency medical services operators to use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance in flight risk assessment decisions. (A-06-14, classified “Open—Acceptable Response”)

In response to this recommendation, on May 5, 2008, the FAA issued Advisory Circular 120-96, “Integration of Operations Control Centers [OCC] into Helicopter Emergency Medical Services Operations,” which provided guidance on the establishment and operation of an OCC by a HEMS operator. The February 21, 2014, final rule contains a requirement in Section 135.619 for certificate holders with 10 or more helicopter air ambulances to establish OCCs and document operations control specialist duties and training in their operations manuals.

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<sup>54</sup> FAA Order 8900.1 provides guidance to FAA inspectors to use when reviewing and approving the flight operations programs of commercial operators.

As a result of a public hearing the NTSB held on HEMS safety on February 3-6, 2009, Safety Recommendation A-09-98 was issued to 40 public aircraft operations HEMS operators that are not subject to FAA oversight:

Implement a safety management system program that includes sound risk management practices. (A-09-98)

Among the 40 public operators receiving this recommendation was STAR Flight of Austin-Travis County, Texas Emergency Medical Services, an operator that conducted both HEMS and other public aircraft missions, including SAR. On October 20, 2009, STAR Flight replied that it had implemented a risk assessment tool for HEMS operations in 2008 and that it was, at that time, developing a risk assessment tool for its SAR, firefighting, and law enforcement operations. On June 2, 2010, the NTSB replied that STAR Flight, by developing the risk-assessment tool for various operations, exceeded the intent of the HEMS recommendation. Consequently, Safety Recommendation A-09-98 to STAR Flight was classified “Closed—Exceeds Recommended Action.”

As a result of the September 27, 2008, accident involving an Aerospatiale (Eurocopter) SA365N1, registered to and operated by the Maryland State Police as a public HEMS flight in District Heights, Maryland, the NTSB issued Safety Recommendations A-09-131 and -132 to the 40 public HEMS operators (NTSB 2009):

Develop and implement flight risk evaluation programs that include training for all employees involved in the operation, procedures that support the systematic evaluation of flight risks, and consultation with others trained in helicopter emergency medical services flight operations if the risks reach a predefined level. (A-09-131)

Use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance in flight risk assessment decisions. (A-09-132)

To date, 15 public HEMS operators have indicated to the NTSB that they have implemented a flight risk evaluation program and use formalized dispatch and flight-following procedures, including 5 state police departments.

### 1.9.3 Inconsistencies Among Weather Information Products

Recent NTSB accident investigations found instances in which nonaviation-specific weather products from the NWS advised of conditions that were more severe than those described in the NWS aviation weather products. As a result, on May 6, 2014, the NTSB issued four safety recommendations to the FAA (Safety Recommendations A-14-13 through -16) and five to the NWS (Safety Recommendations A-14-17 through -21).<sup>55</sup> The NTSB recommended that the FAA do the following:

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<sup>55</sup> For more information about Safety Recommendations [A-14-13 through -16](#), which are addressed to the FAA, and Safety Recommendations [A-14-17 through -21](#), which are addressed to the NWS, see the Safety Recommendations search page, available on the NTSB website at [www.nts.gov](http://www.nts.gov).

Ensure that all [FAA] (and contracted) preflight weather briefings include any products modified or created by the [NWS] in response to Safety Recommendation A-14-17. (A-14-13)

Require that the [NWS] provide a primary aviation weather product (as recommended in Safety Recommendation A-14-18 to the NWS) that specifically addresses the potential for and existence of mountain wave activity and its associated aviation weather hazards. (A-14-14)

In cooperation with the [NWS], revise the Interagency Agreement between the [FAA] and the National Oceanic and Atmospheric Administration/NWS for the center weather service units (CWSU) and its accompanying statement of work if needed to add the new responsibilities of CWSU personnel in response to Safety Recommendations A-14-17 and/or A-14-18 to the NWS, which are in addition to the other responsibilities currently performed by the NWS under this agreement. (A-14-15)

Include center weather advisories in the suite of products available to pilots via the flight information services-broadcast data link. (A-14-16)

The NTSB also recommended that the NWS do the following:

Modify [NWS] aviation weather products to make them consistent with NWS nonaviation-specific advisory products when applicable, so that they advise of hazardous conditions including aviation hazards less than 3,000 square miles in area that exist outside of terminal aerodrome forecast coverage areas. (A-14-17)

Provide a primary aviation weather product that specifically addresses both the potential for and the existence of mountain wave activity and the associated aviation weather hazards (as recommended in Safety Recommendation A-14-14 to the [FAA]). (A-14-18)

In cooperation with the [FAA], revise the Interagency Agreement between the FAA and the National Oceanic and Atmospheric Administration/[NWS] for the [CWSUs] and its accompanying statement of work if needed to add the new responsibilities of CWSU personnel in response to Safety Recommendations A-14-17 and/or A-14-18 to the NWS, which are in addition to the other responsibilities currently performed by the NWS under this agreement. (A-14-19)

Establish a protocol that will enhance communication among meteorologists at the [CWSUs], the Aviation Weather Center, and, as applicable, other [NWS] facilities to ensure mutual situation awareness of critical aviation weather data among meteorologists at those facilities. (A-14-20)

Establish standardized guidance for all [NWS] aviation weather forecasters on the weighting of information reported in pilot reports (PIREPs) that will (1) promote consistent determination of hazard severity reported in a PIREP and (2) assist in aviation weather product issuance. (A-14-21)

The NTSB notes that, at the time that the safety recommendations were issued, the NWS in Alaska was already working to address consistency among weather advisory products in Alaska. The FAA replied on July 24, 2014, and the NWS replied on July 29, 2014. Both organizations stated that they were working together to take the actions recommended. On September 16, 2014, Safety Recommendations A-14-13 through -16 were classified “Open—Acceptable Response,” and, on September 26, 2014, Safety Recommendations A-14-17 through -21 were classified “Open—Acceptable Response.”



## 2. Analysis

### 2.1 General

#### 2.1.1 Pilot Qualifications and Fitness for Duty

The pilot had substantial experience flying helicopters and flying SAR missions for Alaska DPS. All of the pilot's SAR missions were flown under VFR, and he had a significant amount of NVG experience. However, he had received no formal NVG training while employed by Alaska DPS. (NVG training is discussed further in section 2.4.2.)

The pilot had relatively little instrument flying experience, and he was not current for instrument flight. His most recent instrument helicopter flight was logged in 1986, and he had received no instrument training within the past decade.

Toxicological tests were negative for impairing substances, and images from the onboard recorder provided no indication that the pilot experienced any medical impairment or incapacitation during the flight.

Information about the pilot's recent activities provides no indication of sleep restriction or circadian disruption in previous days. Further, the accident occurred well before the period of the circadian trough (when alertness is lowest), so it is unlikely the pilot was fatigued. The pilot spent about an hour on the ground with the trooper between flights, during which time the two men searched for and retrieved the snowmobiler in deep snow. This entailed physical activity and exposure to cold, wet weather. However, the pilot and helicopter were equipped with a wide range of outdoor gear, and evidence suggests that the pilot and trooper used the snowmobiler's snowmobile to transport him to the helicopter. Thus, it is also unlikely that the pilot's performance was degraded as a result of his participation in the ground phase of the SAR mission. The NTSB concludes that the pilot was qualified to fly SAR missions in VMC (but not IMC) in the accident helicopter, and his performance was unlikely affected by medical factors, fatigue, or physical activities associated with the ground portion of the rescue activity.

#### 2.1.2 Helicopter Maintenance and Wreckage Examinations

Although some acquaintances of the pilot reported that he had voiced concerns about the helicopter's maintenance, some of these same people also noted that they thought that he would not fly the helicopter if he believed it to be unsafe. Alaska DPS personnel stated that the pilot and the helicopter's mechanic were often in disagreement about issues such as how the helicopter should be maintained and how long repairs should take. A review of the helicopter's maintenance records found that it was maintained in accordance with applicable regulations and Eurocopter's maintenance procedures. A review of the helicopter logbook for the 30 days before the accident revealed that all maintenance write-ups had been cleared and that there were no open or deferred items. Although the pilot was known to intentionally disable the turn-and-bank indicator by pulling its circuit breaker, the reason he did this is uncertain (thus, it is unknown if there was a problem with the instrument).

The wreckage examinations found no anomalies with the flight controls and no characteristics that were inconsistent with impact damage and exposure to postcrash fire. Examination of the input pinion slippage mark found that the amount of offset in the torquing (tightening direction) was consistent with significant power at the time the main rotor system struck the ground and stopped. In addition, images from the Appareo unit showed no instrument readings or system status lights (from the master caution warning panel) that would indicate problems with the helicopter's engine or systems during the accident flight. The image information provided confirmation that the helicopter was responding to the pilot's control inputs and that the engine was providing torque to the rotor drive system; for example, an engine power increase (determined from engine instrument readings) correlated with the helicopter's climb. Additional investigative benefits of the onboard recording system are discussed in section 2.7. The NTSB concludes that the in-flight image recording and wreckage examinations showed that the helicopter and its engine were operating normally throughout the flight. No mechanical abnormalities with the helicopter were identified.

### **2.1.3 Weather Conditions**

It is not known what weather resources the pilot consulted for the flight; the information that would have been available to him and its potential effect on his flight planning are discussed in section 2.3.1.

A review of the available weather information found that the environment would have been conducive for rain and snow shower activity, with reduced visibilities in heavy rain or snow environments. TKA reported light rain and ceilings varying between VFR and IFR conditions in the 2 hours before the accident with the changeover to snow occurring at 2312, as reported in the 2314 METAR observation. Weather radar images depicted a line of showers moving northward from PAQ through TKA during the accident time. Also, the mountainous terrain in and around the accident site would have acted to enhance any vertical motion associated with the shower activity and help increase the strength of the showers; thus, worse surface conditions than were observed at PAQ would have been expected at TKA and the accident site.

Based on the various weather observations and the nearby witness reports of light rain, sleet, and snow, moderate or worse icing would have been likely in the vicinity of the accident site. Although the cockpit image recording showed no evidence that it was snowing at the remote landing site at the time that the helicopter departed (blowing snow, if present, should have been visible), rain and sleet were likely present. The NTSB concludes that, soon after departure from the remote landing site, the helicopter likely encountered IMC, which included low clouds, heavy snow, and near-zero-visibility conditions.

The presence of sleet would also increase the likelihood of icing conditions above the surface. Although encounters with such icing conditions can adversely affect helicopter performance, the review of image data from the Appareo unit revealed no evidence of an abnormal engine power reduction (as could occur with engine induction icing) or requirements for more power to maintain flight (as could occur with the gradual accumulation of structural icing). Therefore, the NTSB concludes that, although icing conditions were likely present during the accident flight, the performance of the helicopter does not appear to have been degraded at the time of the accident.

Although the 2137 TAF for TKA forecasted a ceiling less than 1,000 ft agl at the airport, an updated FA for the area surrounding TKA referencing a forecast for IFR conditions was not issued, and there was no AIRMET issued for IFR conditions. Typically, these weather information products should be consistent with each other with regard to references to IFR conditions (as discussed in section 1.9.3); the omission of the AIRMET from the FA would also be reflected in the graphical depictions of AIRMETs on the AAWU website. In this accident, because the pilot was already en route at 2137 (when the TKA TAF was issued), it is unlikely that this inconsistency in weather information products had any effect on his decision-making.

## 2.2 Accident Flight

The helicopter departed about 2313, and the flight lasted only about 7 min before it crashed in a wooded area about 3 mi south of the remote landing site. According to images from the Appareo unit, the pilot used his NVGs during the entire flight and had configured the Garmin 296 GPS, which was in the “track up” orientation, to show a magenta course line that extended southwest on the map display. The pilot did not make any adjustments to the Garmin 430 GPS unit (including not slaving it to the HSI) or the Avalex system, and the turn-and-bank indicator remained disabled for the flight. Three min after takeoff, the trooper radioed the dispatcher that the helicopter was en route back to Sunshine, and he requested that an ambulance meet the flight to receive the hypothermic snowmobiler. No further radio communications were received from the flight.

After takeoff, the pilot initially climbed the helicopter to an altitude of about 700 ft msl (about 250 ft agl in that area) and flew it southwest for about 1 min at a 60-knot groundspeed then southeast for about 1 min. This course allowed the pilot to fly around a 1,000-ft-high hill while remaining below the cloud ceiling. At times, the helicopter slowed to about 20 knots and flew as low as about 100 ft agl.

The helicopter’s subsequent climb and acceleration over the Intertie, followed by its descent to less than 100 ft agl, deceleration to ground speeds as low as 27 knots, and circuitous route through a cluster of hills near the accident location indicate that the pilot likely encountered deteriorating weather conditions and responded by flying the helicopter closer to trees and terrain in an effort to maintain external visual references. As discussed previously, however, the helicopter likely encountered very low clouds and near-zero visibility conditions near the accident site, and these conditions likely degraded the pilot’s NVG image to the point where continued flight under VFR was impossible.

The pilot was using a lip light throughout the accident flight, and this light was directed at knobs and buttons on the instrument panel when the pilot manipulated them. In addition, the movement of the lip light beam was suggestive of purposeful scanning inside the cockpit. Although it was not possible to determine when the pilot was looking through his NVGs rather than below them at the instrument panel, and, although it was not possible to determine where the pilot was looking within the beam of light when it was directed at a particular area of the instrument panel, the absence of the beam from the primary flight instruments was indicative of periods when he was not closely attending to them. Thus, the lip light provided some indication of the pilot’s visual attention inside the cockpit.

About 3 min into the flight, as the pilot encountered deteriorating weather and rising terrain, the pattern of the pilot's lip light movement changed. Whereas the light had been frequently on and off the instrument panel, it was now lingering in other locations, primarily the lower right portion of the cockpit where the Garmin 296 was mounted. During the period that this was occurring, the helicopter's indicated airspeed dropped from about 60 to 25 knots, and the helicopter slowly climbed from about 100 to 200 ft agl. (By comparison, the minimum airspeed for IFR flight in comparable IFR-equipped helicopters ranges from 40 to 55 knots.<sup>56</sup>) This indicates that the pilot's attention was directed away from the primary flight instruments just before the attempted transition to IFR flight and that the helicopter slowed down during this time, making it less stable and more difficult to control in IMC.

After the pilot finished attending to the Garmin 296, the beam of the lip light resumed frequent coverage of the primary flight instruments, and the pilot initiated the rapid climb. This maneuver was not necessary to clear any immediate obstacle threat, but it was consistent with a contingency plan for escaping zero-visibility conditions that the pilot had previously discussed with the AMRG observer. Therefore, the NTSB concludes that the pilot experienced a total loss of external visual references while operating in close proximity to terrain, which led him to attempt to transition to instrument flight.

During the climb, which was executed with little forward airspeed, the helicopter turned rapidly to the left. Although it is possible that the pilot initiated the turn (either to try to escape the IMC or because he was aware of a 1,000-foot hill ahead along the original flightpath), it is also possible that the left turn simply resulted from the pilot not applying enough right antitorque pedal to counter the increased torque that accompanied his application of climb power. As the helicopter turned away from its previous direction of travel, the magenta course line on the Garmin 296 rotated out of sight at the bottom of the unit's display screen. Shortly after this occurred, the pilot adjusted the knob on the HSI so that the CDI needle was aligned with a heading that pointed in the direction the helicopter had come from. The pilot, however, did not take any action to halt the turn when the helicopter was pointing in the opposite direction. Rather, the rapid left turn continued without pause. Thus, the turn may or may not have been intentional, and the pilot may or may not have been attempting to reverse course. Regardless, the pilot likely manipulated the knob on the HSI (which was rapidly spinning) to provide a course reference that would aid his navigation. Thus, the pilot was attending to a navigational task during the attempted transition to instrument flight, and this introduced some distraction from primary control tasks that were already quite challenging, given the helicopter's low speed and the encounter with IMC.

About 17 seconds after the pilot adjusted the CDI, the trooper pointed at the Avalex display, possibly attempting to assist the pilot's navigation. Seconds after that, the helicopter entered an uncoordinated maneuver, yawing left, rolling right, and pitching up as the pilot made frequent inputs on the controls.

A 2011 simulator study of helicopter pilot performance during inadvertent flight into IMC found that such episodes were marked by increased workload, as evidenced by pitch and

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<sup>56</sup> According to the flight limitations section of their corresponding flight manuals, the minimum speed for IFR flight for the Agusta A-109C, Bell 430, and AS-355 helicopters is 40, 40, and 55 knots, respectively.

bank angle oscillations of increasing amplitude and higher-frequency, higher-amplitude cyclic control inputs (Krognale and Krebs 2011). Both of these features were apparent during the pilot's climbing turn, suggesting that, during the pilot's attempted transition to instrument flight, he experienced operational distractions, task saturation, and difficulties with aircraft control. These difficulties may have been exacerbated by spatial disorientation, which is an inaccurate perception of one's own orientation and direction of motion that can result from the vestibular sensations that accompany maneuvering flight in zero-visibility conditions.

Several seconds later (at 2318:40), with the helicopter at high pitch and roll angles, the pilot pulled a knob on the instrument panel to cage the attitude indicator (which sets it to display a level flight attitude). Caging an attitude indicator is meant to be performed only when an aircraft is in a level flight attitude, such as on the ground or in straight-and-level, unaccelerated flight. As an experienced pilot and mechanic, he would have understood the conditions under which the attitude indicator could be safely caged. Therefore, the NTSB concludes that the pilot's action to cage the attitude indicator outside those conditions under which it could be safely caged indicates that he distrusted the information he was seeing. (Possible reasons for this distrust are discussed in section 2.6.) By caging the attitude indicator while the helicopter was at high pitch and roll angles, the pilot caused the instrument to provide erroneous attitude indications that would be difficult to ignore in a high-stress situation.

With external visual references gone and the attitude indicator providing erroneous, misleading information, the pilot's only possibility of maintaining control lay in using alternative forms of attitude information from other flight instruments. During instrument helicopter training, which the pilot had completed many years earlier, he was trained in partial-panel techniques, including using the turn-and-bank indicator as a secondary source of obtaining information about the helicopter's bank attitude. However, the turn-and-bank indicator was inoperative during the accident mission because the pilot had previously disabled it. Thus, this source of bank information was not available to help the pilot determine the helicopter's attitude as he tried to maintain turn-and-bank control.

The absence of a functioning turn-and-bank indicator might have been moot because the pilot had minimal (0.5 hour) helicopter actual instrument flying experience, lacked helicopter instrument flying currency, and had no recent instrument training. Therefore, it is unlikely that he would have been able to maintain control of the helicopter using partial-panel techniques during the climbing turn, even with a working turn-and-bank indicator. Research involving instrument-rated, fixed-wing pilots suggests that maintaining aircraft control following a simulated attitude instrument failure in actual instrument conditions with a working turn-and-bank indicator is extremely difficult and leads to loss of control in at least 10% of cases (Roy and Beringer 2002). The success rate for a helicopter pilot during aggressive, low-speed maneuvering in a nonIFR-certificated helicopter would likely be much lower, due to the inherently unstable nature of such helicopters (compared to IFR-equipped helicopters) and the even greater dependence of their pilots on external visual cues for maintaining helicopter control. Therefore, the NTSB concludes that the pilot's caging of the attitude indicator made it very unlikely that he would regain control of the helicopter in IMC. The NTSB further concludes that the helicopter's erratic maneuvers are consistent with the pilot's spatial disorientation, a loss of control in flight, and his inability to recover the helicopter because of his lack of instrument experience and the lack of accurate attitude information.

## 2.3 Pilot's Risk Management Considerations

### 2.3.1 Decision to Accept Mission

The pilot did not call a flight service specialist for a weather briefing, and the investigation was unable to determine which weather information sources the pilot may have examined before deciding to accept the mission. Based on the available weather information products and the standard services provided by a qualified weather briefer, it is likely that, had the pilot called for a briefing at the time that he was notified of the mission, the briefer would have informed the pilot about the radar-depicted line of light-to-moderate echoes that was moving toward TKA.

A review of the typical sources used by Alaska DPS pilots revealed that the FA forecasted visibilities as low as 4 mi in places that included the search area with isolated rain and snow showers, and the TKA TAF issued at 2008 forecasted a cloud ceiling of 1,000 ft agl at the airport. Because the search area was only about 5 nautical mi east of TKA, the pilot likely checked the TKA TAF, and this should have alerted him to the possibility of ceilings in the search area between 350 and 950 ft agl (terrain elevations in the search area ranged from about 400 to 1,000 feet msl).

Low night VFR lighting conditions existed for the accident flight, which the pilot could have determined based on the times of sunset and moonrise, the overcast clouds, and the lack of ground lighting in the search area. Low lighting conditions can have a profound effect on the safety of helicopter night VFR operations by compromising a pilot's ability to maintain visual contact with the horizon and to see and avoid clouds, obstacles, and terrain.<sup>57</sup>

Alaska DPS did not apply across-the-board VFR weather minimums to its helicopter pilots. Some personnel indicated that the pilots had individual weather minimums that may be changed based on experience, whereas other personnel stated that pilots were expected to comply only with the FAA requirements to remain clear of clouds. However, Alaska DPS had minimums on file for the accident pilot. A form dated 2003 indicated that the pilot's night VFR NVG weather minimums were a 500-ft ceiling and 2-mi visibility, and the pilot indicated in a 2009 e-mail to a colleague that his personal minimums for night NVG operations were a 200-ft ceiling and 5-mi visibility. Therefore, the NTSB concludes that, when the pilot was contacted about the mission, forecasts indicated that conditions in the search area would be IFR and that forecast cloud ceilings and visibility would likely be below the pilot's Alaska DPS weather minimums and possibly below his last known personal weather minimums.

The risk of helicopter night VFR operations can be mitigated by use of NVGs, which the pilot used routinely. However, NVGs have a number of limitations, including a reduced field of

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<sup>57</sup>Section 10-2-2, "Helicopter Night VFR Operations," in the *Aeronautical Information Manual* states, in part, "Even in conditions in which visibility and ceiling are determined to be visual meteorological conditions, the ability to discern unlighted or low contrast objects and terrain at night may be compromised. The ability to discern these objects and terrain is the seeing condition, and is related to the amount of natural and man-made lighting available, and the contrast, reflectivity, and texture of surface terrain and obstruction features. In order to conduct operations safely, seeing conditions must be accounted for in the planning and execution of night VFR operations."

view, reduced image resolution, and the presence of digital noise. Low lighting conditions can result in a lower contrast NVG image and increased digital noise. Such images are more difficult to interpret and may cause a tendency to fly lower in an effort to improve image quality. The presence of meteorological obscurants like rain or snow has the potential to further degrade NVG image quality. The effect of precipitation on image quality can be unpredictable and can change with the nature and intensity of the precipitation. Thus, meteorological and astronomical forecasts that included low light, rain, and snow indicated the potential for degraded NVG effectiveness and increased risk of an inadvertent encounter with IMC. Therefore, the NTSB concludes that, at the time the pilot was notified about the stranded snowmobiler, sufficient information was available to indicate that the mission carried a high degree of risk due to the weather and low lighting conditions.

The investigation revealed no evidence that Alaska DPS managers ever pressured the pilot to accept or complete a flight. Thus, it does not appear that the pilot was subjected to any direct management pressure to accept or continue SAR missions. However, the pilot was described as having exceptionally high motivation for flying-related tasks, and he took great pains to make sure that he and the helicopter were always available for any DPS missions. He had frequent conflicts with maintenance personnel over the timeliness of required maintenance and rarely took time off because he did not want to miss opportunities for flying. The pilot reportedly enjoyed flying the helicopter and had achieved a high level of VFR helicopter flying proficiency. Putting this skill to use likely provided some intrinsic satisfaction. The pilot's spouse said that the pilot was very close to his own family, and he appreciated being able to bring other people safely back to theirs. In addition, records indicate that the pilot had received a great deal of public recognition for past rescues. His personnel file contained many heartfelt letters of thanks from people he had rescued, and he had received several high-profile awards. In addition, a substantial amount of the pilot's income came from being on call and flying missions outside of his scheduled work hours. Colleagues and supervisors said that the pilot was very sensitive to any changes in aircraft section operating policies that could reduce his pay, such as reducing his standby time by using the relief pilot. The relief pilot said that the pilot feared being replaced if other pilots were allowed to fly more missions. As a result of these multiple sources of motivation, the pilot carefully guarded his role as the helicopter's primary pilot.

The pilot's exceptionally high motivation likely produced significant internal pressure to accept and complete missions, and this motivation stemmed from multiple factors, such as his awareness of the dire situations faced by the people he rescued, the way that his pay was structured, and the way that he had been rewarded for completing previous high-risk SAR missions. Thus, the NTSB concludes that the pilot's exceptionally high motivation for conducting SAR missions, which was influenced by multiple factors, likely played a part in his acceptance of the accident mission.

### **2.3.2 Preparations for Departure**

After spending about 1 hour on the ground to assist the snowmobiler and transport him to the helicopter, the pilot had to decide whether to take off again. As mentioned previously, light rain and sleet were likely present at the time of departure. The pilot's PED showed that he did not use that device to call for a weather update before departing the remote landing site; however, it is uncertain whether cellular service was available to do so. At the time, TKA was

reporting a changeover from rain to snow. This information about observed snow nearby would have been available to the pilot via the radio on the TKA weather automated surface observing system (ASOS) frequency (and by phone). It is not known if the pilot could have received the TKA ASOS via the radio on the ground; however, in-flight capability was likely. The pilot's only other preflight means of assessing the ceiling, visibility, and obscuring precipitation was by visual inspection of the surrounding area from the ground. However, it was dark and the remote landing site was in a low-lying area surrounded by trees, so the pilot's ability to visually assess the weather conditions from the ground was probably limited.

After starting the helicopter, the pilot configured the Garmin 296 GPS so that it displayed a magenta course line that extended southwest on the map display. The AMRG observer who often flew with the pilot said that the pilot preferred using only the Garmin 296 for navigation. The relief pilot said he also preferred using the Garmin 296 because its position in the cockpit allowed him to easily glance down under his NVGs to see the display in flight. A disadvantage of using the Garmin 296 (as opposed to the Garmin 430 in the center of the panel) was that the pilot's selected course information could not be displayed on the HSI via the CDI. In the event of an encounter with IMC, the pilot's workload would be increased because he would have to alternate his visual attention between the lower right side of the cockpit (where the Garmin 296 was mounted) and the center of the instrument panel (where the primary instruments were located) to both navigate and maintain primary control. (Using the Garmin 430, which can be "slaved" to the HSI, enables the pilot to use the CDI to display course information for the course selected on the Garmin 430, thereby supporting a centralized instrument scan.)

The pilot did not make any adjustments to the Garmin 430, which is consistent with his reported preference for the Garmin 296 and with his not configuring the unit during the previous flight from ANC. The pilot also did not make any adjustments to the Avalex system, which powered up in the "north up" orientation and with a map that showed the outlines of rivers and lakes. This is inconsistent with the pilot's previous flight from ANC, for which he configured the Avalex to show a "track up" orientation with a topographical map displayed. It is also inconsistent with a statement made by the AMRG observer that he and the pilot had agreed that they would always ensure that the Avalex display was powered up and configured properly before takeoff in reduced visibility conditions so that it could be used to maintain awareness of nearby terrain. This could be explained, however, by the fact that the Avalex unit was normally configured and operated by an observer, but the trooper who was serving as an observer had not been trained in its use.

The pilot also did not reset the circuit breaker to enable the turn-and-bank indicator, which remained disabled for the flight. The only maintenance write-up regarding a reported noise problem with the instrument occurred 9 years ago. Alaska DPS personnel could not say with certainty why the pilot disabled the instrument.

Although Alaska DPS sometimes used trained observers who could operate the Garmin 430 and Avalex displays and perform tasks for the pilot like setting up navigational courses, selecting radio frequencies, or calling out terrain and obstacles, the trooper for the accident mission had not been trained to use the helicopter's navigational equipment. Therefore, during the accident flight, the pilot configured the avionics and handled all navigational tasks himself.



### 2.3.3 Decision to Continue Mission

Before the accident flight, when the pilot first arrived in the search area about 2200, he flew the helicopter between 1,100 and 1,200 ft msl, which suggests that the cloud ceiling was at least 650 to 750 ft agl about the time that he landed at the remote rescue location. However, the altitude that the pilot initially flew during the accident flight was about 700 ft msl (250 ft agl), suggesting that the cloud ceiling and/or visibility in the area had deteriorated significantly during the time the helicopter was on the ground. In addition, weather information and witness reports indicate a strong possibility of icing.

The safest course of action at this point was to perform a precautionary landing. An examination of the terrain along the helicopter's ground track identified several open areas that could have served as emergency landing areas for the helicopter. However, due to the changing precipitation and low lighting conditions, it is uncertain whether the pilot could see these potential landing areas well enough to determine whether they were suitable for landing.

Although it is possible that the condition of the snowmobiler created a sense of urgency that prompted the pilot to push on in deteriorating conditions, there is insufficient evidence about the seriousness of the snowmobiler's medical condition to know how it might have been perceived by the pilot and flight observer. Although the flight observer reported to a dispatcher that the snowmobiler was hypothermic, he did not communicate any detailed information about the snowmobiler's condition, and hypothermia cases can range from mild to severe.

A factor that likely influenced the pilot's continued VFR flight in deteriorating weather was his high motivation for performing missions and accomplishing rescues. Although the pilot was described by colleagues as being very safety oriented, the aircraft section commander had expressed concern to the pilot about the riskiness of some flights, and the pilot had responded that he agreed to do such things when he was hired and planned to continue doing them. As a result of his conversations with the pilot, the aircraft section commander said he believed the pilot appreciated the hazards associated with risky decisions but that he felt a self-imposed obligation to take certain risks to accomplish rescues.

Another factor that likely influenced the pilot's continued VFR flight into deteriorating weather was an increased tolerance for risk as a result of successful past outcomes. Although the pilot had experienced a takeoff accident 7 years earlier involving white-out conditions and loss of visibility from snowfall and snow on the ground that billowed up in the rotor wash, he had not experienced any other accidents since, despite conducting additional missions that often involved high-risk activities, such as maneuvering through areas of poor weather at night and flying inches above fast-moving bore tides. The success of these past missions, particularly those involving poor weather, likely increased the pilot's confidence that he could safely continue VFR flight at night in marginal weather conditions.

A precautionary landing would have stranded the pilot, trooper, and hypothermic snowmobiler in an uncomfortable (but probably survivable) situation until the weather improved

or ground resources could assist them.<sup>58</sup> Executing a landing in the dark, reduced-visibility conditions in an unfamiliar clearing with heavy snow on the ground might also damage the helicopter. Continuing VFR flight, on the other hand, increased the pilot's risk of experiencing a weather-related accident, but the risk of this type of accident probably seemed remote to the pilot, given his past experience. Thus, the pilot had to choose between two undesirable alternatives: one that involved a high perceived likelihood of inconvenience and possible helicopter damage and another that involved a low perceived likelihood of a serious accident. The pilot chose the latter option, and the risk of a serious accident was realized. The NTSB concludes that the pilot's exceptionally high motivation for SAR missions and past successes likely increased his risk tolerance and influenced his decision to continue flying in deteriorating weather conditions and risk a weather-related accident rather than accept the certain inconveniences and potential hazards associated with a precautionary landing.

## 2.4 Organizational Issues

### 2.4.1 Risk Assessment

The accident helicopter was a single-engine, nonIFR-certified platform and was crewed by a single pilot who was not instrument-current and had NVGs. This meant that the equipment/crew pairing was capable of operating in dark night VMC conditions but not in IMC. Inadvertent encounters with IMC would result in a high risk. One prudent organizational strategy for managing this risk should have entailed establishing minimum VFR weather requirements that provide some degree of separation between the helicopter and weather conditions that could obscure a pilot's view of the natural horizon, with or without NVGs. However, as discussed previously, the Alaska DPS did not apply across-the-board VFR weather minimums to its helicopter pilots, other than FAA requirements.

The Part 91 regulations that applied to Alaska DPS flights required only that the helicopter be operated clear of clouds below 1,200 ft. In contrast, for HEMS operations conducted under Part 135, the FAA established NVG weather minimums. These minimums, which are part of a HEMS-specific operations specification, range from an 800-ft ceiling and 3-mi visibility for a local flight in nonmountainous terrain to a 1,000-ft ceiling and 5-mi visibility for cross-country flights in mountainous terrain. Neither the pilot's stated personal weather minimums for night NVG VFR helicopter operation (200 ft and 5-mi visibility) nor the minimums that Alaska DPS had on file for him (500 ft and 2-mi visibility) provided an adequate safety margin for the night SAR mission, particularly considering the adverse effects of precipitation and low light on both NVG image quality and the pilot's ability to see and avoid clouds. The pilot's lack of instrument currency and actual instrument experience in helicopters, as well as the helicopter's VFR-only platform, further increased the risk.

The pilot was not required to complete any standardized preflight risk assessment process, either before accepting a mission or while conducting a mission to help evaluate risk as new variables (such as deteriorating weather conditions) were introduced. In addition, Alaska

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<sup>58</sup> Although the outside air temperature was near freezing, survival gear reported to be on board the helicopter included sleeping bags, and the cabin heater could be used when the helicopter's engine was running.

DPS did not ensure that anyone with suitable aviation expertise other than the accident pilot was overseeing the go/no-go decision for each mission. Although an Alaska DPS SAR coordinator was required to authorize every mission for the accident helicopter, the SAR coordinator generally was not involved in weather-related decision-making. The SAR coordinator who authorized the accident mission was a low-time (about 150 hours of flight experience), fixed-wing pilot who had no helicopter experience. He did not discuss weather conditions with the pilot, and he said that he and the other Alaska DPS SAR coordinators normally relied on the pilots to decide whether it was appropriate for them to accept a mission. The accident pilot was not required to fill out any kind of operational risk form, and no Alaska DPS supervisor or manager was required to review or approve a pilot's decision to accept a mission, even if a mission was determined to be high risk.

As previously discussed, information available at the time the pilot was notified indicated that the mission was potentially high risk, and this risk increased during the mission as weather conditions deteriorated. One way for the Alaska DPS to mitigate the risk would be to assign two pilots or one pilot and one trained observer or TFO who could assist with aeronautical decision-making and other tasks that could ease the pilot's workload. Alternatively, the Alaska DPS could have decided that the helicopter and pilot were not appropriate assets for this particular mission. In that case, the SAR coordinator could have organized a ground search party and, if air assets were deemed essential for the mission, referred it to the RCC. The RCC could then have requested a more appropriate platform from the Alaska Air National Guard, such as an IFR-capable HH-60 helicopter equipped with a two-pilot, IFR-trained and current crew. Although the Alaska Air National Guard was capable of flying under IFR in zero-visibility conditions, it followed Air Force training weather minimums of a 700-ft ceiling and 2-mi visibility for night NVG flights (a more conservative ceiling minimum than the accident pilot's), so its pilots might have deferred the mission as well.

In this case, the pilot was not required to perform a formal, systematic risk assessment before or during the mission, and no one else assisted the pilot in evaluating mission-related risk. Thus, the NTSB concludes that the Alaska DPS lacked organizational policies and procedures to ensure that operational risk was appropriately managed, such as formal pilot weather minimums, preflight risk assessment forms, or secondary assessment by another qualified person trained in helicopter flight operations that would have encouraged the pilot to decline the mission or take steps to mitigate weather-related risks.

The development of formal risk assessment procedures and the involvement of another qualified helicopter SAR professional who is one step removed from the launch decision (similar to the procedures the NTSB has previously recommended for HEMS operators) could help Alaska DPS pilots systematically identify hazards and ensure that launch decisions are appropriate, any hazards are appropriately mitigated before the start of a mission, and the hazards are continuously evaluated as the mission progresses.

Alaska DPS has made some progress since the accident by implementing the use of formal risk assessments for every helicopter mission. These measures are important improvements that can help enhance the safety of DPS flight operations. The NTSB, however, is concerned that these efforts do not ensure that employees who are supporting the flight crews in the systematic evaluation of flight risks are adequately trained and knowledgeable about aviation

operations. Therefore, the NTSB recommends that the state of Alaska develop and implement a flight risk evaluation program that includes training for all employees involved in the operation and procedures that support the systematic evaluation of flight risks and consultation with others trained in flight operations if the risks reach a predefined level.

In addition, although the MatCom dispatchers who were communicating with the accident flight were highly trained and capable of precisely tracking AST ground vehicle operations, they were not trained in aviation operations, did not handle aircraft flight plans, and could not provide up-to-date weather information or assist with other flight-risk assessment tasks. The Alaska DPS has taken measures since the accident to equip most aircraft with flight-tracking capability and to provide for flight-following using the RCC, MatCom, and authorized supervisors. The NTSB concludes that the Alaska DPS's reliance on nonaviation-trained dispatchers for dispatch and flight-following support does not ensure that flight crews have adequate access to up-to-date weather information and qualified assistance with flight risk assessment tasks. For example, although it is unknown if the pilot had cell coverage at the remote landing site to call for updated weather information, the flight made radio contact with dispatch 3 min after departure. Had the pilot or the flight observer been communicating with an aviation-trained dispatcher dedicated to providing up-to-date weather information, flight-following, and assisting with other flight risk assessment tasks, it is possible that such a resource would have been aware that the weather conditions observed at TKA included a changeover to snow occurring at 2312 as reported in the 2314 special METAR and notified the flight, which had just departed. Also, the delays that occurred between the time that the helicopter crashed and when someone noticed that it was missing, and the difficulties in the passdown of accurate information on its status and its whereabouts, could have had severe consequences had there been survivors awaiting help. Therefore, the NTSB recommends that the state of Alaska use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance with flight risk assessment decisions.

#### **2.4.2 Pilot Training**

Although the FAA requires certain commercial operators to receive FAA approval before conducting NVG operations, the Alaska DPS, as a public aircraft operator, was not subject to such requirements and did not have a formal NVG training program. The former relief pilot for the accident helicopter said that the accident pilot was the only person he had “ever qualified within the department to fly goggles and that was based on his previous military NVG qualification.” Investigators could find no record that the pilot received formal NVG training in the military.

Formal NVG training emphasizes the limits of NVG capability, including the sudden and unpredictable effects that precipitation can have on NVG image quality and the tendency to fly lower when NVG images degrade. The pilot's personal weather minimums and his actions during the accident flight suggest a lack of awareness or appreciation of these hazards. This might have been rectified through completion of a comprehensive NVG training course. The pilot's accident in 2006 occurred while he was using NVGs, and a goal listed on his January 2010 performance evaluation was to update his training in the NVG environment by attending a commercial initial NVG course. However, the pilot's 2011 performance evaluation indicated that this goal was reconsidered due to the cost of the course.

The NTSB concludes that the Alaska DPS did not provide the pilot with training that could have helped him recognize the hazards that precipitation and low light conditions pose to NVG operations. Such training could improve safety, for the reasons discussed above, particularly for helicopter SAR operations. Further, such training is available from commercial vendors. The Alaska DPS reported that it has suspended NVG operations until a formal training program is implemented. Therefore, the NTSB recommends that the state of Alaska provide all pilots who will perform NVG operations with formal NVG ground and flight training and require them to complete this training on an annual basis to remain on flight status.

The pilot also had not received any IFR helicopter training from Alaska DPS, and he was not IFR-current in the helicopter. In addition, he had not received simulator training on strategies and techniques for recognizing, avoiding, and escaping inadvertent encounters with IMC. This lack of training was problematic for an operation without conservative weather minimums where operations at night and in close proximity to clouds greatly increased the risk of inadvertent encounters with IMC. Research indicates that inadvertent IMC training can improve pilot control and increase the likelihood of surviving such encounters. Such training might have recalibrated the pilot's risk tolerance for situations involving continued VFR flight in IFR conditions, motivated him to avoid them, and helped him to maintain control of the helicopter in the event of an inadvertent encounter with IMC.

The NTSB investigated a previous accident in which a state law enforcement helicopter pilot lost control of a helicopter operated by the NMSP after inadvertently encountering IMC and was unable to safely escape the conditions. That pilot was not instrument qualified in helicopters. The NTSB concludes that pilots involved in SAR missions could benefit from initial and recurrent training on how to recognize, avoid, and safely recover from inadvertent flight into IMC. Although the Alaska DPS informed NTSB investigators that, since the accident, all of its active AS350 helicopter pilots attended inadvertent IMC training, its plans for ensuring ongoing training were unclear. Therefore, the NTSB recommends that the state of Alaska require all pilots who perform state law enforcement SAR missions to receive, on an annual basis, scenario-based simulator training in inadvertent IMC that includes strategies for recognizing, avoiding, and safely escaping the conditions.

In the course of this investigation, investigators had difficulty identifying research validating the effectiveness of currently available commercial helicopter inadvertent IMC training programs or identifying guidelines on best practices for helicopter inadvertent IMC training programs. For example, the FAA's *Helicopter Instructor's Handbook* does not include any information on inadvertent IMC training. Feedback received from the Alaska DPS since the accident indicates that DPS pilots who participated in an inadvertent IMC training program (through a commercial vendor) had questions about its effectiveness. The NTSB concludes that operators lack adequate information about best practices for helicopter inadvertent IMC training. Beginning in 2015, helicopter inadvertent IMC training will be required for all helicopter pilots conducting operations under Part 135. It is essential that the effectiveness of this training be evaluated and that the most effective strategies for conducting such training be identified. Therefore, the NTSB recommends that the FAA work with operators, training providers, and industry groups to evaluate the effectiveness of current training programs for helicopter pilots in inadvertent IMC, and develop and publish best practices for such training.

### 2.4.3 Use of Trained Observers

The AMRG volunteer who often flew with the pilot was unavailable on the day of the accident. When flying with the accident pilot, he typically would have operated the Garmin 430 and Avalex displays and performed other tasks, including setting up navigational courses, selecting radio frequencies, resetting the circuit breaker to enable the turn-and-bank indicator, or calling out terrain and obstacles. Current and former relief pilots for the accident helicopter said that they liked to have a trained observer in the left seat to operate the Garmin 430 and Avalex for them, especially when flying at night using NVGs. The AMRG volunteer also had been trained to use NVGs and, if he had been with the pilot, likely would have been wearing NVGs. This would have been an additional person who could have helped to assess weather conditions and maintain visual contact with the ground.

Operating the Garmin 430 and Avalex display requires significant training and familiarization. The trooper who was on the accident mission had no such exposure and, therefore, could not assist the pilot with such tasks. Also, the trooper was not trained on or equipped with NVGs; thus, he would not have been able to maintain visual contact with the ground or help visually identify obstacles. As discussed previously, the pilot had to handle all navigational tasks himself during the accident flight, and he did not optimally configure the helicopter's navigational equipment and flight instruments before departure. A second crewmember trained in the use of the helicopter's navigational and communications systems could have assisted with operating the systems and performing other flight-related tasks. This could have reduced the pilot's workload and, thereby, reduced his potential for distraction and risk of spatial disorientation, particularly during his attempted transition to instrument flight.

Aside from operating the onboard equipment, a second crewmember (such as a TFO) trained in aeronautical decision-making could have assisted the pilot by helping him obtain updated weather information on the ground or in the air, encouraging him to defer his departure from the remote landing site, or urging him to land when the helicopter encountered extremely low ceilings and visibility. A TFO could also evaluate other courses of action such as choosing a route over lower terrain, which may have been free from clouds or afforded more emergency landing opportunities. Thus, the pilot's decision-making could have been enhanced during the accident flight through the support of a trained observer or TFO. Therefore, the NTSB concludes that a TFO who was capable of assisting the pilot with aeronautical decision-making and operating the helicopter's navigational systems and displays could have helped mitigate risk.

The primary Alaska DPS SAR coordinator stated that the decision to use trained volunteer observers was totally up to the pilot and was based on the pilot's personal relationships with members of the volunteer SAR community. The former relief pilot for the helicopter said that the aircraft section had attempted to train some troopers in the use of helicopter equipment such as the FLIR but that those trained officers were often unavailable for SAR missions due to scheduling conflicts. The current aircraft section commander said he had never met any of the volunteer observers, including the AMRG observer, and was not familiar with the training they had received.

A former Alaska state trooper who served as the state SAR coordinator from 2004-07 and 2010-11 said that the pilot had, with his approval, developed a TFO training program. This

training program was designed to familiarize volunteer TFOs with the Avalex display, FLIR, spotlight, and the use of NVGs. The pilot planned to train six to eight volunteer TFOs in the hangar during his normal duty hours so that a trained observer would always be available for helicopter SAR missions. However, after the former SAR coordinator left that role in 2011, management support for the TFO training program waned and the training program faded away. Because the helicopter had a limited payload and many missions required law enforcement personnel, Alaska DPS management decided that in many cases it would be more appropriate to have the pilot pick up an on-duty state trooper rather than fly with a SAR volunteer. Commissioned troopers generally did not have the same level of training in helicopter operations as volunteer TFOs, and the former SAR coordinator believed Alaska DPS management did not adequately consider the impact of this change on operational safety.

Following the accident, the Alaska DPS reported that it has reduced its SAR aircraft availability to meet the current staffing levels of the aircraft section and that it is developing a formal TFO training program. However, the NTSB notes that the pilot's efforts to start such a program in the past were unsuccessful. The NTSB concludes that, although a TFO program had been recognized by Alaska DPS personnel as a means of improving the safety of helicopter SAR operations, inadequate support for the program at various levels of the organization led to the unavailability of a TFO or other trained observer on the day of the accident. Therefore, the NTSB recommends that the state of Alaska create a formal TFO training program that includes training on aeronautical decision-making, crew resource management, and operating aircraft navigational and communications equipment, and use TFOs during SAR operations.

#### **2.4.4 Safety Management and Safety Culture**

The Alaska DPS investigations of the pilot's previous accident and other events involving the pilot and the accident helicopter provided some insight into the organization's approach to safety management and its underlying safety culture. During its internal review of the pilot's accident with the helicopter in 2006, in which the pilot became disoriented when his vision became obscured by blowing snow during a night NVG takeoff from a frozen lake, the Alaska DPS cited the choice of a VFR departure versus an IFR instrument departure as causal to the accident.

This determination that the accident resulted, in part, from the pilot's decision to perform a VFR rather than an IFR takeoff, was inappropriate and failed to acknowledge critical underlying safety issues. Because the pilot was not IFR current in helicopters and the helicopter was not certificated or equipped for IFR flight, performing an IFR takeoff was not an option. Had the Alaska DPS's investigation been more focused on identifying systemic safety issues, it may have identified that it had not provided the pilot with simulator training in IFR flying or inadvertent IMC encounters and had not imposed adequate weather minimums to maintain separation between the VFR-only operation and IMC. As a result, the Alaska DPS missed an opportunity to identify and correct some of the latent safety deficiencies that again presented themselves in the 2013 accident. Without improvements to pilot training and operational policies, the risk of another inadvertent IMC accident remained high.

DPS investigations of other events also narrowly focused on the actions of the pilot while disregarding the organization's management of flight-related risks. For example, although the

Alaska DPS investigations of the pilot's 2006 accident and the 2009 engine and rotor overspeed event both mentioned the pilot's work schedule, in 2013, the pilot was still allowed to schedule himself for long workdays and extended periods without a day off.<sup>59</sup> Thus, the Alaska DPS did not effectively manage its flight time and duty policies or evaluate the adequacy of its staffing levels to support around-the-clock, on-call SAR availability (or reduce the helicopter's availability based on the available staff). The NTSB concludes that the Alaska DPS's investigation and analysis of the pilot's previous accident and other events were focused on the actions of the pilot and did not adequately identify and address systemic factors that could reduce the likelihood of a recurrence.

The Alaska DPS investigations of the pilot's aircraft accident and other events were focused on apportioning blame or liability. After a committee appointed by the AWT director completed its investigation of the pilot's 2006 accident, the pilot received a memorandum of warning informing him that the accident was due to "pilot error," specifically, his momentary distraction and inability to transition to instrument flight. The memorandum stressed the cost of the accident and warned the pilot that future events could lead to more severe disciplinary action. It stated, "the fact that you took responsibility for the accident and showed great remorse weighs heavily in how the department views this incident," indicating that the pilot's acceptance of liability was considered an important part of the investigation. The AMRG observer indicated that the pilot was concerned about losing his job in the wake of the accident.

The Alaska DPS investigation of the 2009 overspeed event also focused extensively on the culpability of the pilot. Although the pilot reported that a malfunction of the fuel control had initiated the event, the former relief pilot suspected that the pilot had initiated it by moving the collective in an "aggressive manner," and he arranged to have a captain from an outlying post lead an investigation of the incident. The AMRG observer said the pilot was again concerned about losing his job, and the pilot's wife said that he "fought tooth and nail" to be exonerated. Physical findings from a manufacturer's inspection of engine components suggested that a corroded fuel metering needle had frozen in place, initiating the event. However DPS officials determined the cause of the incident to be "inconclusive." After that, the pilot felt distrustful of his colleagues in the aircraft section. According to the lead mechanic and others, the pilot felt that everybody in the organization was against him.

Although the Appareo unit provided the NTSB's investigation with valuable information (discussed in section 2.7), the Alaska DPS management had not installed it for safety-related purposes, such as image and data reviews by the safety officer to monitor the safety of flight operations.<sup>60</sup> Around the time of the 2009 overspeed event, the AWT director suspected that the pilot had tried to conceal his role in some damage that was done to the tail rotor of a Robinson R-44 helicopter. Inspection of the tail rotor assembly indicated that the damage could have resulted from a water strike, but the pilot denied that he had experienced a water strike. The AWT director said that when the pilot was questioned about events like the overspeed or the damaged tail rotor, "it was never his fault" and there was nothing that the AWT director could do

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<sup>59</sup> Shortly before the accident, the AWT deputy director proposed that the relief pilot serve as the primary pilot for the helicopter 2 days a week to give the pilot regularly scheduled days off. However, the accident occurred before this schedule could be implemented.

<sup>60</sup> The Alaska DPS reported in August 2014 that such reviews now occur.



to “take sanctions” against the pilot. As a result, the AWT director told the aircraft section supervisor to research onboard monitoring equipment that could be installed in the helicopter. As a result, the AWT director learned about the Appareo recorder, and he insisted that it be purchased and installed.

Thus, Alaska DPS investigations of the pilot’s past incidents and accident appeared to be punitive in nature. As a result, it appears that the pilot was motivated to conceal safety-related information. After experiencing a brief overtorque event in the helicopter in 2011, for example, the pilot inspected the helicopter, determined that costly repairs were not needed, and signed off the inspection without notifying his supervisor or the helicopter’s maintenance personnel. Maintenance technicians later discovered the pilot’s sign-off in the helicopter’s maintenance logbook, and one of them called an FAA safety hotline, prompting an FAA inspection of the helicopter’s maintenance records. Although the FAA determined that the pilot (as an airframe and powerplant mechanic) was qualified to perform and sign off the inspection, the pilot’s handling of the matter prompted a meeting between the pilot and the AWT director, as well as the issuance of a formal letter by the Alaska DPS stating that the pilot should report any similar future events to the maintenance department in a timely manner.

Any organization that wishes to actively manage safety as part of an effective SMS must continuously strive to discover, understand, and mitigate the risks involved in its operations. This includes establishing a just culture in which mutually agreed principles are established to draw a clear line between acceptable and unacceptable employee behaviors and in which employees are not punished for most unintentional errors. Closely related to just culture is the concept of a reporting culture in which employees are encouraged and even incentivized to participate in the reporting of hazards. Also important is a flexible culture that is capable of adapting to shifting demands and a learning culture that fosters change as a result of information generated by SMS-related activities, including the internal review of past accidents. All of these activities can foster the open sharing of safety-related information that can be used to implement more effective strategies for mitigating related risks. However, an effective SMS requires the active engagement of front-line personnel in the reporting of operational risks and their participation in using the information obtained to develop effective risk mitigation strategies. This cannot occur if a focus of the organization’s approach to dealing with safety-related events is to punish those whose actions or inactions contributed to the event. Although front-line operators may, on rare occasions, be involved in intentional misdeeds, the majority of accidents and incidents involve unintentional errors made by well-intentioned operators who are doing their best to manage competing performance and safety goals. An organizational safety culture that encourages the adoption of an overly punitive approach to investigating safety-related events tends to discourage the open sharing of safety-related information and degrade the organization’s ability to adapt to operational risks.

The Alaska DPS safety culture, which seemed to overemphasize the culpability of the pilot in his past accident and events, appears to have had this effect. The pilot had adopted a defensive posture with respect to the organization and was concealing—rather than openly sharing—safety-related information. He was largely setting his own operational limitations and making safety-related operational decisions in a vacuum, masking potential risks, such as the risk posed by his operation of helicopter NVG flights at night in low IFR conditions. This had a deleterious effect on the organization’s efforts to manage the overall safety of its SAR operations

and hindered its ability to implement more effective strategies for mitigating related risks, such as the development of SAR prelaunch and midlaunch risk assessment protocols. Therefore, the NTSB concludes that the Alaska DPS had a punitive culture that impeded the free flow of safety-related information and impaired the organization's ability to address underlying safety deficiencies relevant to this accident.

The recently retired aircraft section supervisor identified other cultural and structural deficiencies in the organization's approach to safety management. She told investigators that an Alaska DPS captain asked her to get the DPS involved in the Medallion Foundation and that, beginning in 2010, she devoted considerable effort to developing Alaska DPS's SMS program in accordance with Medallion Foundation guidelines. This effort included the development of a hazard reporting system and safety committee. Although the development of these and other safety mechanisms were sufficient to earn a Medallion Foundation star, the aircraft section supervisor told investigators that the safety program lacked high-level Alaska DPS support and, as a result, there was a lack of Alaska DPS pilot confidence and participation in the program.

Trooper pilots did not see the value in participating in the program and would only participate if directed to do so by their supervisors, but the recently retired aircraft section supervisor had little authority to encourage their participation. She was not a uniformed trooper, so she was not in their chain of command and trooper pilots did not report to her. Further, the chain of command for her position was modified in 2012 so that instead of reporting to a high-ranking manager (the colonel who was the AWT director), she reported to the lieutenant who served as the aircraft section commander, a lower-ranking new position. This undermined her influence as safety manager. As a result, trooper pilots and middle managers felt comfortable ignoring the safety policies that she, as safety manager, attempted to put in place.

In addition, the recently retired aircraft section supervisor had very little control over the aircraft section's budget. In 2012, for example, headquarters canceled the annual pilot safety seminar because of a lack of funds. The recently retired aircraft section supervisor said that she felt that the 3-day seminar was important because it was the only time when about 40 trooper pilots were brought together from their stations around the state to receive information about safety issues. However, she had little budgetary control and could not directly countermand this or other decisions affecting safety resources. As a result of these and other factors, she felt that the impact of the safety program on the safety of Alaska DPS aircraft operations was limited.

The recently retired aircraft section supervisor said that she assumed that the aircraft section commander would take over as the manager of the safety program when she left. However, the aircraft section commander said that he was not well versed in the aircraft section supervisor's activities in her role as safety manager. A safety policy statement posted in the main hangar that was signed by the AWT director stated, "A safety manager who is experienced in safety programs will be appointed and will have the responsibility and authority to manage the Alaska DPS aviation safety program. The safety manager should be contacted in regards to any questions or recommendations." However, 3 months after the aircraft section supervisor's retirement, no safety manager had been formally appointed, no safety committee meetings had been held, and the Alaska DPS safety program had effectively ceased operating. The NTSB concludes that, as a result of inadequate high-level management support, the Alaska DPS lacked

a safety program that was capable of correcting latent deficiencies identified in this accident, including deficiencies in training and risk management.

Correcting these deficiencies can be accomplished by ensuring high-level management support, dedicating sufficient resources to safety, and modifying Alaska DPS's safety program structure, policies, and procedures so that they are in line with industry best practices and tailored to the department's mission. Research indicates that the involvement of senior management in sponsoring and supporting safety policies and related resources is key to the continued success of organizational safety programs (Smith and others 1978; Shannon, Mayr, and Haines 1997). Through their policies and actions, senior managers also play a key role in fostering an organizational safety culture that is conducive to the development of an effective SMS.

In recent years, the International Civil Aviation Organization (through its *Safety Management Manual*), the FAA (through its *Safety Management Systems for Aviation Service Providers* advisory circular), the International Helicopter Safety Team (through its *Safety Management System Toolkit*), ALEA (through its *Safety Management System Toolkit*), and the NTSB (through accident investigations and safety recommendations [NTSB 2007, 2009]) have encouraged aviation service providers to adopt SMS programs. As noted in the NTSB's Safety Recommendation A-11-53 to the state of New Mexico, suitable guidance tailored to the needs of law enforcement agencies conducting public aircraft operations is available from organizations such as ALEA. Therefore, the NTSB recommends that the state of Alaska develop and implement a comprehensive SMS for aircraft operations that (1) holds senior state personnel accountable for the safety of state law enforcement aircraft operations, (2) is tailored to the department's missions, and (3) is based on industry best practices. Since the accident, the Alaska DPS had a third-party maintenance audit conducted and, at the time of this report, had scheduled operation and training audits. The Alaska DPS stated that all audits include a safety component for inclusion in the safety program. The NTSB is encouraged by such progress and believes that ongoing reviews are vital to ensuring the program's effectiveness, improvement, and success. Therefore, the NTSB recommends that the state of Alaska arrange for an audit of the SMS implemented in response to Safety Recommendation A-14-105 to be conducted every 3 years by an outside organization.

## 2.5 Similarities with Other Public Aircraft Operations Accidents

As referenced in sections 1.9.2 and 1.9.3, the NTSB has investigated previous accidents involving state law enforcement helicopters that crashed while conducting public aircraft operations, such as during SAR or HEMS missions (as with the NMSP and Maryland State Police accidents, respectively). Because of the similarities between the safety issues identified in those accidents and this accident, the NTSB is concerned that the problems may be widespread. The NTSB concludes that all law enforcement agencies of each state, territory, and the District of Columbia that conduct public aircraft operations<sup>61</sup> can benefit from an effective flight risk evaluation program, formalized dispatch and flight-following procedures, NVG and inadvertent

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<sup>61</sup> An NTSB review found that, at the time of this report, the law enforcement agencies of the following states and territories do not conduct public aircraft operations: Hawaii, Idaho, Rhode Island, Vermont, Wyoming, Guam, American Samoa, US Virgin Islands, and Northern Mariana Islands.

IMC training for pilots, a formal TFO program, and a comprehensive SMS. Therefore, the NTSB recommends that, in addition to Alaska, 44 states, the Commonwealth of Puerto Rico, and the District of Columbia do the following:

Develop and implement a flight risk evaluation program that includes training for all employees involved in the operation and procedures that support the systematic evaluation of flight risks and consultation with others trained in flight operations if the risks reach a predefined level.

Use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance with flight risk assessment decisions.

Provide all pilots who will perform NVG operations with formal NVG ground and flight training and require them to complete this training on an annual basis to remain on flight status.

Require all pilots who perform state law enforcement SAR missions to receive, on an annual basis, scenario-based simulator training in inadvertent IMC that includes strategies for recognizing, avoiding, and safely escaping the conditions.

Create a formal TFO training program that includes training on aeronautical decision-making, crew resource management, and operating aircraft navigational and communications equipment, and use TFOs during SAR operations.

Develop and implement a comprehensive SMS for aircraft operations that (1) holds senior state personnel accountable for the safety of state law enforcement aircraft operations, (2) is tailored to the department's missions, and (3) is based on industry best practices.

Arrange for an audit of the SMS implemented in response to Safety Recommendation A-14-105 to be conducted every 3 years by an outside organization.

## 2.6 Attitude Indicator Limitations

As discussed in section 2.2, about 40 seconds after the helicopter entered IMC, the pilot caged the attitude indicator, likely because he distrusted the information the instrument was displaying. Although the reason the pilot distrusted the information cannot be known, the investigation considered two possible explanations.

One possible explanation is that the pilot might have distrusted the attitude display because he was spatially disoriented. Maneuvering flight without external visual references can lead to a variety of illusions of motion, which can result in inaccurate perceptions of an aircraft's attitude and trajectory. A number of risk factors for spatial disorientation preceded the pilot's operation of the caging knob. These included the pilot's lack of instrument flying currency, the loss of external visual references, his unplanned transition to instrument flight, aggressive maneuvering, and operational distractions related to setting up the navigational instruments for

flight in IMC. Research indicates that spatial disorientation can result in false perceptions of instrument malfunction. In a 2002 spatial disorientation survey, for example, 18% of US Air Force pilots operating rotary wing aircraft reported having experienced at least one instance of illusory instrument malfunction (Matthews and others 2002).

Another possible explanation is related to the instrument's limitations. According to information provided by the attitude indicator's manufacturer, the AIM 1200 attitude indicator is limited to indicating  $\pm 25^\circ$  of pitch. Thus, if an aircraft were to operate at a pitch that exceeded the limitation, the pitch indicator would stop and remain at the limit until the pitch no longer exceeded the limitation. Image evidence shows that, during the first 30 seconds after the helicopter entered IMC, the pitch increased from about  $0^\circ$  to at least  $17^\circ$  nose up. Although pitch indications on the attitude indicator higher than about  $17^\circ$  could not be accurately measured from the cockpit images, the images show that the indicated pitch remained above  $17^\circ$  from 2318:28 to 2318:40. This is consistent with the attitude indicator stopping at  $25^\circ$  and remaining there as the helicopter continued pitching up. Although the operating manual for the AIM 1200 did not include information about the pitch indicating range limits, even if it had, and the pilot were aware of it, it is uncertain whether the pilot would have immediately understood this instrument behavior upon encountering it in a high-stress, high-workload situation. Therefore, it is possible that the helicopter's attitude indicator reached its pitch limit and stopped moving, and the pilot interpreted this as a malfunction and instinctively attempted to "unstick" the instrument by pulling the caging knob.

The AIM-1200, a model commonly installed in many airplanes and helicopters, meets the FAA's technical standard order (TSO) for bank and pitch instruments, which requires a pitch indication range of at least  $\pm 25^\circ$ . However, the instrument's operating manual did not note the pitch indication limits. Further, a review the FAA's *Helicopter Flying Handbook*, *Instrument Flying Handbook*, and *Pilot's Handbook of Aeronautical Knowledge* revealed that they do not inform pilots that attitude indicators have pitch and bank indication limits, that the pitch indicating range is required to be at least  $\pm 25^\circ$ , and that if an aircraft operates at a pitch that exceeds the indicating limits, the pitch indicator may stop and remain at the limit until the pitch no longer exceeds the limitation, or the pitch indicator may tumble.

Further, the NTSB's review of the information on attitude indicators in the *Pilot's Handbook of Aeronautical Knowledge* revealed that it contains information on attitude indicator limitations that is unclear and may be misleading. The handbook states the following:

The pitch and bank limits depend upon the make and model of the instrument. Limits in the banking plane are usually from  $100^\circ$  to  $110^\circ$ , and the pitch limits are usually from  $60^\circ$  to  $70^\circ$ . If either limit is exceeded, the instrument will tumble or spill and will give incorrect indications until realigned.

It is unclear whether this passage is discussing operating limits or indicating limits. This could mislead a pilot into concluding that attitude indicators commonly have pitch indication ranges from  $\pm 60^\circ$  to  $70^\circ$ , although the TSO requirement is only from  $\pm 25^\circ$ . Further, the passage suggests that if an indication limit is reached, the instrument will tumble, rather than stop moving as the AIM-1200 does.

Although it is uncertain whether knowledge of the attitude indicator's limitations would have changed the pilot's actions in this accident, the NTSB believes that it is critical for pilots to have a complete understanding of how each flight instrument functions to safely conduct flight in IMC. As stated in the FAA's *Helicopter Flying Handbook* (FAA-H-8083-21A, Chapter 12, Attitude Instrument Flying, page 12-2), "when attitude instrument flying, it is crucial for the pilot to understand how a particular instrument or system functions, including its indications and limitations." Without knowledge of the limitations of the attitude indicator, an instrument essential for maintaining aircraft control during instrument flight, pilots who encounter these limitations during a high-workload, high-stress situation may react improperly, as the accident pilot may have, by caging the attitude indicator.

The NTSB concludes that because of the lack of accurate, comprehensive information about attitude indication limitations in FAA publications, such as the *Helicopter Flying Handbook*, *Instrument Flying Handbook*, and *Pilot's Handbook of Aeronautical Knowledge*, pilots are likely unaware that attitude indicators have pitch indication ranges that may be limited to  $\pm 25^\circ$ . Therefore, the NTSB recommends that the FAA issue guidance to pilots explaining that attitude indicators have pitch and bank indication limits, that the pitch indicating range is required to be at least  $\pm 25^\circ$ , and that, if an aircraft operates at a pitch that exceeds the indicating limits, the pitch indicator may stop and remain at the limit until the pitch no longer exceeds the limitation, or the pitch indicator may tumble. Further, the NTSB recommends that the FAA revise the *Pilot's Handbook of Aeronautical Knowledge* to clarify the information it contains on attitude indicator pitch and bank limitations to explain that attitude indicators have pitch and bank indication limits, that the pitch indicating range is required to be at least  $\pm 25^\circ$ , and that, if an aircraft operates at a pitch that exceeds the indicating limits, the pitch indicator may stop and remain at the limit until the pitch no longer exceeds the limitation, or the pitch indicator may tumble.

## 2.7 Investigative Benefits of Onboard Recorder

Although the helicopter's onboard Appareo unit was not a crash-resistant flight recorder system, it provided valuable information about the accident flight that helped investigators identify safety issues that would not have been otherwise detectable. Images captured by the recorder provided information about where the pilot's attention was directed, his interaction with the helicopter controls and systems, and the status of cockpit instruments and system indicator lights, including those that provided information about the helicopter's position (like the attitude indicator), engine operation, and systems. Because of these images, the investigation was able to determine precisely how the cockpit navigational displays were configured and that the pilot caged the attitude indicator in flight.

The images, combined with the wreckage examination, also enabled the investigation to conclusively determine that icing was not a factor in the accident and that there were no mechanical anomalies with the helicopter. The NTSB concludes that the information provided by the onboard recorder provided critical information early in the investigation that enabled investigators to make conclusive determinations about what happened during the accident flight and to more precisely focus the safety investigation on the issues that need to be addressed to prevent future accidents.

Because the unit was not a required installation, it was not required to comply with TSO C197. The Alaska DPS did not have the Appareo ICS optional audio link to the helicopter's intercom connected, so voice audio was not recorded. Also, the unit had not been calibrated correctly, which subjected the internal attitude data to inaccuracies. The NTSB believes that voice audio information and accurate sensor data would have been helpful to the investigation and notes that Alaska DPS now uses the optional audio link, and Appareo has revised its installation instructions to include the calibration procedures.

The NTSB has previously addressed the need for recording information on aircraft. On May 6, 2013, the NTSB issued Safety Recommendation A-13-13, which asked the FAA to do the following:

Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder or cockpit voice recorder 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 and images with 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 as specified in [TSO] C197, "Information Collection and Monitoring Systems."<sup>[62]</sup>

On December 10, 2013, the NTSB classified Safety Recommendation A-13-13 "Open—Unacceptable Response" because the FAA stated that it had not found any compelling evidence to require installation of cockpit image recording systems. The FAA stated that it planned no further action to mandate flight deck image recording systems and considered its actions for this recommendation complete. In an August 14, 2014, letter, the FAA repeated to the NTSB its decision not to act, citing costs to the industry, its inability to estimate the number of lives that could be saved or accidents that could be prevented, and its position of promoting and incentivizing the voluntary equipage of such recording systems. Despite the FAA's position, the NTSB continues to support the required installation of flight recorder systems because they enable accident investigators to identify safety issues that may not otherwise be detectable, which is critical to the prevention of future accidents.

On October 23, 2014, the NTSB reiterated Safety Recommendation A-13-13 following its investigation of the November 10, 2013, fatal accident involving a Mitsubishi MU-2B-25 airplane.<sup>63</sup> The airplane, which crashed after the pilot reported "a control problem" and "a left engine shutdown" to an air traffic controller, was not equipped with any type of recording device. The lack of available data significantly increased the difficulty in determining the safety issues that led to the accident. Specifically, the reasons for the pilot's loss of control of the airplane and the engine shutdown could not be determined. Postaccident examination and testing did not reveal evidence of any malfunction that would have precluded normal operations.

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<sup>62</sup> On that date, the NTSB also issued Safety Recommendation A-13-12, which asked the FAA to require the installation of such recorders on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft. Safety Recommendation A-13-12 is also classified "Open—Unacceptable Response."

<sup>63</sup> More information about this accident, NTSB cases number CEN14FA046, is available at [www.ntsb.gov/aviationquery/index.aspx](http://www.ntsb.gov/aviationquery/index.aspx).

Without any onboard recording devices, the investigation lacked valuable insight on the pilot's control inputs, the airplane's motions (such as pitch, bank, and yaw), and the time that the pilot's reported control and engine problems began.

The NTSB notes that it has a long history of recommending that the FAA require image recording devices on board certain aircraft.<sup>64</sup> The NTSB notes that, had the FAA required all turbine-powered, nonexperimental, nonrestricted-category aircraft operated under Parts 91, 135, and 121 to be equipped with crash-protected image recording system by January 1, 2007 (as the NTSB had recommended back in 2003), hundreds of aircraft involved in accidents would have been equipped with crash-resistant recording devices that may have provided investigators with valuable safety information. For example, a review of NTSB accident data shows that, since January 1, 2007, there were 466 accidents involving such aircraft, and these accidents claimed 246 lives. In addition, in 55 of these accidents, the probable cause statements contained some element of uncertainty, such as an undetermined cause or factor.

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<sup>64</sup> Safety Recommendation A-13-13 superseded Safety Recommendation A-03-64, which was issued on December 22, 2003, and asked the FAA to “[r]equire 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 [CFR] Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording system by January 1, 2007.” That safety recommendation (which superseded Safety Recommendation A-99-60) was superseded by Safety Recommendation A-09-10 and, therefore, was classified “Closed—Unacceptable Action/Superseded” on February 9, 2009.



## 3. Conclusions

### 3.1 Findings

1. The pilot was qualified to fly search and rescue missions in visual meteorological conditions (but not instrument meteorological conditions) in the accident helicopter, and his performance was unlikely affected by medical factors, fatigue, or physical activities associated with the ground portion of the rescue activity.
2. The in-flight image recording and wreckage examinations showed that the helicopter and its engine were operating normally throughout the flight. No mechanical abnormalities with the helicopter were identified.
3. Soon after departure from the remote landing site, the helicopter likely encountered instrument meteorological conditions, which included low clouds, heavy snow, and near-zero-visibility conditions.
4. Although icing conditions were likely present during the accident flight, the performance of the helicopter does not appear to have been degraded at the time of the accident.
5. The pilot experienced a total loss of external visual references while operating in close proximity to terrain, which led him to attempt to transition to instrument flight.
6. The pilot's action to cage the attitude indicator outside those conditions under which it could be safely caged indicates that he distrusted the information he was seeing.
7. The pilot's caging of the attitude indicator made it very unlikely that he would regain control of the helicopter in instrument meteorological conditions.
8. The helicopter's erratic maneuvers are consistent with the pilot's spatial disorientation, a loss of control in flight, and his inability to recover the helicopter because of his lack of instrument experience and the lack of accurate attitude information.
9. When the pilot was contacted about the mission, forecasts indicated that conditions in the search area would be instrument flight rules and that forecast cloud ceilings and visibility would likely be below the pilot's Alaska Department of Public Safety weather minimums and possibly below his last known personal weather minimums.
10. At the time the pilot was notified about the stranded snowmobiler, sufficient information was available to indicate that the mission carried a high degree of risk due to the weather and low lighting conditions.
11. The pilot's exceptionally high motivation for conducting search and rescue missions, which was influenced by multiple factors, likely played a part in his acceptance of the accident mission.

12. The pilot's exceptionally high motivation for search and rescue missions and past successes likely increased his risk tolerance and influenced his decision to continue flying in deteriorating weather conditions and risk a weather-related accident rather than accept the certain inconveniences and potential hazards associated with a precautionary landing.
13. The Alaska Department of Public Safety lacked organizational policies and procedures to ensure that operational risk was appropriately managed, such as formal pilot weather minimums, preflight risk assessment forms, or secondary assessment by another qualified person trained in helicopter flight operations that would have encouraged the pilot to decline the mission or take steps to mitigate weather-related risks.
14. The Alaska Department of Public Safety's reliance on nonaviation-trained dispatchers for dispatch and flight-following support does not ensure that flight crews have adequate access to up-to-date weather information and qualified assistance with flight risk assessment tasks.
15. The Alaska Department of Public Safety did not provide the pilot with training that could have helped him recognize the hazards that precipitation and low light conditions pose to night vision goggles operations.
16. Pilots involved in search and rescue missions could benefit from initial and recurrent training on how to recognize, avoid, and safely recover from inadvertent flight into instrument meteorological conditions.
17. Operators lack adequate information about best practices for helicopter inadvertent instrument meteorological conditions training.
18. A tactical flight officer who was capable of assisting the pilot with aeronautical decision-making and operating the helicopter's navigational systems and displays could have helped mitigate risk.
19. Although a tactical flight officer (TFO) program had been recognized by Alaska Department of Public Safety personnel as a means of improving the safety of helicopter search and rescue operations, inadequate support for the program at various levels of the organization led to the unavailability of a TFO or other trained observer on the day of the accident.
20. The Alaska Department of Public Safety's investigation and analysis of the pilot's previous accident and other events were focused on the actions of the pilot and did not adequately identify and address systemic factors that could reduce the likelihood of a recurrence.
21. The Alaska Department of Public Safety had a punitive culture that impeded the free flow of safety-related information and impaired the organization's ability to address underlying safety deficiencies relevant to this accident.
22. As a result of inadequate high-level management support, the Alaska Department of Public Safety lacked a safety program that was capable of correcting latent deficiencies identified in this accident, including deficiencies in training and risk management.

23. All law enforcement agencies of each state, territory, and the District of Columbia that conduct public aircraft operations can benefit from an effective flight risk evaluation program, formalized dispatch and flight-following procedures, night vision goggles and inadvertent instrument meteorological conditions training for pilots, a formal tactical flight officer program, and a comprehensive safety management system.
24. Because of the lack of accurate, comprehensive information about attitude indication limitations in Federal Aviation Administration publications, such as the *Helicopter Flying Handbook*, *Instrument Flying Handbook*, and *Pilot's Handbook of Aeronautical Knowledge*, pilots are likely unaware that attitude indicators have pitch indication ranges that may be limited to  $\pm 25^\circ$ .
25. Information provided by the onboard recorder provided critical information early in the investigation that enabled investigators to make conclusive determinations about what happened during the accident flight and to more precisely focus the safety investigation on the issues that need to be addressed to prevent future accidents.

### **3.2 Probable Cause**

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's decision to continue flight under visual flight rules into deteriorating weather conditions, which resulted in the pilot's spatial disorientation and loss of control. Also causal was the Alaska Department of Public Safety's punitive culture and inadequate safety management, which prevented the organization from identifying and correcting latent deficiencies in risk management and pilot training. Contributing to the accident was the pilot's exceptionally high motivation to complete search and rescue missions, which increased his risk tolerance and adversely affected his decision-making.

## 4. Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following recommendations:

**To the state of Alaska, 44 additional states, the Commonwealth of Puerto Rico, and the District of Columbia:**

Develop and implement a flight risk evaluation program that includes training for all employees involved in the operation and procedures that support the systematic evaluation of flight risks and consultation with others trained in flight operations if the risks reach a predefined level. (A-14-100)

Use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance with flight risk assessment decisions. (A-14-101)

Provide all pilots who will perform night vision goggle (NVG) operations with formal NVG ground and flight training and require them to complete this training on an annual basis to remain on flight status. (A-14-102)

Require all pilots who perform state law enforcement search and rescue missions to receive, on an annual basis, scenario-based simulator training in inadvertent instrument meteorological conditions that includes strategies for recognizing, avoiding, and safely escaping the conditions. (A-14-103)

Create a formal tactical flight officer (TFO) training program that includes training on aeronautical decision-making, crew resource management, and operating aircraft navigational and communications equipment, and use TFOs during search and rescue operations. (A-14-104)

Develop and implement a comprehensive safety management system for aircraft operations that (1) holds senior state personnel accountable for the safety of state law enforcement aircraft operations, (2) is tailored to the department's missions, and (3) is based on industry best practices. (A-14-105)

Arrange for an audit of the safety management system implemented in response to Safety Recommendation A-14-105 to be conducted every 3 years by an outside organization. (A-14-106)

**To the Federal Aviation Administration:**

Work with operators, training providers, and industry groups to evaluate the effectiveness of current training programs for helicopter pilots in inadvertent instrument meteorological conditions, and develop and publish best practices for such training. (A-14-107)

Issue guidance to pilots explaining that attitude indicators have pitch and bank indication limits, that the pitch indicating range is required to be at least  $\pm 25^\circ$ , and that, if an aircraft operates at a pitch that exceeds the indicating limits, the pitch indicator may stop and remain at the limit until the pitch no longer exceeds the limitation, or the pitch indicator may tumble. (A-14-108)

Revise the *Pilot's Handbook of Aeronautical Knowledge* to clarify the information it contains on attitude indicator pitch and bank limitations to explain that attitude indicators have pitch and bank indication limits, that the pitch indicating range is required to be at least  $\pm 25^\circ$ , and that, if an aircraft operates at a pitch that exceeds the indicating limits, the pitch indicator may stop and remain at the limit until the pitch no longer exceeds the limitation, or the pitch indicator may tumble. (A-14-109)

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