National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 10, 2011

In reply refer to: A-11-53 through -55

The Honorable Susana Martinez
Governor, State of New Mexico
Office of the Governor
490 Old Santa Fe Trail
Room 400
Santa Fe, New Mexico 87501

The National Transportation Safety Board (NTSB) is an independent U.S. Federal government agency charged by the U.S. Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The NTSB is making these recommendations because they are designed to prevent accidents and save lives.

These recommendations, which address safety standards, policies, and procedures; fatigue management programs; and communication between airborne and ground search and rescue (SAR) personnel, are derived from the NTSB's investigation of the June 9, 2009, aviation accident in which a New Mexico State Police (NMSP) Agusta A-109E helicopter crashed in mountainous terrain during a public SAR operation and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the NTSB has issued 15 safety recommendations, 3 of which are addressed to the governor of the state of New Mexico. Information supporting the recommendations is discussed below. The NTSB would appreciate a response from you within 90 days addressing the actions you have taken, or intend to take, to implement our recommendations.

On June 9, 2009, about 2135 mountain daylight time,[1] an Agusta S.p.A. A-109E helicopter, N606SP, impacted terrain following visual flight rules (VFR) flight into instrument meteorological conditions (IMC) near Santa Fe, New Mexico. The commercial pilot and one passenger were fatally injured; a highway patrol officer who was acting as a spotter during the accident flight was seriously injured. The entire aircraft was substantially damaged. The helicopter was registered to the New Mexico Department of Public Safety (DPS) and operated by the NMSP on a public SAR mission under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91 without a flight plan. The helicopter departed its home base at Santa Fe Municipal

[1] All times in this letter are mountain daylight time based on a 24-hour clock.

Airport (SAF), Santa Fe, New Mexico, about 1850 in visual meteorological conditions; IMC prevailed when the helicopter departed the remote landing site about 2132.

The NTSB determined that the probable cause of this accident was the pilot's decision to take off from a remote, mountainous landing site in dark (moonless) night, windy, instrument meteorological conditions. Contributing to the accident were an organizational culture that prioritized mission execution over aviation safety and the pilot's fatigue, self-induced pressure to conduct the flight, and situational stress. Also contributing to the accident were deficiencies in the New Mexico State Police aviation section's safety-related policies, including lack of a requirement for a risk assessment at any point during the mission; inadequate pilot staffing; lack of an effective fatigue management program for pilots; and inadequate procedures and equipment to ensure effective communication between airborne and ground personnel during search and rescue missions.[2]

Background

A hiker contacted NMSP personnel to report that she was lost in a wilderness area about 20 nautical miles (nm) northeast of SAF. When the pilot was contacted about conducting an aerial search for the hiker,[3] he initially declined the mission, citing his concerns about strong and gusty winds in the mountainous search area. However, minutes later, after he checked the weather, he accepted the mission. Subsequently, while SAR personnel were initiating a ground search for the lost hiker, the pilot and the spotter departed SAF in the helicopter to conduct an aerial search for her. According to the spotter, the weather at SAF at the time was warm, sunny, and not very windy.

About 1 hour 20 minutes after they left SAF, the pilot and the spotter located the hiker in a small clearing in the woods. When the pilot landed the helicopter at the nearest suitable landing site, a ridge about 0.5 mile uphill of the hiker, it was getting dark and the weather was deteriorating, with strong, cold winds; clouds; and freezing precipitation. Because the hiker would not walk to the helicopter, the pilot walked down the heavily forested slope, found the hiker, and carried her back uphill to the helicopter. About 9 minutes after the pilot and the hiker reached the helicopter, the pilot took off for the return trip to SAF.

At 2134:10, the pilot radioed the dispatcher, stating that he "…struck a mountainside…going down." Radar data showed that the helicopter flew erratically for about 1 minute before it struck terrain again and tumbled down a steep, rock-covered slope. During this descent, components of the helicopter separated from the fuselage, and the pilot and hiker were ejected. The seriously injured spotter took shelter inside the helicopter's wrecked fuselage

[2] For more information, see *Crash After Encounter with Instrument Meteorological Conditions During Takeoff from Remote Landing Site, New Mexico State Police Agusta S.p.A. A-109E, N606SP, Near Santa Fe, New Mexico, June 9, 2009*, Aircraft Accident Report NTSB/AAR-11/04 (Washington, DC: National Transportation Safety Board, 2011), which is available on the NTSB's website at <http://www.ntsb.gov/publictn/2011/AAR1104.pdf>.

[3] An aerial search was deemed advantageous because there were no roads into the search area and ground SAR teams would have to hike in, which would delay the rescue.

overnight and was subsequently located by SAR ground teams about 1155 the next day. SAR ground teams located the helicopter's wreckage about 1816 that day.[4]

Pilot Decision-Making

Decision to Launch on the Mission

A little more than 2 hours of daylight remained when the accident pilot was notified about the mission, and he might have thought it would be a short mission. The pilot knew that the hiker was in communication with the NMSP dispatcher via cellular telephone, and he might have believed that the hiker could quickly guide him to her location. This belief and the fact that the weather at SAF was warm and clear and the wind was calmer than earlier in the day likely contributed to the pilot's decision to accept the flight. Further, the mountains in the search area were visible from SAF, and the pilot would have seen that they were clear of clouds at the time of departure. The pilot likely believed that he could fly to the search area (which was only 20 nm from SAF) and return to SAF quickly and safely before dark. (Several preflight comments indicated that the pilot predicted that the mission would be a quick "in and out" flight.) However, the hiker was unable to provide the pilot with much of the useful guidance that lost hikers can typically provide (such as describing her position relative to the sun, nearby landmarks, or terrain features), likely in part because of her limited proficiency with the English language and the remote, wooded, and unfamiliar area in which she was lost. The SAR mission extended into nighttime. According to the DPS cabinet secretary, when he was a pilot in the NMSP aviation section, a supply of cold-weather gear was carried on board, and he routinely carried a survival kit and extra blankets on such missions.

Additionally, based on the elevation of the targeted search area (estimated to be 11,700 feet), the pilot should have anticipated that the helicopter would be operating near the upper limit of its hovering and/or landing performance capabilities. (The helicopter's dual-engine hover ceiling was 11,800 feet.)[5]

The NTSB concludes that, when the pilot made the decision to launch, the weather and lighting conditions, even at higher elevations, did not preclude the mission; however, after accepting a SAR mission involving flight at high altitudes over mountainous terrain, with darkness approaching and with a deteriorating weather forecast, the pilot should have taken steps to mitigate the potential risks involved, for example, by bringing cold-weather survival gear and ensuring that night vision goggles were on board and readily available for the mission.

Although the pilot may have considered some personal restrictions regarding maximum altitudes, terrain characteristics, and winds that would permit a safe landing in the search area, no official NMSP risk assessment policy existed, and, therefore, there was no evidence that the pilot considered such restrictions.

[4] The investigation revealed that the ELT signals received from the accident helicopter's 406-megahertz emergency locator transmitter focused searchers on areas near the accident site and helped them locate both the survivor and the helicopter wreckage.

[5] The accident helicopter's dual- and single-engine service ceilings were 19,600 and 13,100 feet, respectively.

Decision-Making During the Mission

About 2010, when the pilot finally located the lost hiker, she was in a small clearing in a wooded area, with no suitable landing site nearby. The pilot maneuvered above the hiker and told the dispatcher to instruct the hiker to walk in the direction he was flying to reach the landing site. It is possible that the pilot initially expected the hiker to walk up to the helicopter landing site, and, as a result, the pilot likely believed that they would be able to depart the remote landing site relatively quickly after landing. However, although the hiker was ambulatory, she indicated to the dispatcher that she was cold and could not see well enough to move toward the helicopter's landing site. NMSP dispatch records show that, about 2015 (about 4 minutes before sunset), the dispatcher asked if the pilot could land on top of the hill and send the spotter down to retrieve the hiker. The pilot, sounding exasperated, said, "That's about the only thing we're going to be able to do."

According to the spotter, during the pilot's efforts to evaluate the nearest suitable landing site, the helicopter encountered strong winds and turbulence below 200 feet above ground level, it was getting dark, and low clouds were approaching from the west, all of which would have made the landing more hazardous. Although the incoming weather and the increasing darkness meant that the operation was growing increasingly risky, the pilot made several passes over the landing site and, after determining that a safe landing could be accomplished, proceeded with the landing. About 2030 (11 minutes after sunset), the pilot landed the helicopter on the ridge about 0.5 mile uphill from the hiker and at an elevation of about 11,600 feet. The spotter reported that they encountered moderate turbulence when they arrived at the landing site and that, when they exited the helicopter after landing to pick up the hiker, they encountered strong wind and sleet.

When the spotter contacted the dispatcher by cellular telephone after the helicopter had landed, the dispatcher again reported that the hiker "did not want to move." The pilot subsequently called the dispatcher to clarify the hiker's intentions, and the dispatcher told him that she believed that the hiker expected them to help her to the helicopter. As a result, about 2033, the pilot (who was wearing an unlined summer-weight flight suit) told the dispatcher he was going to "walk down the hill a little bit."[6] He indicated that he expected the weather conditions to deteriorate and stated, "…if it does that, I've got to get the [expletive] out of here." The pilot added, "I'm not going to spend a lot of time or we're going to have two search and rescues." There is no evidence that the pilot took the time to consider his options; rather, he promptly left the helicopter and walked down the heavily forested slope to find the hiker without stopping to get his flashlight out of his flight bag. These communications and actions suggest that the pilot was feeling increasing stress as a result of the deteriorating conditions and that he was fixated on the goal of retrieving the hiker and taking off again as quickly as possible.

The spotter stated that the strong wind continued to blow while the pilot was recovering the hiker. By the time the pilot and hiker returned to the helicopter (about 50 minutes after the pilot left the helicopter to retrieve the hiker and more than 1 hour after sunset), the sleet had turned to snow, and the clouds had lowered. Other witnesses who were camping at a lower

[6] Although the dispatcher suggested that the spotter retrieve the lost hiker, the pilot, who was slightly more appropriately clothed for the conditions, hiked to retrieve her.

elevation nearby reported "a heavy overcast" with heavy rain within 30 minutes of the accident. These conditions indicated a strong likelihood of reduced visibility and the potential for structural icing. In addition, the remote landing site was surrounded by high, rugged terrain that was no longer visible. Yet the pilot quickly prepared the helicopter for departure and, about 9 minutes after the pilot returned to the helicopter with the hiker, the helicopter was airborne again. According to the spotter, the pilot seemed to indicate that he intended to depart through a narrow path, a "tunnel in the clouds."

An interim risk assessment performed at this point may have indicated to the pilot that a different course of action would be more prudent. Even rudimentary consideration of the adverse weather conditions should have indicated to the pilot that it was no longer safe to take off and attempt to return to SAF at that time. At that point, the only safe option was to wait inside the helicopter at the remote landing site, contact SAR personnel for information and assistance, and wait for the weather conditions to improve. Although the temperature was near freezing, the helicopter provided good shelter, and the pilot could have periodically used its engines to generate heat as needed throughout the night. However, because the remote landing site was less than 15 minutes flying time from SAF, the pilot was likely very tempted to attempt to fly back to SAF rather than wait inside the helicopter for an indefinite period of time. The fact that the helicopter was airborne within about 9 minutes of the pilot's return indicates that the pilot was still fixated on departing as soon as possible, and he did not spend much time considering alternative courses of action.

Taking off in a helicopter in dark (moonless) lighting conditions, with marginal visibility, strong wind, turbulence, low clouds, the potential for structural and/or engine icing conditions, and surrounded by high terrain poses an unacceptably high risk of spatial and/or geographic disorientation, which could lead to loss of control and/or a controlled flight into terrain accident. Had the pilot performed an interim risk assessment and considered the external circumstances or discussed them with the spotter,[7] the NMSP dispatcher, or SAR ground personnel, he would have been more likely to recognize the potential hazards associated with an immediate takeoff and might have delayed his departure from the remote landing site until more favorable conditions prevailed. The NTSB concludes that the pilot exhibited poor decision-making when he chose to take off from a relatively secure landing site at night and attempt VFR flight in adverse weather conditions.

Factors Affecting the Pilot's Decision-Making

Fatigue

Cellular telephone records, notes in the accident pilot's planner, and information provided by the pilot's wife indicate that the pilot's available sleep time between Sunday evening, June 7, and Monday morning, June 8, totaled 4 hours 6 minutes[8] and was split into two separate possible

[7] The SAR commander spoke with the spotter while the pilot was retrieving the hiker and urged the spotter to remain in place and wait for ground teams to arrive if it was not safe to take off. However, it is not clear that the spotter shared this information with the pilot when he returned to the helicopter; the spotter did not recall the pilot raising the possibility of remaining on the mountain overnight.

[8] Because people do not normally fall asleep instantaneously, it is likely that the pilot actually slept less than the 4 hours 6 minutes of available sleep time.

sleep periods (2200 to 2326 on June 7 and 0003 to 0243 on June 8) due to work-related phone calls that occurred between 2326 Sunday night and 0003 Monday morning and between 0243 and 0256 Monday morning.[9] Further, the pilot had to get up earlier than usual because of two missions that he flew between 0300 and 1100 Monday morning.

According to the pilot's wife, her husband normally slept about 8 hours (beginning between 2130 and 2200) in a single consolidated sleep period on a night before a work day. However, the pilot's wife said that he frequently watched television later than usual on Sunday nights; although she did not specifically recall her husband's actions on the Sunday before the accident, he might have still been awake when he began to receive work-related telephone calls about 2326 Sunday night.[10] If the pilot watched television rather than slept during this earlier available sleep period, his maximum available sleep time would have been only 2 hours 35 minutes (again, assuming he used every minute of available sleep). Because of his work-related sleep disruptions and the fragmented nature of the pilot's sleep during the preceding 24 hours, it is highly likely the pilot experienced acute fatigue on Monday, June 8.

Between Monday evening and Tuesday morning (the day of the accident), the pilot was in bed for 8 to 8.5 hours. Additionally, according to his wife, the pilot likely took a 30-minute nap on Tuesday afternoon. Therefore, the pilot could have received as much as 8.5 to 9 hours of sleep in the 24 hours before the accident. Research shows that fatigue-related effects linger after one night of near-normal recovery sleep (8 hours) that is preceded by a night of acute sleep restriction.[11] Therefore, the sleep the pilot got Monday night and Tuesday morning probably alleviated some, but not all, of the fatigue resulting from his sleep restriction the day before. It is likely, therefore, that the pilot was still experiencing some residual fatigue on the day of the accident as a result of work-related activities, both public information officer (PIO) duty and flying, that he performed on the preceding day.

At the time of the accident, the pilot had accumulated 11 hours 41 minutes of duty time and 4 hours 30 minutes of flight time in the previous 24 hours. During his normal 8-hour work day (from 0700 to 1500), he spent 2.8 hours flying in the helicopter. Three hours after his normal work day ended, the pilot went back on duty for the accident mission, during which he accumulated an additional 3 hours 41 minutes of duty time and 1 hour 41 minutes of flight time. The accident mission, in addition to the pilot's normal work day, resulted in a long day that approached (and may have eventually exceeded) the aviation section's 12-hour duty time limits.

[9] In addition to his full-time helicopter and fixed-wing pilot duties, the accident pilot was the NMSP aviation section's chief pilot and was assigned public information officer (PIO) duties. The telephone calls noted in this text were related to his PIO duties.

[10] The pilot's wife was working at the time, so she could not be certain about the pilot's actions at home.

[11] For more information, see (a) M. Sallinen and others, "Recovery of Cognitive Performance From Sleep Debt: Do a Short Rest Pause and a Single Recovery Night Help?", *Chronobiology International*, vol. 25, nos. 2 and 3 (2008), pp. 279–296; (b) G. Belenky and others, "Patterns of Performance Degradation and Restoration During Sleep Restriction and Subsequent Recovery: A Sleep Dose-Response Study," *Journal of Sleep Research*, vol. 12, no. 1 (2003), pp. 1–12; and (c) H.P.A. Van Dongen and others, "The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation," *Sleep*, vol. 26, no. 2 (2003), pp. 117–126.

Scientific research and accident investigations have demonstrated the negative effects of fatigue on human performance,[12] including a breakdown in vigilance, degraded response times, and poor decision-making and risk assessment. As discussed in the NTSB's report on a 1993 accident involving American International Airways flight 808 at Guantanamo Bay, Cuba, fixation on a course of action (for example, the NMSP accident pilot's decision to take off from the remote landing site and fly to SAF)[13] while disregarding critical evidence that the course of action is no longer safe is also consistent with the effects of fatigue.[14] An NTSB study of flight crew-involved major accidents found that pilots with more than 12 hours (averaging 13.8 hours) of time since waking made significantly more procedural and tactical decision errors (mostly errors of omission) than pilots with less than 12 hours of time since waking.[15] A 2000 Federal Aviation Administration (FAA)-sponsored study found accidents to be more prevalent among pilots who had been on duty for more than 10 hours.[16] Additionally, a study performed by the U.S. Naval Safety Center found that helicopter pilots who were on duty for more than 10 of the last 24 hours were more likely to be involved in pilot-at-fault accidents than pilots who had not accumulated as much duty time.[17] The U.S. Naval Safety Center study also found that helicopter flights that began between 2100 and 2400 (as the accident flight did) experienced a higher rate of pilot-at-fault accidents than flights originating at other times of day. Therefore, the pilot's time since waking and his substantial cumulative duty time on the day of the accident also increased the likelihood that he was experiencing some fatigue. The pilot's most critical decision during the accident mission—his decision to take off in adverse weather conditions rather than wait on the ground for conditions to improve—was consistent with the effects of fatigue.

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[12] For the scientific research, see (a) J.A. Caldwell, "Fatigue in the Aviation Environment: An Overview of the Causes and Effects as Well as Recommended Countermeasures," *Aviation, Space, and Environmental Medicine*, vol. 68, no. 10 (1997), pp. 932–938; (b) D.R. Haslam, "The Military Performance of Soldiers in Sustained Operations," *Aviation, Space, and Environmental Medicine*, vol. 55, no. 2 (1984), pp. 216–221; and (c) G.P. Kruger, "Sustained Work, Fatigue, Sleep Loss, and Performance: A Review of the Issues," *Work and Stress*, vol. 3, no. 1 (1989), pp. 129–141. For accident investigation research, see *A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 through 1990*, Safety Study NTSB/SS-94/01 (Washington, DC: National Transportation Safety Board, 1994) at <http://www.ntsb.gov/Publictn/A_Stu.htm>.

[13] The NTSB determined that it was reasonable for the pilot to accept the SAR mission; however, investigators found his decision to land at the remote landing site in windy conditions after sunset was questionable. The pilot's subsequent decision to take off from the relative security of that landing site in mountainous terrain and dark, windy, instrument meteorological conditions was ill-advised and was likely affected by his fatigue (due to his duties as pilot, chief pilot, and PIO), self-induced pressure to complete the mission, and situational stress.

[14] See *Uncontrolled Collision with Terrain, American International Airways Flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay, Cuba, August 18, 1993*, Aircraft Accident Report NTSB/AAR-94/04 (Washington, DC: National Transportation Safety Board, 1994) at <http://www.ntsb.gov/Publictn/A_Acc2.htm>.

[15] See NTSB/SS-94/01.

[16] See GRA, Inc., *Flight and Rest Time Safety and Cost Analysis*, Report prepared for FAA Office of Aviation Policy and Plans under Contract No. DTFA01-98-C-00096 (Washington, DC: GRA, Inc. 2000).

[17] See (a) M.S. Borowsky and R. Wall, "Naval Aviation Mishaps and Fatigue," *Aviation, Space, and Environmental Medicine*, vol. 54, no. 6 (1983), pp. 535–538; (b) M.S. Borowsky and R. Wall, "Flight Experience and Naval Aircraft Mishaps," *Aviation, Space, and Environmental Medicine*, vol. 54, no. 5 (1983), pp. 440–446; (c) M.S. Borowsky, *Pilot Flight Experience and Aircraft Mishaps* (Norfolk, Virginia: U.S. Naval Safety Center, 1986); and (d) D.W. Yacavone and others, "Flight Experience and Likelihood of U.S. Navy Aircraft Mishaps," *Aviation, Space, and Environmental Medicine*, vol. 63, no. 1 (1992), pp. 72–74.

Self-Induced Pressure

Self-induced pressure might also have contributed to the pilot's decision to accept the mission and then take off from the remote landing site. The pilot was described by his colleagues as having an exceptionally high degree of motivation for work-related tasks. According to some statements, the pilot may also have had a tendency to act before thinking things through. Specifically, the NMSP fixed-wing pilot told investigators that the accident pilot tended to "act right away before thinking things out." Further, the part-time helicopter pilot told NTSB investigators that he thought the accident pilot lacked "temperance."

The pilot's wife and other aviation section pilots described the accident pilot as being "heroic" and indicated that it was in his nature to take personal risks to try to save others. Although the pilot did not know that the hiker lacked warm clothing and other survival equipment when he accepted the mission,[18] he likely recognized that it would take ground SAR teams a long time to reach her remote location. Because of this concern and his awareness of the cold nighttime conditions on the mountain, the accident pilot was likely concerned that if he did not accept the mission, the hiker would not survive on the mountain overnight. Furthermore, successful past rescue outcomes for the pilot (for example, his recent commendations for the successful rescue of a man trapped in a flooded arroyo) may have reinforced his tendency toward risk-taking in the line of duty. It is likely that the pilot's nature in this regard, combined with his concern for the well-being of the hiker, created significant self-induced pressure for him to ensure that the mission was successfully completed, despite increasingly difficult conditions.

In addition, the accident pilot's relatively brief tenure (about 6 months) in the chief pilot position may have left him vulnerable to management pressure to accept missions**.** Postaccident interviews with NMSP aviation section pilots and management personnel indicated that the DPS cabinet secretary's questioning of pilots regarding launch decisions and his evident displeasure when the NMSP pilots did not accept a mission when others did (such as the New Mexico National Guard) sent the message that he wanted NMSP aviation section pilots to accept SAR missions, without adequate regard for the potential risks involved. Further, the accident pilot was likely aware that the former chief pilot was relieved of his chief pilot duties by the DPS cabinet secretary after he decided not to accept a high-risk mission that would have involved less experienced pilots. The pilot's decision to accept the accident mission, while not inappropriate, was consistent with his understanding of NMSP management's priorities.

Situational Stress

The stress associated with the mission may have also played a role in the pilot's determination to depart from the mountain. The pilot's communications with the dispatcher indicated elevated concern after landing on the mountain, as evidenced by his statements, "It's gonna start snowing up here and if it does that I've gotta get the [expletive] out of here," "I'm not gonna spend a lot of time or we're going to have two search and rescues," and, "Just tell her to start blowing her [expletive] whistle and I'll try to find her, okay?" These statements and the pilot's use of profanity (which was absent during earlier communications with the dispatcher)

[18] The pilot became aware of the hiker's situation during the mission.

suggest that the pilot was experiencing increased situational stress as a result of the perceived challenge posed by the deteriorating conditions. Cognitive effects of stress can include narrowing of attention, response rigidity, longer reaction time to peripheral stimuli, and increased errors.[19] It is possible, therefore, that the "tunnel vision" created by acute situational stress caused the pilot to fixate on the goal of taking off from the remote landing site as soon as possible and to disregard mounting evidence that it was not safe to take off after he returned with the hiker.

Summary of Factors Affecting the Pilot's Decision-Making

The NTSB concludes that the pilot decided to take off from the remote landing site, despite mounting evidence indicating that the deteriorating weather made an immediate return to SAF inadvisable, because his fatigue, self-induced pressure to complete the mission, and situational stress distracted him from identifying and evaluating alternative courses of action.

Organizational Issues

A number of organizational and management issues, including NMSP aviation section staffing, pilot flight and duty time and rest period limitations, and safety management system (SMS) programs and policies,[20] were identified in this accident investigation. Although they may not have directly caused the accident, these latent deficiencies represented a culture and foundation of organizational pressures that contributed to a reduction in the safety of flight operations conducted by the NMSP on a daily basis.

Risk Assessments and Safety Management Systems

Investigators noted that, at the time of the accident, the NMSP aviation section did not have an SMS program. Additionally, the aviation section did not require its pilots to perform a structured, systemic risk assessment before accepting a mission or to reassess risks during a mission. Such risk assessments would have helped the pilot identify and mitigate some of the factors that affected his decision-making. For example, although it was warm and sunny when the pilot left SAF, the forecast for the accident flight included strong wind conditions, lowered ceilings, and precipitation (freezing at higher elevations). If the pilot had completed a structured risk assessment checklist that included obtaining and evaluating the weather conditions, the approaching darkness, and the potential for pilot fatigue, he may have elected to bring a second pilot along on the flight or wait until morning to search for the hiker. At the very least, a structured preflight risk assessment process would likely have prompted the pilot to mitigate potential risks by bringing night vision goggles[21] and cold-weather survival gear on the accident

[19] E. Salas, J.E. Driskell, and S. Hughes, "Introduction: The Study of Stress and Human Performance," in J.E. Driskell and E. Salas, eds., *Stress and Human Performance* (Mahwah, New Jersey: Lawrence Erlbaum, 1996), pp. 1-46.

[20] The FAA defines SMS programs as "…the formal, top-down business approach to managing safety risk, which includes a systemic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures."

[21] Night vision goggles would provide the wearer with visual images with increased levels of illumination in low ambient light conditions (such as moonless nights), which might have allowed the pilot to better maintain outside visual references during the accident flight. However, the benefits of the night vision goggles would have been reduced by the precipitation at the time.

flight. Further, if the NMSP aviation section had implemented a thorough risk assessment program that included interim risk assessments, the accident pilot would have evaluated the associated risks before landing at the remote site and (if he determined that such a landing was prudent) again before departing the remote landing site. The lack of such a risk assessment allowed the decision-making errors that manifested themselves in this accident situation to occur. (Since the accident, the NMSP aviation section has implemented a risk assessment checklist.)

Upper management plays a key role in any safety program because, ultimately, management has control over the personnel and resources that generate exposure to risk. The safety management approach places a responsibility on senior management to develop a formal safety policy, establish safety objectives, develop standards of safety performance, and take the lead in fostering an organizational safety culture. It specifies that management should take responsibility for an organization's safety performance by designating a senior manager as the executive who is accountable for safety performance. Research has shown that this kind of management involvement plays a key role in the success of organizational safety programs.[22, 23]

The New Mexico DPS policies placed responsibility for safety exclusively on pilots and aviation maintenance technicians. No organizational policy established a formal management commitment to safety. The DPS cabinet secretary was the senior manager who devoted the most attention to the aviation section and seemed to have the greatest influence over it. He did not, however, take responsibility for the safety performance of the aviation section, nor did he take the initiative to ensure that it had an effective safety program. In fact, he engaged in behaviors that were actually detrimental to safety. In 2006, when the former chief pilot declined to send two inexperienced helicopter pilots on a SAR mission in mountainous terrain in poor weather and dark lighting conditions, the DPS cabinet secretary relieved the former chief pilot of his chief pilot duties (and associated launch decision-making authority). According to interviews with NMSP aviation section pilots, the DPS cabinet secretary demanded an explanation whenever a pilot declined a SAR mission and complained vigorously when New Mexico National Guard pilots launched on a mission that NMSP pilots had declined. Aviation section pilots stated that the DPS cabinet secretary sometimes asked NMSP pilots to continue checking the weather when they had already decided that the weather was not good enough for an executive transport flight. The NTSB believes that this pattern of behavior sent a message to NMSP pilots that the highest-ranking official in the DPS prioritized mission completion over flight safety and that he was closely monitoring their decisions.

There is no evidence that the DPS cabinet secretary or any NMSP manager advised the pilot to accept the accident mission or that they urged him to take off from the remote landing site. The accident pilot had previously engaged in behaviors that demonstrated a high degree of risk tolerance, and his judgment was likely degraded by a combination of fatigue, stress, and self-induced pressure. These factors are sufficient to explain his decision-making. The DPS cabinet secretary's history of inappropriately involving himself in pilot launch decisions,

[22] M.J. Smith and others, "Characteristics of Successful Safety Programs," *Journal of Safety Research*, vol. 10, no. 1 (1978), pp. 5–15.

[23] H.S. Shannon, J. Mayr, and T. Haines, "Overview of the Relationship Between Organizational and Workplace Factors and Injury Rates," *Safety Science*, vol. 26, no. 3 (1997), pp. 201–217.

however, encouraged NMSP pilots to accept higher levels of risk without ensuring that appropriate controls were in place to mitigate those risks. NMSP management's lack of attention to safety management resulted in the absence of an effective safety program. The NTSB concludes that, although there was no evidence of any direct NMSP or DPS management pressure on the pilot during the accident mission, there was evidence of management actions that emphasized accepting all missions, without adequate regard for conditions, which was not consistent with a safety-focused organizational safety culture, as emphasized in current SMS guidance.

The NTSB has previously discussed the benefits of risk assessment and management programs and issued related safety recommendations. For example, in 2006, the NTSB issued related safety recommendations in its special investigation report on emergency medical services (EMS) operations.[24] In addition, in 2009, as a result of the NTSB's public hearing on helicopter EMS (HEMS) safety and the investigative findings of several 2008 HEMS accidents,[25] the NTSB issued safety recommendations related to the incorporation of SMS programs, including risk assessment and management practices.

Although the NTSB has noted the need for all operators—both public and civil—to develop and implement flight risk assessment and evaluation programs, public operators would not be required to comply with such programs because the FAA does not have the authority to regulate public operators. The NTSB concludes that if operators of public aircraft implemented structured, task-specific risk assessment and management programs, their pilots would be more likely to thoroughly identify, and make efforts to mitigate, the potential risks associated with a mission.

The incorporation of the policies, procedures, and guidelines published by the Airborne Law Enforcement Association (ALEA) in its "Standards for Law Enforcement Aviation Units" and related material would provide an organization like the NMSP aviation section with a comprehensive foundation upon which to build a thorough, explicit set of policies and procedures. However, the NTSB's evaluation of the NMSP aviation section's policies indicated that they did not conform to ALEA's standards. The NMSP aviation section's "Policies and Procedures" document lacked adequate standard operating procedures (SOPs)[26] in several areas, including those of risk management and pilot rest periods, thereby reducing the safety of NMSP aviation operations. Therefore, the NTSB recommends that the governor of the state of New Mexico require the New Mexico DPS to bring its aviation section policies and operations into conformance with industry standards, such as those established by ALEA.

[24] For more information, see *Special Investigation Report on Emergency Medical Services Operations*, Special Investigation Report NTSB/SIR-06-01 (Washington, DC: National Transportation Safety Board, 2006) at <http://www.ntsb.gov/Publictn/A_Stu.htm>.

[25] The associated safety recommendation letter cited the following accidents: NTSB case numbers DFW08FA062, CHI08FA128, DEN08FA101, DEN08MA116A and DEN08MA116B, MIA08MA203, and CEN09MA019. The briefs for these accidents can be accessed online at <http://www.ntsb.gov/ntsb/aviationquery.index.aspx>.

[26] See NTSB/AAR-11/04, appendix B, for a reproduction of the complete document.

Fatigue Management

NMSP aviation section policies limited the pilots to 12 hours of duty time and 6 hours of flight time per day. When the accident pilot accepted the accident mission, he had been on duty 8 hours, with 4.5 hours of flight time in the 24 hours preceding the SAR mission. Because the pilot's total flight and duty times did not approach the aviation section's limits,[27] NMSP policies did not prevent him from accepting the accident mission; however, as stated previously, the accident pilot was likely fatigued as a result of his sleep restriction the preceding day.

The NTSB has issued many safety recommendations related to pilot flight, duty, and rest times.[28] To ensure optimal performance, regulations should not only limit daily flight and duty times but also ensure that pilots are provided with a rest period that provides sufficient time for meals, personal hygiene, and obtaining at least 8 hours of uninterrupted sleep in every 24-hour period. Although NMSP SAR operations are not subject to FAA regulations, the FAA defines a rest period in 14 CFR 91.1057 as follows:

> …a period of time required...that is free of all responsibility for work or duty prior to the commencement of, or following completion of, a duty period, and during which the flight crewmember…cannot be required to receive contact from the program manager. A rest period does not include any time during which the program manager imposes on a flight crewmember…any duty or restraint, including any actual work or present responsibility for work should the occasion arise.

A review of NMSP aviation section policies revealed that, although the NMSP had established maximum pilot flight and duty times for a 24-hour period, it had not defined what constituted a pilot "rest period" or established a minimum continuous pilot rest period before being assigned to another flight. NMSP management had assigned the accident pilot multiple duties (full-time pilot, chief pilot of the NMSP aviation section, and part-time PIO), which, in combination, often interfered with the pilot's ability to get adequate rest for flying.[29] For example, the accident pilot had performed work-related duties at various times of the day and night during the preceding 72 hours, without adequate opportunity for a contiguous, ensured restful sleep period. As a result, when the pilot reported for duty about 0300 the day before the accident, he was functioning on, at most, 4 hours 9 minutes of interrupted sleep.[30] Thus, the pilot's work duties did not afford him an opportunity for sufficient restful sleep in the days before the accident, even though they were not in violation of NMSP aviation section's pilot flight and duty policies.

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[27] The NMSP policies did not specifically address pilot rest periods.

[28] For example, see *Collision with Trees and Crash Short of Runway, Corporate Airlines Flight 5966, BAE Systems BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004*, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: National Transportation Safety Board, 2006) at <http://www.ntsb.gov/Publictn/A_Acc1.htm>.

[29] The pilot had asked to be relieved of the PIO duties for safety-related reasons; however, his requests were denied, largely because NMSP upper management did not understand how the pilot's PIO duties conflicted with his pilot and chief pilot responsibilities.

[30] The part-time helicopter pilot also reported being called out to fly missions late in the evening after he had worked all day.

Because the NMSP aviation section is a public operator, it has no flight and duty time or pilot rest limitations imposed on it by the FAA, and the NMSP is responsible for monitoring its own compliance with flight and duty time policies. However, FAA regulations for similar civil operations (commuter or on-demand charter operations under 14 CFR Part 135) state that each flying assignment must provide for "at least 10 consecutive hours of rest during the 24-hour period that precedes the planned completion time" of the flight and "no certificate holder may assign any flight crewmember to any duty with the certificate holder during any required rest period." (A slightly shorter minimum rest period of 8 consecutive hours per 24-hour period is allowed for HEMS pilots, but 10 consecutive hours of rest are required before a HEMS pilot transitions to "on-call" status.)

Although the accident pilot's schedule during the 2 days leading up to the accident flight was permitted by NMSP flight and duty time policies, the pilot's PIO duties prevented him from obtaining sufficient rest, and NMSP policies did not ensure protected rest periods for its pilots. Fatigue was one of several factors that likely affected the pilot's decisions and actions on the night of the accident. The NTSB concludes that an effective pilot flight and duty time program would address not only maximum flight and duty times but would also contain requirements for minimum contiguous ensured rest periods to reduce pilot fatigue; the NMSP aviation section's flight and duty time policies did not ensure minimum contiguous rest periods for its pilots.

The NTSB reviewed the NMSP aviation section's staffing level of two full- and one part-time helicopter pilots[31] to determine whether this level of staffing was sufficient to support helicopter availability 24 hours per day, 7 days per week, while also ensuring that each pilot could receive a protected rest period of at least 10 consecutive hours per 24 contiguous hours (a rest period sufficient to allow for adequate sleep, meals, and personal hygiene) and could be afforded 2 full days off per week. (In its evaluation, the NTSB also took into account the fact that the accident pilot had additional duties and responsibilities associated with his chief pilot and PIO assignments, which imposed unpredictable demands on his time and interfered with his ability to obtain adequate rest.) The NTSB found that it was not possible to devise such a schedule with this level of staffing. The NTSB further noted that NMSP aviation section staffing levels also limited its ability to assign two pilots to potentially high-risk missions (such as the accident flight) in an effort to mitigate the potential risks during such missions.[32]

A recent study sponsored by the U.S. Air Force assessed the minimum number of flight crews required to provide 24-hour availability for an aircraft; the study found that four flight crews provided the optimal balance between "the work, health, social, and safety demands placed upon the shiftworker (in terms of hours worked per unit time…) and personnel cost to the employer for safe and productive system operation."[33] Thus, based on this study, the NMSP aviation section would be unable to support an appropriate 24 hours per day, 7 days per week

[31] One of the two full-time helicopter pilots (the accident pilot) also held chief pilot and PIO responsibilities. The part-time helicopter pilot was typically called to fly missions in the evening, after he had already worked a day shift performing duties unrelated to aviation.

[32] A two-pilot operation would allow for additional monitoring and reduces an individual pilot's workload.

[33] See J.C. Miller, *Fundamentals of Shift-Work Scheduling*, Technical Report No. AFRL-HE-BR-TR-2006-0011. (Brooks City Base, Texas: U.S. Air Force Research Laboratory, Human Effectiveness Directorate, Biosciences and Protection Division, Biobehavioral Performance Branch, 2006), p. 26.

schedule under existing staffing levels. The NTSB concludes that at the time of the accident, the NMSP aviation section staffing level was insufficient to allow helicopter operations 24 hours a day, 7 days a week without creating an unacceptable risk of pilot fatigue. Therefore, the NTSB recommends that the governor of the state of New Mexico require the New Mexico DPS to develop and implement a comprehensive fatigue management program for the NMSP aviation section pilots that, at a minimum, requires NMSP to provide its pilots with protected rest periods and defines pilot rest (in a manner consistent with 14 CFR 91.1057) and ensures adequate pilot staffing levels and aircraft hours of availability consistent with the pilot rest requirements.

Search and Rescue Communication

The overall communication and coordination of efforts between the NMSP and the volunteer New Mexico SAR personnel did not ensure that the accident mission was performed as safely as possible. The accident helicopter was equipped with a radio that received and transmitted on police band frequencies and a very high frequency transceiver radio. Using the two radios, the pilot could monitor two frequencies simultaneously but could transmit on only one frequency. As a result, the pilot could not monitor and communicate on both the NMSP dispatch frequency and a SAR frequency at the same time. SAR personnel, with the use of their multiband transceiver radio, were able to communicate on three frequencies simultaneously. (The helicopter that was purchased to replace the accident helicopter was equipped with a multiband transceiver radio that allowed for communications on three frequencies simultaneously.)

Although SAR command personnel communicated with the dispatcher and with the spotter (through cellular telephone calls with the NMSP dispatcher and SAR personnel) during the mission, they could not communicate directly with the pilot. After the helicopter had landed to pick up the hiker, SAR command personnel suggested to the spotter (via cellular telephone) that the helicopter remain on the mountain if the weather deteriorated to the point that it was not safe to take off. There is no indication that the pilot was apprised of this suggestion; if this suggestion had been passed on to the accident pilot, he might have been prompted to reassess his decision to take off.

During postaccident interviews, it was apparent that NMSP personnel were confused about how the chain of command was supposed to work during airborne SAR missions. The SAR plan indicated that the SAR field coordinator was responsible for directing all SAR resources (including NMSP aviation section personnel); however, postaccident interviews indicated that NMSP personnel often conducted SAR missions based on 911 notifications before receiving SAR initialization. Additionally, the NMSP aviation section SOP did not address procedures for SAR missions. These issues likely resulted in the accident pilot believing that he did not need to communicate with SAR field commanders during the accident mission, and, as a result, he did not. If the pilot had communicated with SAR field commanders, he would have been aware of the SAR ground teams' efforts, which might have influenced his decision to takeoff from the remote landing site. The NTSB concludes that NMSP personnel did not regularly follow the SAR plan, and NMSP pilots, including the accident pilot, did not routinely communicate directly with SAR commanders during SAR efforts, which reduced the safety and effectiveness of SAR missions. Therefore, the NTSB recommends that the governor of the state

of New Mexico revise or reinforce NMSP SAR policies to ensure direct communication between NMSP aviation units and SAR ground teams and field personnel during a SAR mission.

Therefore, the National Transportation Safety Board makes the following recommendations to the governor of 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)
>
> Require the New Mexico Department of Public Safety to develop and implement a comprehensive fatigue management program for the New Mexico State Police (NMSP) aviation section pilots that, at a minimum, requires NMSP to provide its pilots with protected rest periods and defines pilot rest (in a manner consistent with 14 *Code of Federal Regulations* 91.1057) and ensures adequate pilot staffing levels and aircraft hours of availability consistent with the pilot rest requirements. (A-11-54)
>
> Revise or reinforce New Mexico State Police (NMSP) search and rescue (SAR) policies to ensure direct communication between NMSP aviation units and SAR ground teams and field personnel during a SAR mission. (A-11-55)

The National Transportation Safety Board also issued four safety recommendations to the Airborne Law Enforcement Association, four safety recommendations to the National Association of State Aviation Officials, and four safety recommendations to the International Association of Chiefs of Police.

In response to the recommendations in this letter, please refer to Safety Recommendations A-11-53 through -55. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred with these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman