Special Investigation Report on Emergency Medical Services Operations

Aviation Special Investigation Report

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PB2006-917001
Notation 4402E

National Transportation Safety Board
Washington, D.C.

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NTSB/SIR-06/01 (PB2006-917001)

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- Page number 50 in Appendix E has been added. *(March 6,2006)*
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Adopted January 25, 2006

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

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Abstract: This report discusses safety issues identified during the Safety Board's special investigation of 55 emergency medical services (EMS) aircraft accidents that occurred in the United States between January 2002 and January 2005. Safety issues discussed in this report focus on less stringent requirements for EMS operations conducted without patients on board, a lack of aviation flight risk evaluation programs for EMS operations, a lack of consistent, comprehensive flight dispatch procedures for EMS operations, and no requirements to use technologies such as terrain awareness and warning systems to enhance EMS flight safety.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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Abbreviations

AC	advisory circular
AMPA	Air Medical Physician Association
ATC	air traffic control
CFR	*Code of Federal Regulations*
CFIT	controlled flight into terrain
SIGMET	Convective Significant Meteorological Information
CRM	crew resource management
EMS	emergency medical services
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
IMC	instrument meteorological conditions
IHC	Intermountain Health Care
MFS	Mountain Flight Service, Inc.
NVG	night vision goggles
NVIS	night vision imaging systems
NOTAM	notices to airmen
POI	principal operations inspector
TAWS	terrain awareness and warning system
VFR	visual flight rules
VMC	visual meteorological conditions

Executive Summary

Emergency medical services (EMS) aviation operations (conducted with either helicopters or fixed-wing aircraft) provide an important service to the public by transporting seriously ill patients or donor organs to emergency care facilities. The pressure to safely and quickly conduct these operations in various environmental conditions (for example, inclement weather, at night, and unfamiliar landing sites for helicopter operations) makes EMS operations inherently dangerous, and the hazards associated with EMS operations are resulting in an increasing number of accidents. This special investigation report of EMS operations and accidents is not intended to burden operators with undue requirements or to handicap this vital function in any way; rather the purpose of the report is to identify and recommend operational strategies and technologies that will help ensure that these vital EMS flights arrive safely and continue to provide a valuable service to the public.

Between January 2002 and January 2005, 55 EMS aircraft accidents occurred in the United States[1] (this number of EMS accidents had not been seen since the 1980s);[2] these accidents resulted in 54 fatalities and 18 serious injuries (see appendix B for more information). Although the number of flight hours flown by EMS helicopter operations has increased from about 162,000 in 1991 to an estimated 300,000 in 2005,[3] the average accident rate has also increased from 3.53 accidents per 100,000 flight hours between 1992 and 2001 to 4.56 accidents per 100,000 flight hours between 1997 and 2001.[4] As a result, the National Transportation Safety Board initiated a special investigation of these 55 accidents and identified the following recurring safety issues:

- less stringent requirements for EMS operations conducted without patients on board,
- a lack of aviation flight risk evaluation programs for EMS operations,
- a lack of consistent, comprehensive flight dispatch procedures for EMS operations, and
- no requirements to use technologies such as terrain awareness and warning systems (TAWS) to enhance EMS flight safety.

[1] Of these 55 EMS aircraft accidents, 41 were helicopter EMS accidents, 16 of which were fatal, resulting in a total of 39 fatalities and 13 serious injuries; 14 were airplane EMS accidents, 5 of which were fatal, resulting in 15 fatalities and 6 serious injuries. Since the initiation of this special investigation in January 2005, 9 additional EMS aircraft accidents have occurred, resulting in 8 fatalities.

[2] Comprehensive activity data regarding EMS operations (for example, exposure rates and missions flown) are limited because the sources for these data are generally poor. On May 12, 2005, the Safety Board issued Safety Recommendations A-05-11 through -13 to the Federal Aviation Administration to address the integrity of general aviation flight activity data. Information about these safety recommendations can be found at the Board's Web site at <http://www.ntsb.gov>.

[3] "Improving Safety in Helicopter Emergency Medical Services (HEMS) Operations," Helicopter Association International (Alexandria, VA: August 2005).

[4] Ira J. Blumen, "A Safety Review and Risk Assessment in Air Medical Transport," Supplement to the *Air Medical Physician Handbook*, (November 2002): 35.

Of the 55 accidents that occurred between January 2002 and January 2005, the following seven were considered to provide the best examples of the safety issues involved:

- **Salt Lake City, Utah (FTW03FA082).** On January 10, 2003, an EMS helicopter crashed into terrain while maneuvering in dense fog on an aborted mission to pick up a patient. The pilot and flight paramedic were killed, and the flight nurse was seriously injured.
- **Redwood Valley, California (LAX04FA076).** On December 23, 2003, an EMS helicopter was en route to pick up a patient when it collided with mountainous terrain while operating in high winds and heavy rain. The pilot, flight nurse, and paramedic were killed.
- **Dodge City, Kansas (CHI04FA066).** On February 17, 2004, an EMS airplane crashed about 5 miles beyond Dodge City Regional Airport while on a repositioning flight. The pilot, flight paramedic, and flight nurse, who were at the end of a 14-hour duty day, were killed.
- **Pyote, Texas (FTW04FA097).** On March 21, 2004, an EMS helicopter crashed into terrain while maneuvering in reduced visibility conditions while transporting a patient. The pilot, flight paramedic, patient, and patient's mother were killed, and the flight nurse was seriously injured.
- **Newberry, South Carolina (CHI04MA182).** On July 13, 2004, an EMS helicopter collided with trees shortly after picking up a patient from an accident site on an interstate. The pilot, flight nurse, flight paramedic, and patient were killed.
- **Battle Mountain, Nevada (SEA04MA167).** On August 21, 2004, an EMS helicopter crashed into mountainous terrain at night and in deteriorating weather conditions while transporting a patient along a direct route through mountainous terrain rather than taking an indirect route around the high terrain. The pilot, two medical crewmembers, patient, and patient's mother were killed.
- **Rawlins, Wyoming (DEN05FA051).** On January 11, 2005, an EMS airplane that was operating in icing conditions crashed when it impacted terrain while en route to pick up a patient. The pilot and two medical crewmembers were killed, and a third medical crewmember sustained serious injuries.

These seven accidents have been specifically cited, where applicable, in this report's discussion of each safety issue. More detailed flight histories, as well as probable cause statements for these accidents, are provided in appendix A.

The Safety Board examined similar safety issues after the occurrence of 59 EMS accidents between May 1978 and December 1986 and concluded in a 1988 safety study[5] that

[5] National Transportation Safety Board, *Commercial Emergency Medical Service Helicopter Operations*, Safety Study NTSB/SS-88-01 (Washington, DC: NTSB, 1988).

many areas of EMS operations needed improvement, including weather forecasting, operations during instrument meteorological conditions (IMC), personnel training requirements, design standards, crashworthiness, and EMS operations management. As a result of its findings, the Board issued 19 safety recommendations to the Federal Aviation Administration (FAA) and others, which have since been closed (see appendix G information about these recommendations and their classifications). Most of the recommendations to the FAA were closed as a result of the June 20, 1991, issuance of Advisory Circular (AC) 135-14A, "Emergency Medical Services/Helicopter (EMS/H)," which addressed equipment, training, crew resource management (CRM), decision-making, flight-following procedures, weather minimums, and the development of safety programs for EMS helicopter flights operating under 14 *Code of Federal Regulations* (CFR) Part 135. Although the Safety Board expressed concern at the time that the FAA chose to issue an AC instead of regulations, the number of EMS accidents was decreasing, thus the recommendations were closed.[6] Despite the guidance provided in AC 135-14A and AC 135-15, EMS aircraft accidents have continued to occur in significant numbers, as shown in table 1 for the 15-year period from 1990 to 2005.

Table 1. EMS Accidents From 1990 to 2005

			Total Injuries		
Year	**Number of accidents**	**Number of fatal accidents**	**Fatal**	**Serious**	**Minor**
1990	1	0	0	0	0
1991	1	1	4	0	0
1992	3	2	3	4	0
1993	3	2	5	3	3
1994	4	2	6	0	3
1995	5	1	3	0	2
1996	5	3	9	1	0
1997	3	1	4	0	0
1998	11	2	8	5	5
1999	6	0	0	6	0
2000	6	2	7	0	4
2001	13	1	1	2	2

[6] On November 19, 1990, the FAA issued AC 135-15, "Emergency Medical Services/Airplane," which contained guidance information similar to AC 135-14A. However, the recommendations from the 1988 study focused on EMS helicopter operations, so the closure of these recommendations was based on the issuance of AC 135-14A.

			Total Injuries		
Year	Number of accidents	Number of fatal accidents	Fatal	Serious	Minor
2002	13	6	14	8	4
2003	19	3	3	2	16
2004	19	9	29	7	3
2005	13	6	13	5	5

Recent industry publications regarding the safety of EMS aviation operations are consistent with the Safety Board's findings. For example, after an extensive 2-year safety review and risk assessment of helicopter EMS accidents, the Air Medical Physician Association (AMPA) reported in November 2002 that the time of day that flights occur could contribute to accidents.[7] The report indicated that even though 38 percent of all helicopter EMS flights occur at night, 49 percent of accidents during a 20-year period occurred during nighttime hours. The report also cited controlled flight into terrain (CFIT), in particular during the takeoff or landing sequence, as a common problem, as well as collision with objects (wires were the most common obstacles for EMS helicopters); inaccurate weather forecasts (about 26 percent of helicopter EMS accidents were weather-related, with most occurring because of reduced visibility and IMC while the helicopter was en route); and communications problems with air traffic control (ATC) or a lack of communications due to remote locations and high terrain.

AMPA's report also cited time pressures related to the patient's condition, rapid mission preparation, flight to the patient pick-up location, and low fuel as frequent issues in EMS aircraft accidents. According to a query of the National Aeronautics and Space Administration's Aviation Safety Reporting System, patient condition was cited in 44 percent of the EMS accidents or incidents reports as a contributor to time pressure leading to inaccurate or hurried preflight planning. In addition, the AMPA report stated that accidents occurred more often when flight crews were en route to pick up a patient than at any other time during flight. A white paper[8] published by Helicopter Association International in August 2005 examined many of the same issues as AMPA.

This special investigation report is not intended to represent a comprehensive statistical analysis of EMS accidents. Because 14 CFR Part 135 operators are not required to maintain flight activity data, such an analysis is not possible. The purpose of this report is to discuss the safety issues identified during the Safety Board's investigation and

[7] Ira J. Blumen, MD, and the UCAN Safety Committee, "A Safety Review and Risk Assessment in Air Medical Transport." Supplement to the *Air Medical Physician Handbook*, (November 2002): 2.

[8] "Improving Safety in Helicopter Emergency Medical Services (HEMS) Operations," Helicopter Association International (Alexandria, VA: August 2005). The Safety Board has reviewed this white paper and determined that this special investigation report further amplifies many of the issues mentioned in the white paper.

suggest recommendations that, if implemented, could address these issues. (See appendix C for a list of accidents that were examined during the Board's investigation that might have been prevented by the corrective actions proposed in this report.) The Safety Board also recognizes that the use of EMS aircraft operations involves aspects of public policy (for example, the decision to use EMS aircraft instead of ground transportation, the reimbursement structure of vital services, and the economic competition among EMS operators) that will not be the focus of this report.

The Safety Board notes that the FAA has recently taken positive steps to improve the safety of EMS operations. For example, in August 2004, the FAA convened a Helicopter Air Ambulance Accident Task Force to make recommendations to reduce helicopter EMS accidents; to date the task force has not issued any recommendations or rule changes. On January 28, 2005, the FAA released Notice N8000.293, "Helicopter Emergency Medical Services Operations," which contained information that FAA inspectors could provide to helicopter EMS operators "for a review of pilot and mechanic decision-making skills, procedural adherence, and crew resource management" (see appendix D). On August 1, 2005, the FAA released Notice N8000.301, "Operational Risk Assessment Programs for Helicopter Emergency Medical Services," which identified possible risks and dangers to flight crews and patients and encouraged aircraft EMS operators to promote the use of risk assessment models (see appendix E). The FAA issued similar (although less detailed) guidance in AC 135-14A; however, the recommended practice of risk assessment and decision-making had not been incorporated in a formalized manner into the EMS operations that were investigated as part of this special investigation.[9] Finally, on September 27, 2005, the FAA released Notice N8000.307, "Special Emphasis Inspection Program for Helicopter Emergency Medical Services," which provided guidance to aviation safety inspectors for the examination of operational factors that were identified as causal to EMS accidents from 1999 to 2004, such as operational control, safety culture development, and access to and use of weather information by flight crews, management, and in-flight communications specialists (see appendix F).

Despite these positive steps to improve EMS operation safety, the FAA has not yet imposed any requirements for all aircraft EMS operators regarding flights without patients on board, risk management, flight dispatch, or the use of technologies. The FAA's recently published notices are simply information for principal operations inspectors (POI) to convey to their operators and encourage them to incorporate into their operations. Because the guidance provided in ACs 135-14A and 135-15 was not widely adopted by EMS operators, the Safety Board does not anticipate that the guidance provided in the FAA's notices will be widely implemented. The Board is concerned that, without requirements, some EMS operators will continue to operate in an unsafe manner, which could lead to further accidents. Although the Board recognizes that the nature of EMS operations involves some risks, operators should be required to provide the best available tools to minimize those risks and help medical personnel, flight crews, and patients arrive at their destinations safely.

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[9] See "Aviation Flight Risk Evaluation Programs for EMS Operations" in this report for more information.

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Requirements for EMS Operations Conducted Without Patients On Board

While carrying patients or organs for transplant, EMS flights are required to be conducted in accordance with the operator's 14 CFR Part 135 regulations.[10] However, when flights are conducted without patients aboard (positioning flights), they are permitted to operate under the provisions of 14 CFR Part 91,[11] which are less stringent than the provisions of Part 135. Positioning flights often carry medical personnel who, although classified as "crew members," are primarily responsible for helping the patient and not operating the flight. The Safety Board notes that 35 of the 55 EMS accidents studied during this investigation, including the accidents in Salt Lake City, Redwood Valley, Dodge City, and Rawlins, occurred with medical crewmembers but no patient on board and were conducted under Part 91. As noted previously, the AMPA study found that more EMS accidents occurred when a patient was not on board the flight than at any other time during flight.

Requirements regarding weather/visibility minimums differ significantly between Part 135 and Part 91. Section 91.155, "Basic VFR [visual flight rules] Weather Minimums," stipulates only that helicopters must remain "clear of clouds" when operating below 1,200 feet above the surface under VFR. In contrast, Safety Board staff's review of the Part 135 operations specifications for several EMS helicopter operators revealed that the specifications require weather/visibility minimums of at least 1,000-foot ceilings and 3 miles visibility.

The circumstances of some of the accidents discussed in this report demonstrate that adverse weather conditions are often key factors in these accidents. For example, the Salt Lake City accident flight was conducted at night as a Part 91 positioning flight in weather conditions below Part 135 VFR minimums. The helicopter eventually crashed in an area where visibility was reported at 1/16 of a mile with fog and vertical visibility was 200 feet.[12] EMS positioning flights are often conducted in accordance with Part 91 minimums; thus, the flights may operate in weather/visibility conditions that are below Part 135 minimums because they are not required to meet the more stringent Part 135 requirements.

Part 135 and Part 91 also differ regarding crew rest requirements. The provisions of Part 135 require that the flight crew obtain adequate rest before conducting an EMS

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[10] Title 14 CFR Part 135 prescribes rules governing commuter or commercial on-demand operations.

[11] Title 14 CFR Part 91 prescribes rules governing the operation of aircraft within the United States, including the waters within 3 nautical miles of the U.S. coast.

[12] Vertical visibility is the distance that can be seen upward into a surface-based obscuration (for example, fog), or the maximum height from which a pilot in flight can recognize the ground through a surface-based obscuration.

flight with a patient on board, calling for a maximum duty time of 14 hours. In contrast, Part 91 has no duty time restrictions. Fatigue has been shown to impair performance and diminish alertness,[13] both of which are critical to safe flight operations. If a pilot has delivered a patient and has worked the maximum duty time under Part 135 requirements but returns the helicopter to departure base (a Part 91 flight), the hours flown for the Part 91 flight with no patient on board currently do not count toward his duty time restrictions.[14] This situation could result in a pilot flying in a fatigued condition during the Part 91 leg of the flight or not getting adequate rest during his time off, leaving him fatigued when he returns to duty the following day. If the return flight were conducted under Part 135 requirements, the pilot could request that his duty hours be extended to reposition the flight, but a longer rest period before returning to duty would be required. Further, the hours that a pilot flies under Part 91 do not count toward the total duty time the pilot is permitted to fly under Part 135 requirements. If a pilot were to conduct lengthy flight operations under Part 91, this flight time would not be indicated in his duty record and his eligibility to fly Part 135 flights would not be affected.

The Safety Board also notes that when pilots are permitted to proceed under Part 91 requirements in minimal weather conditions or near the end of their duty time (if their Part 91 and Part 135 duty hours were combined) to pick up a patient, the patient's critical condition might significantly influence pilots to complete the mission and transport the patient to a hospital even though the flight would not be permissible under Part 135 requirements. It is critical that EMS aircraft arrive safely at patient pick-up or drop-off locations. If the flight is unable to operate safely under Part 135 requirements, then the mission should not be attempted. Transporting a patient to the hospital is of utmost importance; however, if a flight is unable to safely reach the patient, the safety of the entire operation is compromised, and it may be to the patient's benefit to be transported by some other means, such as ground transportation. Of the 55 accidents investigated from January 2002 to January 2005, 10 flights were operating under the less stringent requirements of Part 91 and would not have met authorized weather minimums if they had been required to operate under Part 135 (see appendix C).

The Safety Board does not believe that EMS operations should be permitted to continue to operate under the less strict requirements of Part 91 simply because a patient is not on board. An EMS positioning flight does not fit the traditional definition of a

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[13] National Transportation Safety Board, *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Fatigue*, Safety Report NTSB/SR-99/01 (Washington, DC: NTSB, 1999).

[14] The Safety Board issued Safety Recommendation A-94-194, which asked the FAA to revise the regulations contained in 14 CFR Part 135 to require that pilot flight time accumulated in all company flying conducted after revenue operations—such as training and check flights, ferry flights, and repositioning flights—be included in the crewmember's total flight time accrued during revenue operations. The recommendation is currently classified "Open—Unacceptable Response" because of the FAA's inaction. The Board also issued Safety Recommendation A-95-113 to the FAA to finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues. This recommendation also asked that the new regulations prohibit air carriers from assigning flight crews to flight conducted under 14 CFR Part 91 unless the flight crews meet the flight and duty time limitations of 14 CFR Part 121 or other appropriate regulations. The recommendation is also classified "Open—Unacceptable Response." These recommendations are on the Safety Board's Most Wanted List of Safety Improvements.

positioning flight, which involves flying an empty aircraft from one location to another for future operations. Rather, a positioning flight in EMS operations is a critical part of transporting medical personnel to a patient's location or returning from a patient drop-off; therefore, the positioning legs of flights should not be separated from the patient-transportation leg. All three of these flight functions comprise the EMS mission and should not be differentiated. Because Part 135 requirements impose additional safety controls that are not present under Part 91 requirements, the Safety Board concludes that the safety of EMS operations would be improved if the entire EMS flight plan operated under Part 135 operations specifications; 35 of the 55 accidents in this special investigation occurred with crewmembers on board but no patients on board.

Further, the Safety Board is aware that some certificate holders may train medical personnel to perform duties that loosely relate to the operation of the aircraft, such as looking outside the aircraft for possible obstructions or evaluating a landing site, so that these personnel are classified as flight crewmembers, which permits positioning flights to be operated under Part 91.[15] The Board does not consider the assignment of limited operational duties to medical personnel to provide a sufficient basis for operating under the less rigorous requirements of Part 91, which provides inadequate safety controls for the transport of these medical personnel passengers. Without specific flight training (which medical personnel generally do not receive),[16] medical personnel cannot be expected to meaningfully participate in the decision-making process to enhance flight safety or to significantly contribute to operational control of the flight; therefore, regardless of any operational duties medical personnel may be assigned, they should be considered passengers on all EMS flights. The Safety Board concludes that the minimal contribution of medical personnel to the safe operation of EMS flights is not sufficient to justify operating EMS positioning flights under the less stringent Part 91 requirements.

The Safety Board notes that, because all EMS operators already fly under Part 135 operations specifications when patients are on board, little change would be required regarding the way they operate flights under Part 135 operations specifications when only medical personnel are on board. Because of the frequency with which EMS aviation accidents continue to occur while operating under Part 91 provisions, the Safety Board believes that the FAA should require all EMS operators to comply with Part 135 operations specifications during the conduct of all flights with medical personnel on board.

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[15] According to FAA Order 8400.10, "Air Transportation Operations Inspector's Handbook," volume 4, chapter 5, medical personnel may or may not be considered crewmembers at the operator's discretion. The order states, in part, "if the operator desires to consider the medical personnel crewmembers, the medical personnel must complete initial and recurrent crewmember training programs [and]…must perform some duty in an aircraft that relates to the operation of that aircraft." A note in the order states, "when only crewmembers are on board the aircraft, the flight may be conducted under FAR [Federal Aviation Regulations] Part 91. When a patient or passenger is on board the aircraft, the flight must be conducted under FAR Part 135."

[16] According to AC 135-14A, "Emergency Medical Services/Helicopter (EMS/H)," medical personnel need only to be trained in the use of aviation terminology, physiological aspects of flight, aircraft evacuation, and patient loading and unloading.

Aviation Flight Risk Evaluation Programs for EMS Operations

Much of the EMS mission has associated risks. Pressure to take or complete a mission, weather, nighttime flight, spatial disorientation resulting from lack of visual cues, and pilot training and experience were all identified as risk factors in the Safety Board's 1988 safety study of commercial EMS helicopter operations. The 2002 AMPA study cited additional risks, such as unprepared landing sites, complacency, and situational stress. Safely operating in such a high-risk environment calls for the systematic evaluation and management of these risks. According to AMPA's study, an effective flight risk evaluation program acknowledges and identifies threats, evaluates and prioritizes the risks, considers the probability that a risk will materialize, and mitigates loss. The Safety Board's investigation determined that, in the EMS environment, conducting a flight risk evaluation would require 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 accompany the initial call requesting services. The Board's investigation of recent EMS accidents found that all of the operators involved did not have an established aviation flight risk evaluation program that would assist pilots in making an objective determination of the risks that would be present.

For example, an aviation flight risk evaluation program did not exist at Intermountain Health Care (IHC) Health Services, Inc., when the accident occurred in Salt Lake City in January 2003. If an aviation flight risk evaluation program had been in place, the pilot would likely have been required to complete a standardized flight risk evaluation matrix before the flight, including assessing weather minimums and the route of flight. The poor nighttime weather conditions would have raised the risk rating for the mission, requiring further consideration of the flight risks. As noted in the accident description in appendix A, a previous pilot who aborted his attempt at the mission informed the accident pilot of the weather conditions, but the accident pilot decided to take the flight anyway. A systematic evaluation of the flight risks might have prevented the flight.

The Safety Board has learned that IHC Health Services implemented a risk management program after the January 2003 accident; the program includes a risk matrix form that pilots begin filling out when their shift begins. When an EMS call is received, the pilot completes the remainder of the form and calculates the flight risk. Depending on the calculated risk, the flight is categorized as low risk, mid-risk (which requires approval of a senior pilot before the mission can be attempted), or high risk (which requires approval of the director of operations, lead pilot, or chief pilot to accept the mission). The risk matrix also contains standardized flight procedures that require a flight dispatcher's agreement so that the pilot is alleviated of the sole responsibility for deciding whether to attempt a mission. In addition, IHC Health Services developed a safety awareness program for its EMS operations and, along with other EMS operators in Salt Lake City, developed and instituted a policy letter concerning communications between operators during adverse weather and hazardous conditions.

If the operator involved in the Battle Mountain accident had an established flight risk evaluation program, a different route may have been chosen before the accident flight. The pilot chose to take a direct route over a remote area of rugged mountainous terrain with little lighting instead of a slightly longer route that followed an interstate highway and avoided the highest terrain. The pilot might have felt additional pressure to take the direct route because the patient was an infant. If a risk management program had been in place, the dark night conditions and the mountainous route of flight might have raised the risk rating for the mission, which might have led the pilot to make an alternative decision regarding the flight (such as taking a less mountainous route) to lower the risk. The investigations of the Pyote and Rawlins accidents also revealed that neither operator had risk assessment programs in place at the time of the accidents. Both accidents occurred in hazardous weather conditions at night, indicating that the decisions to perform the flights in these conditions were flawed. As shown in appendix C, 13 of the 55 accidents studied during this investigation might not have occurred if flight risk evaluation programs had been in place because the flights might have been rejected or the risks might have been mitigated.[17]

The Safety Board is aware that Notice N8000.301, "Operational Risk Assessment Programs for Helicopter Emergency Medical Services," recommends that company procedures manuals contain procedures for maintaining operational control and conducting risk assessment and management. The notice indicates that although a pilot has ultimate responsibility and authority to determine risk, the company should promote the pilot's use of information from mechanics, communications specialists, ground and flight medical personnel, managers, and other support personnel involved in flight operation. The notice states that typical risk variables include weather, airworthiness, technologies to aid in managing risk, performance margins, flight crew performance, operating environment, and the organizational environment.

The Safety Board is pleased that Notice N8000.301, which was issued in 2005, is more detailed than AC 135-14A, which was issued in 1991 and had similarly addressed the need to consider judgment and decision-making in the development of safety programs for EMS operation. However, the Board is not confident that the new guidance will be any more widely adopted by EMS operators than the previous guidance because most operators examined during this investigation did not have a decision-making or a risk evaluation program in place (as suggested in the 1991 guidance) when accidents involving their aircraft occurred. Because aviation risk evaluation programs include training and procedural requirements that promote the risk evaluation of each flight in a systematic manner and consultation with others trained in EMS flight operations if the risks reach a predefined level, the Safety Board concludes that the implementation of

[17] Safety Board investigators analyzed the facts, conditions, and circumstances of all 55 accidents and applied the general criteria described in FAA Notice N8000.301, "Operational Risk Assessment Programs for Helicopter Emergency Medical Services," to reach this determination.

flight risk evaluation before each mission would enhance the safety of EMS operations. Therefore, the Safety Board believes that the FAA should require all 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.

Flight Dispatch Procedures

The Safety Board's investigations revealed that many EMS operators lack a consistent, comprehensive flight dispatch procedure, which—as part of a flight risk evaluation program—would help EMS pilots determine whether it is safe to accept or continue a mission. In commercial, passenger-carrying (Part 121) operations, flight dispatchers are responsible for authorizing the release of a flight based on, among other factors, the airworthiness of the aircraft, weather conditions, and the satisfactory operation of communication and navigation facilities along the route of flight, such as expected route, landing information, and notices to airmen (NOTAM). Flight dispatchers for Part 121 operations are also responsible for providing flight-following and updated information the pilot may not otherwise have access to during the flight, such as weather and routing.

Currently, most Part 135 EMS operations specifications permit the pilot to be notified of an assignment by the local 911 dispatch system or emergency hospital staff, yet 911 dispatch or hospital staff do not have expertise in or an understanding of the requirements of flight or landing procedures, particularly at night or in adverse conditions. When a pilot is dispatched by someone other than a flight dispatcher[18] and accepts the flight, the pilot would typically check[19] the most accessible source of weather information available (usually via computer, using sources that are not necessarily specific to aviation)[20] and begin the flight. The pilot would then have limited access to updated information. Safety Board staff found that, in many instances, 911 dispatchers or emergency hospital staff did not provide, nor were they expected to provide, EMS operators or pilots with more than minimal information concerning expected route, landing information, weather updates, or NOTAMs before or during a flight. For several accidents, the missing information was critical and could have helped avoid the accident.

As shown in appendix C, formalized flight dispatch procedures may have mitigated the results of 11 of the 55 accidents examined during the Safety Board's

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[18] The Safety Board makes the distinction between a 911 or hospital dispatcher, who generally works for the local government or hospital and dispatches all emergency services, and a flight dispatcher, who generally works for or under contract to an aviation operator and has specific aviation knowledge, including the effects of weather, mechanical reliability, and operational needs of the flight.

[19] For Part 91 flights, 14 CFR 91.103, "Preflight action," states the following, "each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include - (a) For a flight under [instrument flight rules] or a flight not in the vicinity of an airport, weather reports and forecasts." For Part 135 flights, 14 CFR 135.213, "Weather/reports and forecasts," states in part, "Whenever a person operating an aircraft under this part is required to use a weather report or forecast, that person shall use that of the U.S. National Weather Service, a source approved by the U.S. National Weather Service, or a source approved by the Administrator. However, for operations under VFR, the pilot in command may, if such a report is not available, use weather information based on the pilot's own observations or on those of other persons competent to supply appropriate observations."

[20] Nonaviation-specific weather sources do not contain or analyze information that is important to flight safety, such as visibility, winds, and temperature/dew point spread.

assessment.[21] For example, in the Pyote, Texas, accident, the pilot contacted the hospital dispatcher at the destination hospital only after he had departed Alpine, Texas, with the patient on board. He did not obtain a weather briefing before departure as he should have. If he had obtained a briefing, he would have been informed of expected thunderstorm activity in the area. A Convective Significant Meteorological Information (SIGMET) bulletin issued about 0154 (22 minutes before the accident) indicated an area of thunderstorms predicted for the accident site. Other weather information obtained from satellites and the National Weather Service also indicated thunderstorm activity surrounding the accident site at the time of the accident. Although the pilot took off about 15 minutes before the SIGMET was issued, he might not have continued the flight if he had been in contact with a flight dispatcher with knowledge of and access to this weather information.

For the Salt Lake City accident, the 911 and company dispatchers might not have been aware of the kind of information that is critical to flight safety when dispatching a flight. A transcript of the conversation between the IHC Health Services pilot and his company's flight dispatch center suggested that the pilot was frustrated with the 911 dispatcher's request to fly the mission, even though the 911 dispatcher knew that another company had aborted its flight because of low visibility. Despite this apparent frustration, the pilot and his company's flight dispatch center operator accepted the flight. The transcript showed that his company's dispatcher provided little support other than encouraging the pilot to accept the flight. The pilot was primarily responsible for obtaining weather, coordinating with the on-scene rescue personnel, and maintaining visual flight. Based on reports from the company that had just aborted its flight, it should have been clear that the IHC flight should not have been attempted. A flight dispatcher with specific knowledge of flight requirements would likely have been able to more fully comprehend the importance of the other company's aborted flight, independently gather pertinent weather information from all available sources, recognize that the available weather information was severe enough to not even attempt the mission, and provide sound advice to the mission pilot. Similarly, in the Rawlins, Wyoming, accident, St. Anthony's Hospital in Denver, Colorado, provided hospital dispatch for the accident flight by notifying the EMS operator, Mountain Flight Service, Inc. (MFS), only of the mission. The MFS pilot decided to launch into adverse weather conditions without obtaining additional information (other than a standard FAA flight service station briefing) related to the flight, such as the route of flight and the changing weather conditions near the destination.

An effective dispatch combined with a flight risk evaluation program (as discussed in the previous section) enhances the safety of these often-difficult missions and, for example, might have prevented the Newberry, South Carolina, accident. Three EMS flight crews had declined this mission because of weather conditions that were not conducive to safe flight. During postaccident interviews, the first pilot stated that he took off from Columbia, South Carolina, for the flight but canceled because of developing fog

[21] Safety Board investigators analyzed the facts, conditions, and circumstances of all 55 accidents and applied the procedures used by Part 121 flight dispatchers as outlined in the FARs to reach this determination.

conditions. The second pilot, who was located in Greenville, South Carolina, indicated that based on his experience and observation of the fog conditions and lack of a temperature/dew point spread, he classified the weather conditions as "red."[22] The third pilot, located in Columbia, declined the mission once he learned that the first pilot returned to the airport due to fog conditions. The accident pilot, located in Spartanburg, South Carolina, was not informed by the Spartanburg County 911 dispatcher that the first pilot had attempted but had not completed the mission or that the other two pilots had refused it. If a flight dispatcher who understood the weather risks based on the other pilots' refusals to take the mission were involved and relayed these risks to the accident pilot, or if a flight risk evaluation program had been in place, the accident pilot might also have rejected the mission.

Dispatch can also track flights to provide updated weather and terrain information or, if necessary, provide flight-locating services. In the Battle Mountain accident, the lack of a comprehensive flight dispatch and flight-following system resulted in the helicopter not being reported overdue until about 4 hours after its departure for a 1 hour 20 minute flight. The EMS operator used local county 911 dispatch systems for flight-following. As the flight crossed from one county into another, flight-following responsibility moved from one 911 dispatch center to another. However, the 911 dispatch centers did not directly communicate with one another about the progress of a flight; instead, the pilot was responsible for initiating these communications when changing county dispatch centers. When the accident pilot failed to make his required 15-minute position report after departing Battle Mountain, the Battle Mountain 911 dispatcher took no action, likely because she was not expecting another report from this pilot as he traveled into the next county. The helicopter was not reported overdue until personnel at the hospital in Reno, Nevada, became concerned when the patient did not arrive. Although this accident was not survivable, in other situations, flight-following and immediate notification would result in more timely search and rescue operations, which could have potentially life-saving benefits.

The Safety Board is aware that some EMS operators have company-trained dispatchers on staff who communicate with hospital emergency personnel or on-scene emergency services and notify the EMS pilot of flight assignments. These flight dispatchers obtain weather information for a pilot before a flight and, after a flight begins, they obtain updated weather information if requested by a pilot. These flight dispatchers also file a company flight plan and monitor the flight so that it can be quickly located if it is involved in an accident. This function is an important aspect of safe flight operations, and the safety of EMS operations would be enhanced if formalized dispatch procedures were used.

Formalized dispatch procedures would include a person knowledgeable in flight operations, weather, maintenance, and flight-following who would be able to evaluate all flight risks and advise a pilot about whether to accept or continue a mission in changing weather situations. Because the flight dispatcher would be detached from the emergency

[22] A "red" classification is a designation used by the pilot's company indicating that the pilot would not take off until the weather conditions improved.

itself (the flight dispatcher would not be the 911 or hospital dispatcher), the flight dispatcher would be less susceptible to making flight decisions based on the urgency of the situation and would be able to obtain an overall perspective of the mission's safety. The Safety Board concludes that formalized dispatch and flight-following procedures, including a dedicated dispatcher with aviation-specific knowledge and experience, would enhance the safety of EMS flight operations by providing the pilot with consistent and critical weather information, assisting in go/no go decisions, and monitoring the flight's position. Therefore, the Safety Board believes that the FAA should require EMS operators to use formalized dispatch and flight-following procedures that include up-to-date weather information and assistance in flight risk assessment decisions.

Use of Technology to Assist in EMS Flight Operations

Terrain Awareness and Warning Systems

The study by AMPA found that CFIT is a common factor in helicopter EMS accidents, in particular during the takeoff or landing sequence.[23] During low flight over terrain or flight over variable terrain, the use of TAWS could provide valuable information to pilots who are trained in instrument flight but do not completely or properly use all of their instruments, as well as those pilots who are not instrument-trained.[24] TAWS can substantially reduce pilot workload and improve the margin of safety during limited visibility conditions, which are often encountered during EMS operations. The FAA has already recognized the benefit of TAWS by requiring these systems on turbine-powered airplanes with six or more passenger seats. Requiring TAWS for EMS aircraft would extend this benefit to the patients and medical personnel traveling on EMS flights. One system specifically manufactured for helicopters operates in multiple modes that provide ample warnings to the flight crew when dangerous flight profiles are encountered. These modes allow for six different flight regimes from takeoff to landing and include warnings for altitude deviation and excessive sink rate.

The use of TAWS might have helped the pilot in the Battle Mountain accident avoid the terrain. According to data supplied by a U.S. manufacturer of TAWS equipment, the reconstructed flight profile of the accident helicopter indicated that, if the helicopter had been equipped with a TAWS, a "caution terrain" aural message would have sounded 30 seconds before impact, and a "warning terrain" aural message would have sounded 25 seconds before impact and continued to the end of the flight. These warnings would have provided adequate time to allow the pilot to take appropriate action to avoid impact with the terrain. The investigations of the Pyote and Dodge City accidents revealed that, if a TAWS had been installed on the aircraft involved and had been appropriately set to a minimum altitude setting, the pilots would have received ample warning during their respective aircraft's gradual descent into terrain, thus preventing the accidents. Further, for 17 of the 55 accidents, TAWS might have helped the pilots avoid terrain. (See appendix C.)

[23] Blumen, MD, and the UCAN Safety Committee (2002): 8.

[24] Although similar in purpose, TAWS functionality is different from that of a radio altimeter, which uses the reflection of radio waves from the ground to determine the height of an aircraft above the surface. On October 7, 2002, the Safety Board issued Safety Recommendation A-02-35, asking the FAA to require the installation of radar altimeters in all helicopters conducting commercial, passenger-carrying operations in areas where flat light or whiteout conditions routinely occur. In a September 6, 2005, response, the FAA indicated that an aviation rulemaking committee has discussed requiring "radio altimeters in helicopters and will recommend the installation in aeromedical operations." The FAA also stated that it would solicit comments on whether radio altimeters should be installed in all helicopters conducting commercial passenger-carrying operations when it publishes a notice of proposed rulemaking.

The Safety Board concludes that the use of TAWS would enhance the safety of EMS flight operations by helping to prevent CFIT accidents that occur at night or during adverse weather conditions. Although FAA Notice 8000.293 encourages operators to consider installing TAWSs for nighttime operations (see appendix D), merely encouraging the use of a technology is not sufficient; operators should be required to incorporate systems and practices that will improve the safety of their operations. Additionally, as TAWS become more widely used, its cost will continue to decrease.[25] Therefore, the Safety Board believes that the FAA should require EMS operators to install TAWS on their aircraft and to provide adequate training to ensure that flight crews are capable of using the systems to safely conduct EMS operations.

Night Vision Imaging Systems

Safety Board staff found that some EMS operators use night vision imaging systems (NVIS),[26] which enhance a pilot's ability to see and avoid obstructions at night. However, most EMS operators do not use such equipment because of its relatively recent introduction into the nonmilitary community; the expense of the system, training, and aircraft modifications; and the fact that the equipment cannot be used in locations that have ambient light, such as populated areas. An FAA study found that "[w]hen properly used, NVGs [night vision goggles] can increase safety, enhance situational awareness, and reduce pilot workload and stress that are typically associated with night operations."[27] The study by AMPA found that collision with objects poses a problem for EMS helicopters and that wires are the most common obstacles (NVGs can help pilots see wires). The study also noted that although 38 percent of all helicopter EMS flights were at night, 49 percent of accidents occurred during nighttime hours.[28]

The FAA allows Part 135 operators to use NVIS to aid in night flight during visual meteorological conditions (VMC), but they are not to be used during IMC; therefore, VFR weather minimums must be complied with during a flight. The FAA's Technical Standard Order-C164 describes the minimum performance standards NVGs must meet for design approval. The FAA also issued Flight Standards Handbook Bulletin for Air Transportation 04-02, "Night Vision Imaging Systems," which guides POIs in the evaluation of operations, training, currency, and equipment after an operator's request to use NVIS.

The use of NVIS might have helped the pilots involved in the Battle Mountain and Redwood Valley accidents. If the Battle Mountain pilot had been using NVIS, he would likely have seen the ridgeline and been able to avoid the impact. In the Redwood Valley

[25] Current market cost for TAWS installation is about $30,000.

[26] The term NVIS most commonly refers to night vision goggles but can also include technology such as thermal imaging equipment, night vision cameras, and heads-up displays. NVIS can enhance vision in dark conditions by amplifying available light several hundred times.

[27] W.T. Sampson, G.B. Simpson, and D.L. Green. *Night vision goggles in Emergency Medical Services (EMS) Helicopter, FAA report DOT/FAA/RD-94/21 (1994): Federal Aviation Administration*.

[28] Blumen, MD, and the UCAN Safety Committee (2002): II.

accident, the pilot was flying at night in a narrow canyon and would not have been able to see any outside cues about his location in relation to the terrain around him as he tried to reverse course to return to his departure base. If this pilot had been using NVIS, he would likely have been able to identify the walls of the canyon, negotiate the terrain, and avoid the accident. The Safety Board notes that, among other improvements to its operations, the EMS operator involved in the Salt Lake City accident expedited the implementation of an NVG program after the accident.

As shown in appendix C, for 13 of the 55 accidents, NVIS might have helped the pilots more clearly observe obstacles and take evasive action to avoid the accidents. The Safety Board concludes that if used properly, NVIS could help EMS pilots identify and avoid hazards during nighttime operations. The Safety Board is pleased that the FAA has encouraged the use of NVIS in EMS operations and hopes that this technology will be more widely used. Currently, the Safety Board is not recommending that NVIS be required for all EMS operators because NVIS are not feasible in some situations, such as populated areas with ambient light and numerous streetlights. The required use of NVIS needs to be made on an individual operator basis. However, the Safety Board will monitor the effectiveness of the FAA's recommendation that operators use NVIS to determine whether this recommendation is sufficient to implement NVIS use on a more widespread basis or if a requirement is necessary.

Conclusions

Findings

1. The safety of emergency medical services (EMS) operations would be improved if the entire EMS flight plan operated under 14 *Code of Federal Regulations* Part 135 operations specifications; 35 of the 55 accidents in this special investigation occurred with crewmembers on board but no patients on board.

2. The minimal contribution of medical personnel to the safe operation of emergency medical services (EMS) flights is not sufficient to justify operating EMS positioning flights under the less stringent 14 *Code of Federal Regulations* Part 91 requirements.

3. The implementation of flight risk evaluation before each mission would enhance the safety of emergency medical services operations.

4. Formalized dispatch and flight-following procedures, including a dedicated dispatcher with aviation-specific knowledge and experience, would enhance the safety of emergency medical services flight operations by providing the pilot with consistent and critical weather information, assisting in go/no go decisions, and monitoring the flight's position.

5. The use of terrain awareness and warning systems would enhance the safety of emergency medical services flight operations by helping to prevent controlled flight into terrain accidents that occur at night or during adverse weather conditions.

6. If used properly, night vision imaging systems could help emergency medical services pilots identify and avoid hazards during nighttime operations.

Recommendations

To the Federal Aviation Administration:

Require all emergency medical services operators to comply with 14 *Code of Federal Regulations* Part 135 operations specifications during the conduct of all flights with medical personnel on board. (A-06-12)

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)

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)

Require emergency medical services (EMS) operators to install terrain awareness and warning systems on their aircraft and to provide adequate training to ensure that flight crews are capable of using the systems to safely conduct EMS operations. (A-06-15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

MARK V. ROSENKER
Acting Chairman

ELLEN ENGLEMAN CONNERS
Member

DEBORAH A. P. HERSMAN
Member

KATHRYN O. HIGGINS
Member

Adopted: January 25, 2006

Board Member Statement

Member Kathryn O. Higgins' Concurring Statement

While I fully concur with all findings, conclusions and recommendations proposed in the Board's report, I am concerned that the report did not address a significant issue that impacts safety in Emergency Medical Services - the lack of good data on the EMS industry and on flight operations. We don't know how many operators there are, who they are and where they are. We don't know how many rotor and fixed wing assets are used for EMS flights, and how many and when flights occur. We are told that the industry has grown significantly over the last ten years but the rate of that growth cannot be officially documented. The only data that exists is gathered by the industry and they acknowledge that it is incomplete.

In 2003, the NTSB issued safety recommendation A-03-037 to the FAA asking that they require nonscheduled Part 135 operators to report activity data on an annual basis. This data is critical in assessing the state of aviation safety because this segment of aviation operations accounts for more than half of all commercial accidents each year. The recommendation specifically mentions collecting data for each aircraft on the proportion of time spent in air ambulance service.

While A-03-037 as well as other open recommendations issued by the Safety Board ask the FAA to require activity reporting, the FAA has said that they will not mandate reporting but will conduct a survey of all nonscheduled Part 135 operators in an effort to obtain the desired information, and that they will specifically ask for the percentage of time that an aircraft is used in air ambulance service. The information on activity during 2005 from that survey will be available in the fall of 2006.

I am concerned that a voluntary survey will not yield the information required to adequately monitor and evaluate the safety record of the EMS industry. While I would have preferred that the Board report reiterate recommendation A-03-037, I am prepared to wait for the survey results. Staff has indicated that it will review the results of the 2005 survey when it is released in the fall of 2006. Based on the results of the survey, and staff's analysis of those results, I reserve the right to present this issue to the Board for further action.

Member Hersman joined Member Higgins in this concurring statement.

Appendix A

Accident Synopses

Salt Lake City, Utah

On January 10, 2003, about 2050 mountain standard time, an Agusta A-109-K2 twin-engine helicopter, N601RX, operated by Intermountain Health Care (IHC) Health Services, Inc., crashed into terrain while attempting to maneuver in dense fog near Salt Lake City International Airport (SLC), Salt Lake City, Utah. (See figure 1) The instrument-rated commercial pilot and the flight paramedic were killed, the flight nurse was seriously injured, and the helicopter was destroyed. Night IMC prevailed for the 14 CFR Part 91 positioning flight, which originated at LDS Hospital in Salt Lake City about 2032 mountain standard time and was destined for Wendover, Utah, to pick up a patient before the flight was aborted.

Figure 1. N601RX Wreckage Near Salt Lake City, Utah

Before the accident flight, a pilot working for another EMS helicopter operator located in Salt Lake City had attempted the same mission but aborted the mission because of deteriorating weather conditions.[1] After returning to the helicopter's departure base, he

[1] According to this EMS operator, several other flights were canceled because of extreme fog.

learned that a pilot from IHC Health Care Services would be attempting the mission and radioed the IHC pilot to inform him of the deteriorating weather conditions. According to the pilot who aborted the mission, the IHC pilot indicated that he was going to attempt to “get over” the fog and complete the mission. Before attempting the mission, the IHC pilot checked the weather conditions via a company weather computer station and reported to the company dispatcher that the weather “had gotten really bad [near SLC]” but that he would try to fly.

After proceeding through SLC airspace, the pilot encountered increasing adverse weather and decided to abort the mission and return to LDS Hospital. However, the air traffic controller could not permit the helicopter back through SLC airspace until traffic arriving at SLC was cleared. The pilot stated he could hold near his position until ATC gave him clearance through the SLC airspace. After holding for about 10 minutes, the pilot declared an emergency because of an inadvertent encounter with IMC. The air traffic controller received no further communications from the pilot. The helicopter wreckage was located 1/2 mile southwest of SLC. Witnesses located near the accident site reported that the weather was very foggy. The Safety Board determined that the probable cause of this accident was the pilot’s delayed remedial action and continued flight into known adverse weather conditions, which resulted in his failure to maintain clearance with the ground. Contributing factors were the prevailing fog and the pressure to complete the mission induced by the pilot-in-command as a result of the emergency medical services operation.

Redwood Valley, California

On December 23, 2003, about 1932 Pacific standard time, an Agusta A109A, N25RX, operated by Mediplane, Inc., crashed into mountainous terrain near Redwood Valley, California, in high winds and heavy rain while en route to pick up a patient. (See figure 2) The instrument-rated pilot and two flight nurses were killed, and the helicopter was destroyed by a postimpact fire. The 14 CFR Part 91 positioning flight departed the Sonoma County Airport, Santa Rosa, California, about 1900 Pacific standard time and landed at the Ukiah Municipal Airport, Ukiah, California, about 1925, ending the instrument flight rules (IFR) portion of the flight. Afterward, the helicopter departed from Ukiah under VFR[2] and was en route to a California Department of Forestry (CDF) helipad just south of Willits, California, to pick up a patient.

[2] Night VMC prevailed at the time of departure.

Figure 2. N25RX Wreckage Near Redwood Valley, California

About 1930, the pilot told the CDF that the helicopter would be returning to Ukiah because of an inadvertent encounter with IMC. No further transmissions were received from the pilot. Residents and rescue personnel near the accident site stated that high winds and heavy rain were present at the time of the accident. Recorded data indicated that the pilot obtained a weather report from an aviation-specific weather reporting service before departing Santa Rosa.

The Safety Board determined that the probable cause of this accident was the pilot's improper in-flight planning and decision to continue flight under VFR into deteriorating weather conditions, which resulted in an inadvertent in-flight encounter with IMC and a collision with rising terrain while attempting to reverse course.

Dodge City, Kansas

On February 17, 2004, about 0256 central standard time, a Beech BE-B90 twin-engine airplane, N777KU, operated by Ballard Aviation, Inc., was destroyed when it impacted terrain about 5 nautical miles (nm) northwest of Dodge City Regional Airport (DDC), Dodge City, Kansas. (See figure 3) The pilot, flight nurse, and flight paramedic were killed. The 14 CFR Part 91 positioning flight departed Wichita Mid-Continental Airport (ITC), Wichita, Kansas, about 0210 and was en route to DDC. Night VMC prevailed. The flight was on an IFR flight plan, but the pilot cancelled the IFR flight plan about 37 miles east of DDC and proceeded under VFR.

Figure 3. N777KU Wreckage Near Dodge City, Kansas

The Safety Board's investigation revealed that the pilot had been awake for as long as 21 hours at the time of the accident. Additionally, the accident occurred 14.5 hours after his duty day began. Recorded radar data indicate that the airplane initiated a gradual, straight-line descent toward the airport but flew past the airport before descending into the ground. No communications from the airplane were made during this descent, which suggests that the pilot was fatigued.

The Safety Board determined that the probable cause of this accident was the pilot's failure to maintain clearance with terrain due to pilot fatigue (lack of sleep).

Pyote, Texas

On March 21, 2004, about 0216 central standard time, a Bell 407 helicopter, N502MT, owned and operated by Med-Trans Corporation of Bismarck, North Dakota, crashed into terrain near Pyote, Texas, while the aircraft was maneuvering in reduced visibility conditions. (See figure 4) The instrument-rated commercial pilot, a flight paramedic, the patient, and the patient's mother were killed, and a flight nurse was seriously injured. The flight was conducted under the provisions of 14 CFR Part 135. Night IMC prevailed throughout the area.

Figure 4. N502MT Wreckage Near Pyote, Texas

According to company personnel, the aircraft arrived at Big Bend Regional Medical Center in Alpine, Texas, about 0044 to pick up the patient and passenger; they boarded the helicopter about 0139. The flight then departed for the University Medical Center in Lubbock, Texas. About 1 minute before the accident, the pilot contacted the dispatcher at the Medical Center Hospital and began to provide a position report when he stated, "hold on a [minute] dispatch." The Safety Board's investigation revealed that severe thunderstorms were moving through the area at the time of the accident and that the pilot had not obtained a weather briefing from the FAA flight service station. In addition, witnesses reported brown-out[3] conditions at the time of the accident.

The Safety Board determined that the probable cause of this accident was the pilot's inadvertent encounter with adverse weather, which resulted in the pilot failing to maintain terrain clearance. Contributing factors were the dark night conditions, the pilot's inadequate preflight preparation and planning, and the pressure to complete the mission induced by the pilot as a result of the nature of the EMS mission.

Newberry, South Carolina

On July 13, 2004, about 0532 eastern daylight time, a Bell 407 helicopter, N503MT, also operated by Med-Trans Corporation, was traveling to the Spartanburg Regional Medical Center, Spartanburg, South Carolina, when it collided with trees shortly

[3] Brown-out conditions connote in-flight visibility restrictions due to dust or sand in the air.

after takeoff from interstate highway 26 near Newberry, South Carolina. (See figure 5) The instrument-rated pilot, flight nurse, flight paramedic, and patient were killed, and the helicopter was destroyed by impact and postcrash fire. Night VMC (mist and light fog) prevailed at the time of the accident. The Safety Board's investigation found that three EMS flight crews had previously turned down this mission because of weather conditions that were not conducive to flight.

Figure 5. N503MT Wreckage Near Newberry, South Carolina

The flight was on a company flight plan and was receiving flight-following from Regional One Communications provided by Spartanburg County 911. The Med-Trans Spartanburg EMS operation was a VFR program only. The Bell 407 helicopter that Med-Trans operated was not authorized for flight into IMC, and Med-Trans pilots were not required to train for flight in IMC. The accident pilot had logged about 2,133 flight hours, which were all in helicopters. He had flown about 104 hours in the Bell 407, including 6.1 hours in the last 30 days. He had logged 250 hours of total night flight, including 2.7 hours of night flight in the last 30 days.

The Safety Board determined that the probable cause of this accident was the pilot's failure to maintain terrain clearance as a result of fog conditions. A contributing factor was inadequate weather and dispatch information relayed to the pilot.

Battle Mountain, Nevada

On August 21, 2004, about 2358 Pacific daylight time, a Bell 407 helicopter, N2YN, operated by Jeflyn Aviation, Inc., of Boise, Idaho, d.b.a. Access Air Ambulance, crashed into mountainous terrain during cruise flight about 27 nm southwest of Battle Mountain, Nevada. (See figure 6) The instrument-rated pilot, two medical crewmembers, a patient, and the patient's mother were killed, and the helicopter was destroyed. Night VMC prevailed at the time, and the accident occurred in a sparsely populated area with minimal ground lights.

Figure 6. Wreckage Near Battle Mountain, Nevada

After takeoff, the pilot reported his departure to the Lander County dispatch center (where the hospital was located) and stated that his estimated time en route was 1 hour 20 minutes. No further radio communications were received from the helicopter. Radar data, which showed that about 4 minutes of the helicopter's flight before coverage was lost due to mountainous terrain, were consistent with the flight following the direct route. The helicopter impacted terrain about 75 feet below the top of a ridgeline at an elevation of about 8,600 feet along the intended course line between the departure location and the intended destination. Evidence indicated that the helicopter was in level flight, which is consistent with CFIT. Weather reports indicated clouds and light rain before and at the time of the accident. Although company flight-following procedures stated that an aircraft would be reported missing as soon as it failed to make a required 15-minute position report, the search for the helicopter was not initiated until about 4 hours after the accident, when it had not arrived at the destination hospital. However, this accident was not survivable and a faster notification would not have changed the outcome.

The Safety Board determined that the probable cause of this accident was the pilot's failure to maintain clearance from mountainous terrain. Contributing factors were the pilot's improper decision to take the direct route over mountainous terrain, the dark night conditions, and the pressure to complete the mission induced by the pilot as a result of the nature of the EMS mission.

Rawlins, Wyoming

On January 11, 2005, about 2145 mountain standard time, a Beech E-90 twin-engine airplane, N41WE, operated by Mountain Flight Service, Inc., (MFS) was destroyed when it impacted terrain while performing a nonprecision approach to runway 22 at the Rawlins Municipal Airport/Harvey Field (RWL), Rawlins, Wyoming. (See figure 7) The airline transport pilot and two medical crewmembers on board the airplane were killed. A third medical crewmember passenger sustained serious injuries. Night IMC prevailed at the time of the accident. The EMS flight was being conducted on an IFR flight plan under the provisions of 14 CFR Part 91.

Figure 7. N41WE Wreckage Near Rawlins, Wyoming

The flight originated at Steamboat Springs, Colorado, about 2116 and was en route to RWL to pick up a patient for transfer to Cheyenne, Wyoming. Radar contact was lost about 2142. At that time, the airplane was at 9,200 feet mean sea level and midway through the procedure turn inbound for the approach to runway 22. About 2140, the automated surface observation system at RWL reported the weather as low clouds with light snow and mist.

Several witnesses near the accident site reported surface weather conditions varying from freezing rain to heavy snow. The airplane impacted the windward side of a 7,269-foot msl ridgeline, 2 1/2 nm from RWL in a wings-level attitude and aligned with runway 22. About 1 1/2 inch of clear ice was found on the leading edges of the airplane's wings, the leading edge of the vertical tail, portions of the main landing gear tires and portions of one of the two propellers.

The Safety Board determined that the probable cause of this accident was the pilot's inadvertent flight into adverse weather [severe icing] conditions, resulting in an aerodynamic stall impact with rising, mountainous terrain during approach. A factor contributing to the accident was the pilot's inadequate planning for the forecasted icing conditions.

Appendix B

EMS Accidents: January 10, 2002 to January 30, 2005

TOTAL:55 accidents, 21 fatal accidents (38%), 15 fatal accidents at night (27% of total accidents, 71% of fatal accidents)
Injuries: F(Fatal) S(Serious) M(Minor) N(None)
Mission: EMS=Patient Transport including the flight to the patient's location and return
EMS PT=Patient on board
EMS To=Flight to pick up patient
EMS Rtn=Flight returning from patient drop off
Phase of Flight: TO(Take-off) C(Cruise) LDG(Landing); A/P(Airport) H(Helipad) LZ(Unimproved Landing Zone)

Helicopter

2005

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
01/29/05	DEN05LA053	91	1N	AS350B3	N	EMS TO	NVG, Snowstorm	C	Y	0
01/10/05	NYC05MA039	91	2F,1S	EC135	N	EMS RTN	Nt. Water	C	N	0
01/05/05	ATL05FA038	91	1F	AS350D	N	EMS RTN	Nt. IMC	TO,LZ	Y	0
2005: 3 Total, 2 Fatal										

2004

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
12/14/04	LAX05FA053	91	1F, 2S	AS350B3	N	EMS To	LOC, Landing	LDG,LZ	N	0
11/09/04	DFW05LA019	91	2M, 1N	BH-206L1	N	EMS RTN	Bag. Door opened	C	N	0
11/2/04	LAX05LA025	91	3N	AS350B3	D	EMS To	Power loss at TO	TO	N	0
10/20/04	MIA05FA008	91	3F	BO-105S	N	EMS To	Nt. IMC	C	Y	0
09/27/04	DEN04LA149	91	1N	AS350B3	N	EMS RTN	LOC on t/o	TO,H	N	0
08/21/04	SEA04MA167	135	5F	BH-407	N	EMS PT	CFIT	C	N	2
07/14/04	SEA04LA145	135	4N	BH-222U	D	EMS PT	Loss of rpm	TO,LZ	N	1
07/13/04	CHI04MA182	135	4F	BH-407	N	EMS PT	Wx, hit trees on t/o	TO,LZ	Y	1
06/26/04	LAX04LA285	91	3N	AS350B3	N	EMS To	Hard landing	LDG,LZ	N	0
05/23/04	FTW04LA133	91	3N	BH-412	D	EMS RTN	T/r strike on t/o	TO,H	N	0
04/20/04	CHI04FA107	135	1F,3S	BH-206L1	N	EMS PT	CFIT	C	N	1
03/21/04	FTW04FA097	135	4F,1S	BH-407	N	EMS PT	CFIT	C	Y	2
2004: 12 Total, 6 Fatal										

2003

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
12/27/03	DEN04LA033	91	1N	AS365 N-2	D	EMS Rtn	R strike on taxiing	LDG,A/P	N	0
12/23/03	LAX04FA076	91	3F	A109A	N	EMS To	Wx, VFR into IMC	C	Y	0
12/20/03	NYC04CA049	91	3N	BH-407	N	EMS To	T/r strike on ldg	LDG,LZ	N	0
12/16/03	ATL04LA055	91	3M	BK117A3	N	EMS To	VFR into IMC	C	Y	0
11/29/03	FTW04LA069	91	3N	BK117B2	N	EMS To	T/r strike on ldg	LDG,LZ	N	0
11/28/03	FTW04CA030	91	2M	BH-206L1	N	EMS To	Start w/ m/r tied	TO,H	N	0
11/03/03	LAX04LA035	91	4N	AS350B3	D	EMS PT	Hyd., LOC on ldg	LDG,A/P	N	1
09/20/03	CHI03LA319	135	3N	BH-206L1	N	EMS To	Hard landing, dust	LDG,LZ	Y	0
09/03/03	FTW03FA211	91	2N, 1M	A109E	N	EMS To	Eng failure on t/o	TO,A/P	N	0
06/20/03	NYC03LA133	91	1S, 2M	BO105C	D	EMS To	Hard ldg	TO,H	N	0
06/11/03	MIA03FA120	135	1N, 3M	AS355F1	D	EMS PT	LOC	TO,H	N	1
06/07/03	DEN03FA099	91	1F,1M,1N	A109K2	D	EMS Rtn	t/r trunnion fatigue	C	N	0
03/16/03	CHI03LA084	91	1N	BH-430	N	EMS To	T/r strike on t/r	TO,LZ	N	0
03/06/04	FTW03LA104	91	3N	BH-206L3	D	EMS To	Blanket hit t/r	C	N	0
02/20/03	FTW03LA112	91	2N, 1M	AS350B3	D	EMS To	VFR into IMC	C	Y	0
01/10/03	FTW03FA082	91	2F/1S	A109K2	N	EMS To	VFR into IMC	C	Y	0
2003: 16 Total, 3 Fatal										

2002

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
12/26/02	NYC03LA033	91	3N	BK-117A4	D	EMS To	M/r strike on start	TO,H	N	0
12/17/02	SEA03LA019	135	4N	EC-135 P1	N	EMS PT	VFR into IMC	C	Y	1
11/08/02	IAD03LA015	91	1N	BH-206L1	D	EMS To	LOC (LTE)	LDG,LZ	N	0
09/09/02	CHI02FA288	135	4F	BH-206L1	N	EMS PT	LOC, Night	C	Y	1
09/07/02	LAX02FA276	91	3F	BH-222U	N	EMS To	M/r separation	LDG,LZ	N	0
08/31/02	MIA02FA161	91	3M, 1S	S-76A+	D	EMS To	M/r blade strike	TO,H	N	0
06/21/02	CHI02FA174	91	3F	AS350B2	D	EMS To	Mech., LOC	LDG,A/P	N	0
06/09/02	FTW02LA176	91	3N	BH-206L3	N	EMS To	T/r strike on ldg	LDG,LZ	N	0
03/21/02	LAX02FA114	91	1F, 2S	AS350B	D	EMS Rtn	CFIT, glassy water	C	N	0
01/18/02	IAD02FA026	91	2F, 1S	BK-117A3	N	EMS To	LOC, wind, hit bld	TO,H	N	0
2002: 10 Total, 5 Fatal										

Fixed Wing

2005

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
1/11/05	DEN05FA051	91	3F, 1S	BE90	N	EMS To	Nt. IMC	LDG,A/P	Y	0

2004

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
12/20/04	CHI05LA047	91	4N	Lear 25B	D	EMS Rtn	N gear/direct. cntrl	LDG,A/P	N	0
10/24/04	LAX05FA015	91	5F	Lear 35A	N	EMS Rtn	CFIT	TO,A/P	N	0
9/4/04	DEN04LA138	135	5N	Lear 25B	D	EMS PT	Tires blown at TO	TO	N	1
8/18/04	LAX04CA296	91	4N	PC-12	N	EMS To	Hit an Elk on TO	TO	N	0
2/20/04	ANC04FA026	91	1S,1M,2N	Lear 25B	N	EMS Rtn	Overrun	LDG,A/P	N	0
2/17/04	CHI04FA066	91	3F	BE-B90	N	EMS To	CFIT	C	N	0
1/31/04	LAX04FA113	91	3F	C-414A	N	EMS To	VFR into IMC	C		0
2004: 7 Total, 3 Fatal										

2003

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
3/19/03	DEN03LA053	91	3M	BE-90	N	EMS To	CFIT	LDG,A/P	N	0

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
2/16/03	LAX03LA088	135	5N	C-421C	N	EMS PT	Truck Collision	Taxiing	N	1
1/30/03	ANC03LA030	135	5N	C-208B	N	EMS To	Pax Loading	TO,A/P	N	1
2003: 3 Total, 0 Fatal										

2002

Date	Accident #	FAR	Injuries	Type	Day / Night	Mission	Comments	Phase of Flight	< 135 min	# Patients
12/18/02	ANC03LA019	91	4N	SA-226T	N	EMS To	Struck Terrain	LDG	N	0
8/30/02	NYC02FA177	135	1F,4S,1M	Lear 25C	D	EMS PT	Overrun	LDG,A/P	N	1
6/27/02	CHI02LA173	91	4N	BE-90	N	EMS To	Struck deer	LDG,A/P	N	0
2002: 3 Total, 1 Fatal										

Appendix C

Table of Potentially Preventable EMS Accidents and Safety Issues Discussed in This Report

The following table identifies 29 of the 55 EMS accidents examined during the Safety Board's special investigation that the Board believes could have been prevented if the corrective actions recommended in this report had been implemented.[4]

	Accident Number	Compliance with Part 135	Aviation Dispatcher	Flight Risk Evaluation	TAWS	NVIS
1.	DEN05FA051			✓		
2.	DEN05LA053	✓	✓	✓	✓	✓
3.	NYC05MA039				✓	
4.	ATL05FA038	✓	✓	✓		
5.	MIA05FA008		✓	✓	✓	
6.	DEN04LA149					✓
7.	SEA04MA167		✓	✓		
8.	CHI04MA182	✓	✓	✓		✓
9.	LAX04LA285					✓
10.	CHI04FA107				✓	✓
11.	FTW04FA097		✓	✓	✓	
12.	LAX04FA076	✓		✓	✓	✓
13.	NYC04CA049					✓
14.	ATL04LA055	✓	✓	✓	✓	
15.	FTW04LA069					✓
16.	CHI03LA319					✓
17.	CHI03LA084					✓
18.	FTW03LA112	✓	✓	✓	✓	
19.	FTW03FA082	✓	✓	✓	✓	
20.	SEA03LA019	✓	✓	✓	✓	
21.	CHI02FA288	✓	✓	✓	✓	✓
22.	LAX02FA276					✓
23.	MIA02FA161			✓		
24.	FTW02LA176				✓	✓
25.	LAX02FA114				✓	
26.	LAX05FA015				✓	
27.	CHI04FA066				✓	
28.	LAX04FA113	✓		✓	✓	
29.	DEN03LA053				✓	

[4] Safety Board investigators analyzed the cause and contributing factors of each of the accidents in appendix B and determined which accidents may have been prevented had this report's recommendations been implemented and adhered to at the time of the accident. Accidents not appearing in this table likely could not have been prevented through the recommendations contained in this report.

Appendix D

FAA Notice N8000.293: Helicopter Emergency Medical Services Operations

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8000.293

1/28/05

Cancellation
Date: 1/28/06

SUBJ: HELICOPTER EMERGENCY MEDICAL SERVICES OPERATIONS

1. PURPOSE. This notice, which was developed in close coordination with the Helicopter Emergency medical Services (HEMS) industry, provides guidance for principal inspectors (PI) in all specialties regarding HEMS operators for whom they have oversight responsibilities. This notice also contains information which PIs can provide to HEMS operators for a review of pilot and mechanic decisionmaking skills, procedural adherence, and crew resource management (CRM).

2. DISTRIBUTION. Hard copy of this notice is distributed to the division level in the Flight Standards Service in Washington headquarters; to the branch level in the regional Flight Standards divisions; to the Flight Standards District Offices, and to the Regulatory Standards Division at the Mike Monroney Aeronautical Center. This notice is also distributed electronically to the division level in the Flight Standards Service in Washington headquarters and to all regional Flight Standards divisions and district offices. This information is available to the public at no charge at the Federal Aviation Administration's (FAA) Web site at: http://www.faa.gov/avr/afs/notices/8000/N8000-293.doc.

3. BACKGROUND.

a. Introduction. The HEMS role is a very demanding and time critical-/mission-orientated operation. One consistent priority that must be addressed by each individual EMS organization is the safety of their flightcrew, medical staff, and passengers. The safety of these persons must be a priority. Preventing accidents is the responsibility of everyone involved in HEMS operations. Reducing accidents takes the dedicated involvement of all the aviation and medical professionals involved.

b. Soft Skills. "Soft skills" often refers to proficiencies that go beyond technical knowledge and psychomotor skills necessary to operate a helicopter. Soft skills are often the first line of defense – and sometimes the last – against accidents caused by lapses in human performance. Soft skills include adherence to standard operating procedures, decisionmaking, judgment, air medical resource management (AMRM) (similar to CRM), and professionalism. These skills are not easily or quickly conveyed in training programs but are developed through the continuing commitment of corporate managers, trainers, pilots, mechanics, and medical staff.

c. Preliminary Review. A preliminary review of the commercial HEMS accidents from January 1998 through December 2004 reveals that CONTROLLED FLIGHT INTO TERRAIN (CFIT), NIGHT OPERATIONS, AND INADVERTENT FLIGHT INTO INSTRUMENT METEOROLOGICAL CONDITIONS (IMC) are predominant factors. Of the 27 fatal HEMS accidents, 21 occurred during night operations. Of the 21 night accidents, 16 of the operations originated under visual flight rules (VFR) and inadvertently flew into IMC conditions resulting in CFIT. In addition, approximately 13 accidents during this timeframe were attributed to maintenance. See the table below.

Total Number of HEMS Accidents ('98-'04)	**85**
Fatal HEMS Accidents (all)	**27**
Day Operations	**06**
Night Operations	**21**

In 16 of the 27 fatal accidents, VFR into IMC and CFIT are listed as contributing factors by the NTSB.
This data derived from NTSB accident investigation reports and does not include accidents from the public sector.

d. Course of Action. The FAA plans to continue surveillance and inspection oversight. In cooperation with air medical industry the FAA will help develop strategies, such as risk management tools and system safety approaches, to reduce the number of accidents. Operators can make an immediate difference by reviewing their human performance issues, and aggressively implementing measures to enhance human performance in air medical operations. Those measures begin with a strong corporate safety culture that carries through to flight operations and training. There must be an unwavering commitment of every individual involved.

4. INTERVENTION STRATEGIES.

a. FAA Actions. Because of rapid growth of the HEMS industry in recent years and an unacceptable rise in the number of accidents, more emphasis and cooperation between the FAA and the HEMS industry is required.

(1) Certificate Holding District Offices (CHDO) will meet with their assigned HEMS operators to determine the location of all operating bases and geographic areas of operations. Principals will review and update Vital Information Subsystem (VIS) environmentals as required.

(2) If a CHDO determines that its HEMS operator has operating bases and/or geographical areas of operations outside its boundaries, the CHDO will notify other affected CHDOs of the operator's name (to include dba), location(s) of base(s), geographical areas of operation, and points of contact. The CHDO should also determine if the other affected CHDOs have assigned geographic inspectors to the HEMS operator and determine who these inspectors are. These actions will be completed prior to March 18, 2005.

(3) Determine, with the HEMS operator, if its operations specifications are consistent with Order 8400.10, Air Transportation Operations Inspector's Handbook, volume 4, chapter 5, paragraphs 1335, 1337,1339, and 1343.

b. Operator Initiatives. These are voluntary initiatives which PIs shall encourage HEMS operators to undertake to help in mitigating accident risk factors. (FAA resources are listed below. There may be industry organizations that have similar resources available to operators.)

(1) Determine if pilot training includes inadvertent IMC and night cross-country for their specific area of operation (i.e., mountainous or flat areas). Operators are encouraged to develop action plans to deal with inadvertent IMC for their local flying areas.

(2) Review FAA-H-8083-21, Rotorcraft Flying Handbook, Chapter 14, Aeronautical Decision Making, to see if your policies, procedures, and training programs reflect the principles in the handbook. The handbook is available at the following Web site: http://av-info.faa.gov/data/traininghandbook/faa-h-8083-21.pdf.

(3) Emphasize a safety culture within your HEMS organization that applies basic system safety attributes and risk management techniques to your operation. Apply safety attributes or risk management/assessment strategies to each flight. Information on System Safety and Risk Management can be found at the FAA Office of System Safety Web site: http://www.asy.faa.gov/Risk/

(4) Consider incorporation of realistic night flight training such as Line Oriented Flight Training (LOFT), provide operating experience for new crewmembers, and consider conducting line checks under operating conditions.

(5) Emphasize the use of a radar altimeter for night operations.

(6) Consider using enhanced vision systems and a Terrain Awareness Warning System (TAWS) for night operations when conditions and mission dictate.

(7) Consider the incorporation of an FAA-approved night vision goggle or enhanced vision system into your flight program. HBAT-04-02, TSO C-164 and AC29-2C Chapter 3 Miscellaneous Guidance.

(8) Consider a review of weather minimums particularly at night for each operational area, focusing on minimums specific to the terrain of the intended operational area. If necessary, increase weather minimums to enhance safety.

(9) Ensure pilots are aware of the importance of receiving a current weather briefing at the time of mission launch.

(10) Consider using an operations risk assessment tool to include dual decisionmaking for authorization to accept or continue a flight assignment (i.e., two or more persons' permission required).

(11) Determine that operational control (flight locating) procedures are current and applicable for each base of operation (see Title 14 of the Code of Federal Regulations (14 CFR) part 135, sections 135.23(l) and 135.79).

(12) Make pilot compartment, to the extent possible, free of glare and reflections. Ambient light may have been a factor in some of the night accidents (see 14 CFR part 27, sections 27.773 and 29.773).

(13) Operators should review pilot and mechanic shift schedules and fatigue management programs.

5. ACTION. Principal inspectors assigned to HEMS operators should review the contents of this notice, take the FAA actions specified in paragraph 4, and provide a copy of this notice to their assigned operators. Principal inspectors should encourage the operators to distribute this notice to each of the operator's bases.

6. TRACKING. Document the conveyance of the information contained in this notice for each HEMS operator:

a. Use Program Tracking and Reporting Subsystem (PTRS) codes 1030, 3030, 5030, Convey Non-Reg. Info.

b. Enter "N8000293" in the "National Use" field (without the quotes).

c. Once the initial notification is completed close out the PTRS.

7. DISPOSITION. Because a number of considerations in this notice may require regulatory change, this notice will not be incorporated into Order 8400.10. Questions concerning this notice should be directed to the Air Carrier Operations Branch, AFS-220, at (202) 267-9518.

/s/ James J. Ballough
Director, Flight Standards Service

Appendix E

FAA Notice N8000.301: Operational Risk Assessment Programs for Helicopter Emergency Medical Services

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8000.301

8/1/05

Cancellation
Date: 8/1/06

SUBJ: OPERATIONAL RISK ASSESSMENT PROGRAMS FOR HELICOPTER EMERGENCY MEDICAL SERVICES

1. PURPOSE. This notice was developed with the helicopter emergency medical services (HEMS) community to provide for principal inspectors (PI) in all specialties guidance related to risk assessment programs used by HEMS operators. This notice also contains information for PIs to provide to HEMS operators for developing their risk assessment program.

> **NOTE: This notice identifies possible risk factors and the dangers those risks pose to both flightcrew and patient; for this reason, all aircraft operators involved in air medical flight should actively promote the use of risk assessment models.**

2. DISTRIBUTION. This notice is distributed to the division level in the Flight Standards Service in Washington headquarters; to the branch level in the regional Flight Standards divisions; to the Flight Standards District Offices, and to the Regulatory Standards Division at the Mike Monroney Aeronautical Center. This notice is also distributed electronically to the division level in the Flight Standards Service in Washington headquarters and to all regional Flight Standards divisions and district offices. This information is also available on the Federal Aviation Administration's (FAA) Web site at: http://www.faa.gov/library/manuals/examiners_inspectors/8000/media/n8000-301.doc.

> **NOTE: For budgetary reasons, the examples in the appendixes are printed in black and white. To view them in color, go to the above Web address.**

3. BACKGROUND.

a. Introduction. HEMS operate in a demanding environment. They provide an invaluable service to the nation by providing crucial, safe, and efficient transportation of critically ill and injured patients to tertiary medical care facilities. While the contribution of HEMS is profound as a component of the nation's medical infrastructure, from an operational standpoint, it is a commercial aviation activity performed by air carrier operators. It therefore must be conducted with the highest level of safety. To meet this requirement, risks must be identified, assessed, and managed to ensure that they are mitigated, deferred, or accepted according to the operator's ability to do so within the regulations and standards appropriate to the operation.

Distribution: A-W(FS)-2; A-X(FS)-3; A-FFS-7 (LTD); AMA-200 (80 cys)
(Electronically: A-W(FS)-2; A-X(FS)-2; A-FFS-7)
Initiated By: AFS-820

b. Regulatory Requirements.

(1) Title 14 of the Code of Federal Regulations (14 CFR) part 135 operators are required to have management personnel identified per 14 CFR part 119, § 119.69. This section states, in pertinent part (***emphasis added***):

> (a) Each certificate holder must have sufficient qualified management and technical personnel to ensure the safety of its operations. Except for a certificate holder using only one pilot in its operations, the certificate holder must have qualified personnel serving in the following or equivalent positions:
>
> (1) Director of Operations.
> (2) Chief Pilot.
> (3) Director of Maintenance.
>
> ……………………………………………………
>
> (d) The individuals who serve in the positions required or approved under paragraph (a) or (b) of this section and anyone in a position to exercise control over operations conducted under the operating certificate must—
> (1) Be qualified through training, experience, and expertise;
> (2) To the extent of their responsibilities, ***have a full understanding*** of the following material with respect to the certificate holder's operation—
> ***(i) Aviation safety standards and safe operating practices;***
> (ii) 14 CFR Chapter I (Federal Aviation Regulations);
> (iii) The certificate holder's operations specifications;
> (iv) All appropriate maintenance and airworthiness requirements of this chapter (e.g., parts 1, 21, 23, 25, 43, 45, 47, 65, 91, and 135 of this chapter); and
> (v) The manual required by § 135.21 of this chapter; and
> ***(3) Discharge their duties to meet applicable legal requirements and to maintain safe operations.***

(2) HEMS operators, which are certificated under part 135, must have adequate management personnel in place. These personnel, within the extent of their responsibilities, must have a full understanding of safe aviation operating practices. They must discharge their duties to meet applicable legal requirements and to maintain safe operations throughout their organization and locations. The use of a risk assessment and risk management program provides a way to ensure that these management responsibilities are met. The company's operating procedures should incorporate the program's principles throughout the flight, as portions of the flight may be conducted under 14 CFR part 91 (general operating rules) or part 135 (EMS passenger-carrying operations).

c. Review of Recent Accident Data.

(1) A preliminary review of the commercial HEMS accidents from January 1998 through December 2004 revealed that CONTROLLED FLIGHT INTO TERRAIN (CFIT), INADVERTENT FLIGHT INTO INSTRUMENT METEOROLOGICAL CONDITIONS (IMC), AND LACK OF OPERATIONAL CONTROL are predominant factors, particularly at night and during low visibility conditions. Of the 27 fatal HEMS accidents, 21 occurred during night operations. Of the 21 night accidents, 16 of the operations originated under visual flight rules (VFR); the pilots inadvertently flew into IMC conditions, resulting in a CFIT accident.

(2) This preliminary review revealed that inadequate risk assessment and management deficiencies may have contributed to many recent fatal accidents in HEMS operations. Notice N 8000.293, Helicopter Emergency Medical Services Operations, provides a recommendation that HEMS operators emphasize a safety culture within their organization by applying basic system safety attributes and risk management techniques to operations. Operators were also advised to apply safety attributes or risk assessment/management strategies to each flight. As a reference, operators and inspectors could access information on system safety and risk management from http://www.asy.faa.gov/Risk/.

d. Basic Concepts Used in a System Safety Risk Management/Assessment Program. System Safety Risk Management techniques optimize safety by identifying operational hazards and related risk, and eliminating or mitigating them to a safe state by using established policies and procedures. The company procedures manual should contain clearly defined procedures for maintaining operational control during all phases of aircraft operations, and those procedures should contain processes or procedures for risk assessment and management. The pilot has the ultimate responsibility and authority to determine the risks associated with a flight operation. However, the method of operational control should promote his/her use, as a resource, the input of the mechanics, communications specialists (individuals who function as a dispatcher/flight follower), both ground and flight medical personnel, managers, and all other related support personnel involved with a flight operation.

(1) Concepts. The basic concepts of risk management include:

(a) The overriding concept is that the pilot's authority to decline a flight assignment is supreme, while his/her decision to accept a flight assignment is subject to review, if certain risks are identified.

1 The pilot's decision to decline, cancel, divert, or terminate a flight overrides any decision of other parties to accept or continue a flight.

2 The pilot's decision to accept a flight assignment may be overridden by other personnel by use of the operational control procedures and policies of the certificate holder, including the use of risk assessment and management tools and techniques.

(b) If the pilot has declined a flight assignment, NO other parties (e.g., management, operations, etc.) shall continue to conduct risk assessments pertaining to that flight as their input could not be used to override the pilot's decision to decline the assignment.

(c) A risk-assessment plan is a tool used by the flight management personnel and flightcrews to expand the parameters of decisionmaking for the pilot and flightcrew, and to assist in preflight planning and operational control of the aircraft. The company should have procedures on how to mitigate or reduce the risk to an acceptable level.

(d) If the pilot's initial risk assessment results in a tentative decision to accept the flight, but significant risks have been identified, then per the company's integrated risk assessment plan, additional operational inputs are used.

(e) As potential hazards are identified in the assessment process, a collaborative group of additional persons who have the experience/knowledge to assist the flightcrew in safety determinations are brought into the decisionmaking process. Such collaboration should never result in the questioning or overruling of the pilot's determination that the risks associated with a flight mission or operation are too numerous or high.

(2) Examples. Examples of risk assessment and risk management could include:

(a) A flightcrew is aware of a maintenance discrepancy that has been repaired, or a component that has been overhauled. The flightcrew may be concerned with what to watch for on subsequent flights, i.e., higher temperatures or higher pressures (providing the instrument readings are within the required operating range), and seek input from maintenance professionals.

(b) A VFR-only pilot accepts a flight assignment in marginal VFR conditions, and following the company's risk management plan receives subsequent input on the status of nearby airports/heliports. The pilot then uses the information to support his/her decision: to fly the planned flight, cancel the flight, delay the flight until weather improves, or determine that an IFR (instrument flight rules) certificated aircraft and flightcrew is required. In any case, the information is used to support the pilot's decisionmaking process.

(3) Variables. In the above examples, as more information is attained to assist the flightcrew with the go/no-go decisionmaking process, another iteration or cycle in the risk assessment process is begun and the determination to fly is reviewed against a new, better-defined, standard/environment. Typical risk variables include, but are not limited to:

(a) Weather (Current and Forecast).

- Ceiling, visibilities—departure, en route, arrival, alternate
- Precipitation—type(s)
- Turbulence—existing and forecast
- Icing—type and forecast
- Winds/gust spread—wind direction, speed, gust spread
- Density altitude
- Ambient lighting

(b) Airworthiness Status of the Helicopter.

- Proper preflight
- Any deferred items in accordance with the Minimum Equipment List (MEL)
- Fuel and oil serviced
- Security of cowling(s), doors and/or equipment

- VFR vs. IFR equipment capabilities
- Inspection status
- Recent maintenance actions
- Time remaining until next inspection, overhaul, teardown, etc.
- Required current maps, approach plates, NOTAMs

(c) Incorporation of Technologies to Aid in Managing Risks.

- Radio/radar altimeters
- High intensity search/landing light systems
- Global positioning system (GPS) moving map systems
- Airborne weather radar systems
- Night vision goggles
- Enhanced vision systems
- Autopilot/stability augmentation systems
- Terrain Avoidance Warning System (TAWS)
- Adequacy of training on new technologies

(d) Performance Margins.

- Weight/center of gravity margins
- High density altitudes
- Fuel margins and range limitations

(e) Pilot and Flight Crewmember Performance.

- Experience in make and model of helicopter, area of operations, and type of operation
- Rest, duty, and flight time impacts on human performance (additional duties during duty time and adequate sleep during rest period time)
- Personal performance factors, such as personal stress (recent divorce, death, illness, or birth in family)
- Influence of pilot's knowledge of the patient's status (pediatric, critical injury)
- Communication between crew and all pertinent specialists
- Continuity during shift changes
- Currency of training
- Inadvertent IMC training
- Crew resource management
- Experience of crewmembers operating together as a unit

(f) Operating Environment.

- Terrain/obstructions
- Ambient lighting
- Natural and industrial weather factors
- Availability and status of airports/heliports

- Air traffic density
- Knowledge that other operators in the area have declined the flight due to
  - Localized weather
  - Forecast weather
  - Recent flight(s) experiencing marginal conditions
- Airspace requirements
- Communications and navigation facilities
- Availability of low-level VFR route structure

(g) Organizational Environment.

- Changes in required management personnel
- Changes in air carrier management
- Rapid expansion or growth
- New or major program changes
- Merger or takeover
- Labor management relations
- Organization accidents, incidents, or occurrences

4. RISK ASSESSMENT PROGRAM CONFIGURATIONS.

NOTE: Appendixes 1, 2, and 3 contain examples of risk assessment tools that are currently used in the HEMS operational community. There is no "one size fits all" tool. Each operator should consider its own operational and environmental needs in developing its risk assessment tool(s) and plans. In addition, these unique operational and environmental needs will drive the relative weight of each identified risk for each operation and/or location. The operator must determine the specific weighting of risks for its particular operation. The examples given are for reference only; the FAA does not endorse the use of one tool over another. Each of the following risk assessment configurations is useful; however, an integrated program providing enhanced training in aeronautical decisionmaking, combining procedure-weighted, training-weighted, and other programs, may achieve the best results.

a. Procedure-weighted Program. To standardize risk assessment while minimizing training requirements, an operator may opt to develop and implement a "procedure-weighted" program configuration. This configuration typically uses a checklist format tool, often with numerical weighting values, which trigger levels of concurrence with the pilot's "go" decision. Appendix 1 includes examples of representative procedure-weighted tools.

(1) Advantages of the Procedure-weighted Configuration Include:

(a) Minimal training is required on the principles of risk assessment and risk management.

(b) Standardized assessment of risks and mitigations, especially when using a system that is numerically based.

(2) Disadvantages of the Procedure-weighted Configuration Include:

(a) Takes more time and effort to complete the assessment, and may delay departure.

(b) May not provide visual cues to the level of risk and, therefore, may not be as obvious to all users.

(c) A checklist does not address the continuing risk assessment skills necessary during the entire flight. Risk assessment is an ongoing process; during a single flight, multiple risks are monitored on different levels.

b. Training-weighted Program. To minimize the time spent upon receiving a flight assignment, an operator may opt to "front load" its efforts in risk assessment and risk management by providing a higher level of training on the principles of risk assessment and developing a highly integrated risk management program. In doing so, it may be able to achieve an effective risk assessment and risk management program by using fairly simple (and often graphically based) decision tools. Appendix 2 includes representative examples of training-weighted tools.

(1) Advantages of the Training-weighted Configuration:

(a) In practical use, minimal time is required to make the series of decisions necessary to assess and manage risks.

(b) The use of graphical tools provides a visual, immediately understood description of the risk and the required mitigations.

(2) Disadvantages of the Training-weighted Configuration:

(a) May require more demanding training at the initiation of the process and in subsequent recurrent training.

(b) May require a stronger set of "soft skills" by users of the process.

NOTE: "Soft skills" refers to proficiencies that go beyond technical knowledge and psychomotor skills necessary to operate a helicopter and are often the first line of defense—and sometimes the last—against accidents caused by lapses in human performance. This includes adherence to standard operating procedures, decisionmaking, judgment, air medical resource management (known as AMRM; similar to crew resource management), and professionalism. These skills are not easily or quickly conveyed in training programs but are developed through the continuing commitment of corporate owners/executives, managers, trainers, pilots,

crewmembers, mechanics, medical staff, and communication specialists to an organizational safety culture.

c. Alternative Risk Intervention Policy. Some operators integrate “releasing authority” after a nonroutine event. Experience has shown that the community tends to hire “mission oriented” individuals who will seek ways around an obstacle to complete the mission. It may be beneficial to intentionally slow the go/no-go decisionmaking process, particularly at the first indication that an abnormal situation might be developing. Appendix 3 includes an example of an alternative risk management tool.

5. ACTION. PIs assigned to HEMS operators should review the content of this notice and provide a copy of this notice to their assigned operators. PIs should encourage the operators to distribute this notice to each of the operator’s bases and sub-bases. Operators should be strongly encouraged to implement a risk assessment and management program, which may incorporate this notice as a component of the program, or otherwise identify their management processes and operational controls that ensure that safe operating practices are applied in flight operations and to maintain safe operations.

6. TRACKING. Document the conveyance of the information contained in this notice for each HEMS operator:

a. Use Program Tracking and Reporting Subsystem (PTRS) codes 1030, 3030, or 5030, as applicable.

b. Enter “N8000301” in the “National Use” field (without the quotes).

c. After the review of the certificate holder’s procedures is complete, close out the PTRS.

7. DISPOSITION. This notice will NOT be incorporated into Order 8400.10, Air Transportation Operations Inspector’s Handbook, nor into Order 8700.1, General Aviation Operations Inspector’s Handbook. Questions concerning this notice should be directed to the Air Carrier Operations Branch, AFS-220, at (202) 267-9518, or the Operations and FAA Safety Team Support Branch, AFS-820, at (202) 267-8212.

/s/ James J. Ballough
Director, Flight Standards Service

8/1/05

N 8000.301
Appendix 1

APPENDIX 1. EXAMPLES OF PROCEDURE-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES

EXAMPLE 1. GO/NO-GO DECISION MATRIX

STATIC RISK FACTORS		SCORE
< 6 mos. on Current Job	+1	______
< 1 yr. in EMS	+1	______
< 200 hrs. in Type	+1	______
> 500 hrs. in Type	-1	______
Last Flight > 30 Days	+1	______
Last Night Flight > 30 Days (night requests only)	+1	______
6 mos. Since Check Ride	+2	______
Cockpit Not Configured for Inadvertent IMC	+1	______
Navigation or Radio Item on MEL	+1	______
Back-up Aircraft	+1	______
Newly-installed Equipment (i.e., satellite phone, avionics, GPS)	+1	______
Night Vision Goggles (NVG) Equipped	-1	______
< 3 NVG Flights in the Last 120 Days	+1	______
Medical Crew < 1 yrs. Experience (both crewmembers)	+1	______
IFR Program	-4	______
VFR Program	+1	______
External Stresses (divorce, illness, family/work issues/conflicts)	+1	______
Total Static Score		

DYNAMIC RISK FACTORS		
Ceiling within 200' of Program Minimums	+1	______
Visibility within 1 Mile of GOM Minimums	+1	______
Precipitation with Convective Activity	+1	______
Convective Activity with Frontal Passage	+1	______
Deteriorating Weather Trend	+1	______
High Wind or Gust Spread Defined by Operations Manual	+2	______
Moderate Turbulence	+2	______
Temperature/Dew Point < 3 Degrees F	+1	______
Forecast Fog, Snow, or Ice	+2	______
Weather Reporting at Destination	-1	______
Mountainous or Hostile Terrain	+1	______
Class B or C Airspace	+1	______
Ground Reference Low	+1	______
Ground Reference High	-1	______
Night Flight	+1	______
90% of Usable Fuel Required (not including reserve)	+1	______
Flight Turned Down by Other Operators Due to Weather (if known)	+4	______
Control Measures		
Delay Flight	-1	______
Avoid Mountainous/Hostile Terrain	-1	______
Utilize Pre-Designated LZs for Scene Requests	-1	______
Plan Alternate Fuel Stop	-1	______
Familiarization Training (self-directed)	-1	______
Total Dynamic Score		

APPENDIX 1. EXAMPLES OF PROCEDURE-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES (Continued)

EXAMPLE 1. GO/NO-GO DECISION MATRIX (Continued)

Grand Total of Static and Dynamic Scores	

RISK CATEGORY	COLOR CATEGORY		EOC ACTION	TOTAL POINTS
NORMAL		GREEN	Pilot Approval	0 – 14
FLIGHT MANAGER LEVEL		YELLOW	Call Manager	15 – 18
UNACCEPTABLE		RED	Cancel Flight	19 or Greater

NOTE: This example is for reference only. Each operator should consider its own operational and environmental needs in developing its risk assessment tool(s) and plans.

APPENDIX 1. EXAMPLES OF PROCEDURE-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES (Continued)

EXAMPLE 2. ASSESSMENT CHART

1. EXPERIENCE **Less than 2 years** **2–3 years** **4–5 years**	**+10** **+5** **+2**	☐
2. WEATHER **Less than 3,000' – 5 sm** *(Anywhere on the route)*	**+5**	☐
3. NIGHT *(During any portion of the flight)*	**+5**	☐
4. NON-LOCAL *(Applies to all flights out of defined local flying area)* **Not local** **New location**	**+4** **+3**	☐ ☐
5. EARLY MORNING **Flight between 2 a.m. and 5 a.m.** *(If any portion of the flight to fall in this time window)*	**+1**	☐
TOTAL		☐

Considerations—

1) Have you been to this destination before? How recently?
2) What are the weather conditions? How confident are you of the weather along the entire route?
3) Is all or any part of this mission going to occur at night? If so, will you have some moonlight?
4) Have you thought through the entire mission? That is, can you return as easily as you can get there?
5) Are there any problems with the aircraft that may be a factor for this mission?
6) How many consecutive shifts have you worked prior to this mission? How much flying have you done during those shifts?
7) Do you feel fully rested and capable to accept this mission?
8) Do you have any reservations at all with accepting this mission?

A TOTAL of 20 or higher requires greater operational control.

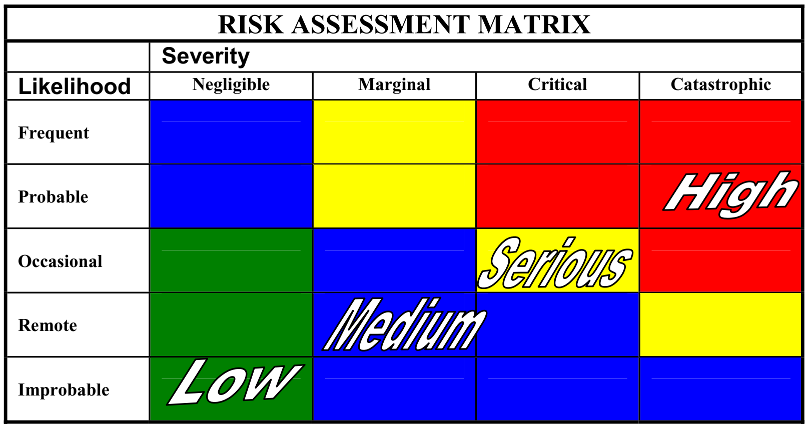
NOTE: This example is for reference only. Each operator should consider its own operational and environmental needs in developing its risk assessment tool(s) and plans.

8/1/05

N 8000.301
Appendix 2

APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES

EXAMPLE 1. RISK ASSESSMENT MATRIX



Severity Scale Definitions	
Catastrophic	Results in fatalities and/or loss of the system.
Critical	Results in severe injury and/or major system damage.
Marginal	Results in minor injury and/or minor system damage.
Negligible	Results in less than minor injury and/or less than minor system damage.

Likelihood Scale Definitions		
Frequent	Individual	Likely to occur often.
	Fleet	Continuously experienced.
Probable	Individual	Will occur several times.
	Fleet	Will occur often.
Occasional	Individual	Likely to occur sometime.
	Fleet	Will occur several times.
Remote	Individual	Unlikely to occur, but possible.
	Fleet	Unlikely, but can reasonably be expected to occur.
Improbable	Individual	So unlikely, it can be assumed it will not occur.
	Fleet	Unlikely to occur, but possible.

APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES (Continued)

EXAMPLE 2A. RISK ASSESSMENT MATRIX: NIGHT OPERATIONS

RISK ASSESSMENT MATRIX: NIGHT OPERATIONS				
Use this tool to assess the potential for links in the safety chain.				
	Applicable Weather for Flight			
Apply Operational Factors	**WEATHER Well Above Minimums and Stable**	**CEILING Within 1000' of Minimums**	**VISIBILITY Within 3 mi. of Minimums**	**CEILING & VIS Within 3 mi. and 500' of Mins.**
NIGHT Normal ops				
AIRCRAFT Performance near max Back-up or different A/C MEL items				
ENVIRONMENTAL Extreme heat or cold High winds Storms in area				
FATIGUE Late in shift? Consecutive shifts?				

Risk Assessment Value:

	Normal Ops
	Caution
	Extreme Caution
	Critical Safety Decision Required

NOTE: The operator will have to next determine how to manage the identified risk by either transferring, eliminating, accepting, or introducing a mitigating action. The operator may assign different values based on its operating environment.

APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES (Continued)

EXAMPLE 2B. RISK ASSESSMENT MATRIX: DAY OPERATIONS

RISK ASSESSMENT MATRIX: DAY OPERATIONS				
Use this tool to assess the potential for links in the safety chain.				
	Applicable Weather for Flight			
Apply Operational Factors	**WEATHER Well Above Minimums and Stable**	**CEILING Within 1000' of Minimums**	**VISIBILITY Within 3 mi. of Minimums**	**CEILING & VIS Within 3 mi. and 500' of Mins.**
DAY Normal ops				
AIRCRAFT Performance near max Back-up or different A/C MEL items				
ENVIRONMENTAL Extreme heat or cold High winds Storms in area				
FATIGUE Late in shift? Consecutive shifts?				

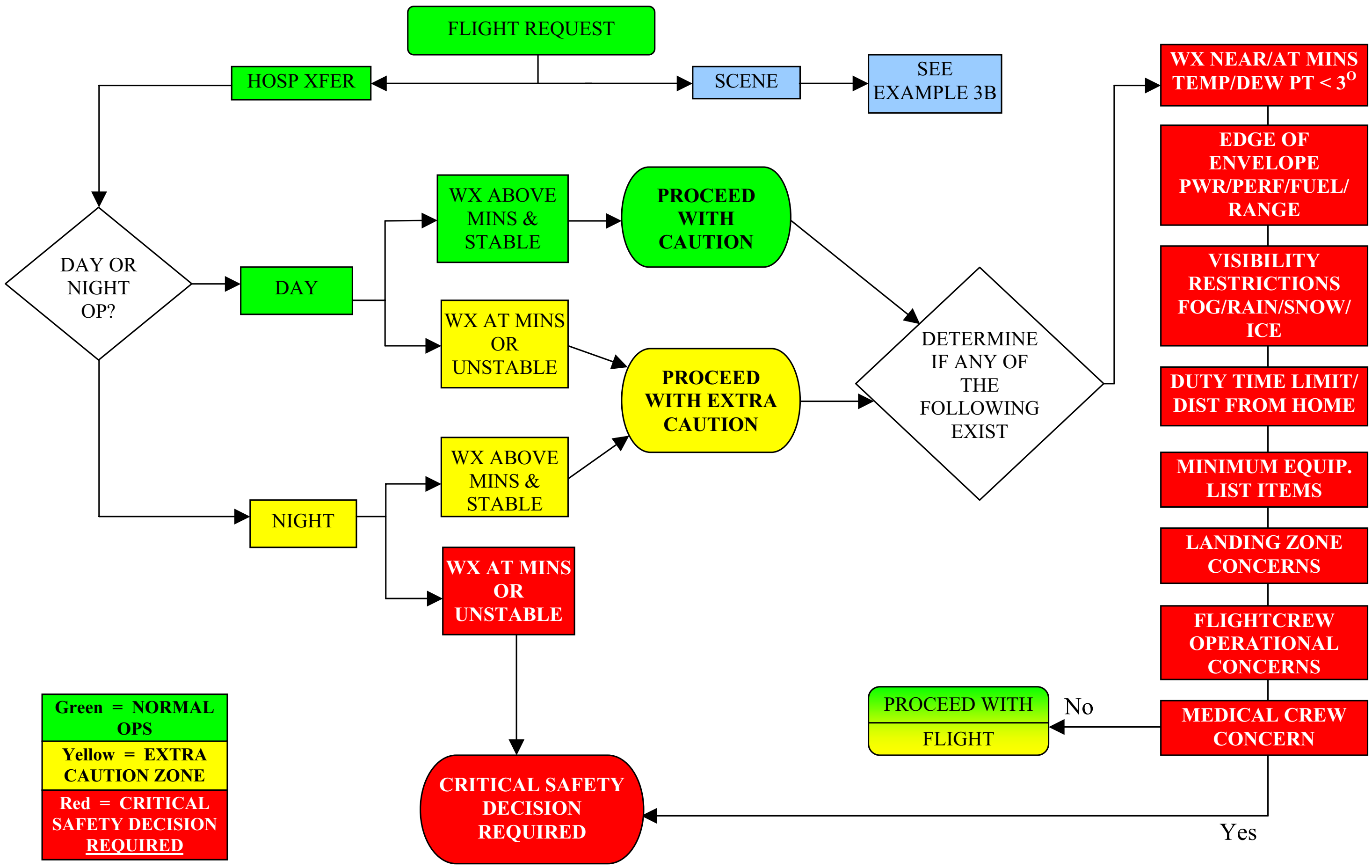
Risk Assessment Value:

	Normal Ops
	Caution
	Extreme Caution
	Critical Safety Decision Required

NOTE: The operator will have to next determine how to manage the identified risk by either transferring, eliminating, accepting, or introducing a mitigating action. The operator may assign different values based on its operating environment.

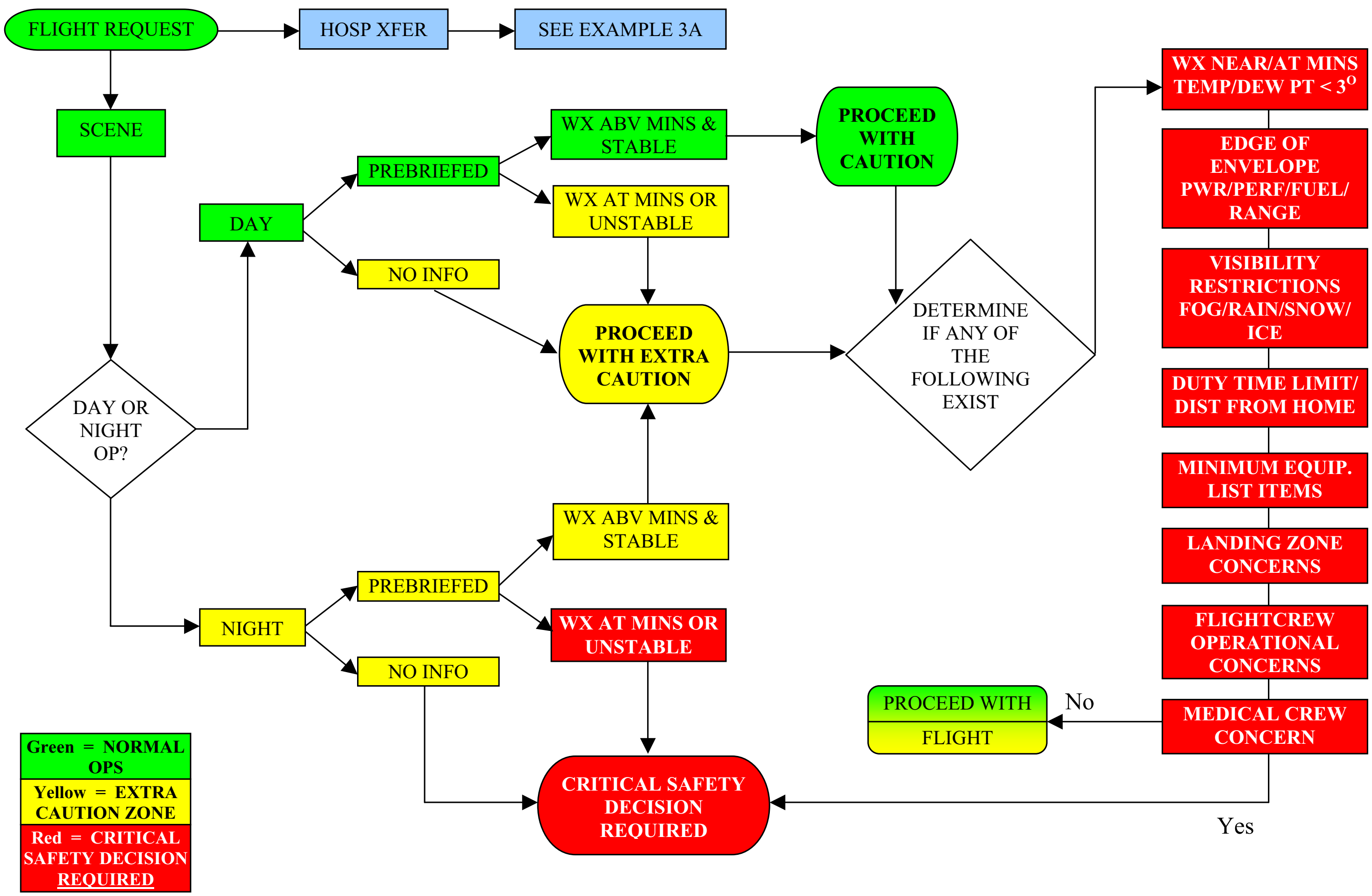
APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES

EXAMPLE 3A. HOSPITAL TRANSFER



APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES

EXAMPLE 3B. SCENE PROCEDURES



APPENDIX 2. EXAMPLES OF TRAINING-WEIGHTED RISK ASSESSMENT AND MANAGEMENT PROCESSES (Continued)

EXAMPLE 4. MISSION ASSESSMENT

WEATHER	Improv-ing	Deteri-orating	Yes	No
Starting point				
Ceiling within 500' VFR Wx mins				
WX at VFR Mins				
WX below VFR Mins				
En route				
Ceiling within 500' VFR WX mins				
WX at VFR Mins				
WX below VFR Mins				
Destination				
Ceiling within 500' VFR WX mins				
WX at VFR Mins				
WX below VFR Mins				
IFR				
WX for IAP to be flown < 2000-3				
Alternate airport required				
Forecast WX at alt. <800-2				
WX at or below 400-1				

MISSION PROFILE	Yes	No
Night		
Scene, new LZ or no IAP within 5 miles		
Concerns related to availability of fuel		
Terrain (mountainous)		
WX within 500' of mins at destination/alt		
Pilot not recent on IAP to be flown		
Flight conducted overwater		
Winds > 30 kts, gusts > 15 kts		
Severe WX, icing, thunderstorms		

Overall assessment: Can the mission be completed as requested?

Totals from the Weather Chart: For any more than 6 shaded items checked "Yes," exercise extreme caution and re-brief options.
If "Yes" box and adjacent "Deteriorating" box are checked, VFR flight is not recommended or flight should be rejected.

Combined Totals from the Weather and Mission Profile Charts: For any more than 6 items checked "Yes," exercise extreme caution and re-brief options.
If in excess of 10 items checked "Yes" or shaded, flight should be rejected.

NOTE: This example is for reference only. Each operator should consider its own operational and environmental needs in developing its risk assessment tool(s) and plans.

APPENDIX 3. EXAMPLE OF ALTERNATIVE RISK INTERVENTION POLICY

MEMORANDUM

TO: All Pilots
FROM: Vice President, Operations
DATE: June 22, 2005
RE: The “Official Time Out” Policy

Over the past year, we have achieved some new highs and have seen some new lows in safety and regulatory compliance. A common thread connecting the several incidents and accidents is appearing. In nearly every case we have, as aircraft commanders, been required to take action that most of us would describe as outside the norm. Examples include bird strikes, engine failures, and component failures. In nearly every case we have conducted ourselves in the best traditions of aviation, successfully concluding these flights by doing that which we are trained to do.

It is only after the kettle is removed from the fire that we tend to make decisions that in retrospect seem less than optimal. We would do well to ask ourselves if making a go/no-go decision immediately after concluding an in-flight emergency is in anyone’s interest. It is the organization’s firm belief that the level of expertise at this air carrier is a standard to which most of the industry can only aspire. With this professionalism comes an inherent desire to complete the mission and consequently we permit ourselves to push on.

Effective immediately, it is the policy of this air carrier that if as a member of a flightcrew you are involved in any of the events listed at the end of this memo, you may be awarded an “OFFICIAL TIME OUT” (i.e., off duty for the remainder of the shift). The Official Time Out is as simple as saying “Nice job—take the rest of the day off.”

The awarding of an Official Time Out is at the discretion of the Chief Pilot, but may be granted by the Vice President, Operations, Director of Operations, or Director of Safety in his absence. Any award of an Official Time Out is contingent upon notification of Headquarters and specific direction by the Chief Pilot or any of the above listed personnel. **Site Managers have the Emergency Authority to award an Official Time Out if, in their judgment, waiting for specific direction from the Chief Pilot would compromise operational safety.** The object of this policy is to remove you from the decisionmaking process. There are numerous pilots, maintenance technicians, and support personnel on this team. This is the time to use their knowledge and experience. The following is not an all-inclusive list and your comments are solicited.

EVENTS SUBJECT TO AWARD OF AN OFFICIAL TIME OUT

1. Any aircraft system malfunction requiring a precautionary landing.
2. An in-flight engine failure.

3. Any event for which an NTSB report is required.
   a) An aircraft incident.
   b) A flight control system malfunction.
   c) The inability of a flight crewmember to perform his duties due to injury or illness.
   d) Failure of structural components of a turbine engine excluding compressor and turbine blades and vanes.
   e) In-flight fire.
   f) Damage to property other than the aircraft in excess of $25,000.
   g) Aircraft collision in flight.
   h) In-flight failure of electrical systems requiring sustained use of emergency bus power such as a battery or auxiliary power system.
   i) In-flight failure of hydraulic systems.
   j) Sustained loss of engine power.
   k) An evacuation of the aircraft in which the emergency egress system is used.
4. Any time an emergency is declared.
5. Should there be a question as to whether an event fits the criteria for an Official Time Out, the Site Manager's emergency authority applies until the Chief Pilot, VP-Ops, DO, or DOS can be notified.

Appendix F

FAA Notice N8000.307: Special Emphasis Inspection Program for Helicopter Emergency Medical Services

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8000.307

9/27/05

Cancellation
Date: 9/27/06

SUBJ: SPECIAL EMPHASIS INSPECTION PROGRAM FOR HELICOPTER EMERGENCY MEDICAL SERVICES

1. **PURPOSE.** This notice was developed to provide guidance for aviation safety inspectors (ASI) in all specialties on the Special Emphasis Inspection Program for Helicopter Emergency Medical Services (HEMS) operated under Title 14 of the Code of Federal Regulations (14 CFR) part 135.

2. **DISTRIBUTION.** This notice is distributed to the division level in the Flight Standards Service in Washington headquarters; to the branch level in the regional Flight Standards divisions; to the Flight Standards District Offices, and to the Regulatory Standards Division at the Mike Monroney Aeronautical Center. This notice is also distributed electronically to the division level in the Flight Standards Service in Washington headquarters and to all regional Flight Standards divisions and district offices. This information is also available on the Federal Aviation Administration's (FAA) Web site at: http://www.faa.gov/library/manuals/examiners_inspectors/8000/media/N8000-307.doc.

3. **BACKGROUND.**

a. Introduction. HEMS operate in a demanding environment. They provide an invaluable service to the public by providing crucial, safe, and efficient transportation of critically ill and injured patients to tertiary care medical facilities. While the contribution of HEMS is profound as a component of the nation's medical infrastructure, from an operational standpoint, it is a commercial aviation activity performed by FAA certificated air carrier operators. HEMS, therefore, must be conducted with the highest level of safety. In order to support compliance with this standard, a special emphasis inspection program has been developed for Fiscal Year (FY)-06. These inspections are to be accomplished in addition to the established National Program Guidance (NPG) inspection program. These inspections are expected to be included in the FY-07 and subsequent NPG.

b. HEMS Operational Environment. HEMS operations are conducted according to a variety of business models and operating configurations. Typically, a customer hospital contracts with an air carrier certificate holder to conduct HEMS operations in support of the customer's medical program. In this business model, the HEMS flight operation is based out of the customer's facility (the hospital) and is often remote from the certificate holder's main base, main maintenance facilities, and management. This complicates the management and operational control of flight operations and maintenance activities. It also complicates FAA oversight of such operations when locations exist outside the certificate-holding district office's (CHDO) geographic area of responsibility. Such configurations require significant coordination between the CHDO and the geographic Flight Standards District Office (FSDO). Other HEMS configurations include a hospital-owned certificate holder, which accomplishes the HEMS function for that hospital. Cooperative systems exist in which a consortium of hospitals share ownership of a certificate holder. While these configurations are often contained wholly within the CHDO's area, operational control issues may exist between the customer (hospital) and the service provider (certificate holder).

c. Each state and territory in the United States has a lead Emergency Medical Services (EMS) agency. These agencies are usually a part of the state health department, but in some states they are part of the public safety department, or are an independent state agency. A list is available from the National Association of State EMS Directors at http://www.nasemsd.org/index.php?option=content&task=view&id=72. Inspectors assigned to surveillance activities involving HEMS operators are encouraged to contact the appropriate state or territory EMS agency and to coordinate efforts and to use those agencies as a resource.

NOTE: Additional background information may be found in FAA Notice N 8000.293, Helicopter Emergency Medical Services Operations.

4. SPECIAL EMPHASIS AREAS FOR THIS HEMS INSPECTION PROGRAM.

a. This Special Emphasis Inspection Program focuses on areas identified as causal factors in a review of HEMS accidents from 1999-2004. For all specialties, the areas of special emphasis include:

(1) Operational control, including policies, procedures, training, communications, and management.

(2) Safety culture development, including policies, procedures, and training.

b. Within the operations specialty, areas of special emphasis include:

(1) Weather information access and use by flightcrews, management, and in-flight communications specialists.

(2) Operator's knowledge of terrain, obstructions, airspace, and special weather considerations for operating in the specific geographic area, especially at night, and in periods of reduced visibility.

(3) Operator's knowledge of the certificate holder's risk assessment and management procedures, including crewmember and management duties, responsibilities, and authorities as related to assigning, accepting, declining, and canceling flight assignments, and the continuation, diversion, or termination of flights once underway.

(4) Pilot and flightcrew knowledge of all installed aircraft equipment, including communications, navigation, and any special equipment such as Night Vision Goggles (NVG), terrain awareness and warning systems (TAWS), radar altimeters, etc.

(5) Safety procedures in and around the heliport and off-site landing zone, especially at night.

(6) Coordination with local EMS, law enforcement, and fire services for off-site landing zone preparation, including weather estimation, obstruction and other hazard evaluation, lighting, and other operational considerations.

(7) Procedures for use of non-pilot flight crewmembers for situational awareness during flight operations (clearing the aircraft for obstructions, keeping a lookout for traffic, monitoring checklist functions), especially at night and in periods of reduced visibility.

c. Within the airworthiness specialties (maintenance and avionics) areas of special emphasis include:

(1) A review of aircraft records for helicopter airworthiness status, regulatory compliance (Airworthiness Directives, Bulletins, or any other required compliances), Minimum Equipment List (MEL) compliance, maintenance record retention procedures, and any other reviews deemed necessary.

(2) A review of maintenance procedures used on-site. This could include inspection of special equipment, technician qualifications/experience/training, and maintenance program for each make/model helicopter at base.

(3) A review of technical data such as maintenance manuals, service bulletins, manufacturers manuals, illustrated parts catalogs, etc., used for on-site maintenance.

(4) Proper tools, equipment and materials for the conduct of maintenance and inspections.

(5) A review of the Weight and Balance program being used at each operational site. Many HEMS programs have special weight and balance procedures for the various configurations used depending on the specific type of mission (i.e., litter, isolate, additional litter, patient weight, etc.).

(6) A review of the NVG maintenance program and FAA installation approval if applicable.

(7) Inspection of refueling facility if located at the helicopter base of operations.

5. ACTION.

a. Regional Flight Standards Divisions.

(1) Identify a resource within the region's operations and airworthiness inspector workforce to serve as the Regional Helicopter Emergency Medical Services Resource, and forward the names of the selected inspectors to AFS-820, no later than December 15, 2005. An operations and airworthiness candidate should be selected. The candidates should meet the following requirements, as appropriate:

(a) Operations ASIs: Hold a commercial or airline transport pilot certificate with a rotorcraft-helicopter rating, and have pilot experience in HEMS operations. If no candidate exists with HEMS operations experience, a helicopter rated operations inspector should be selected.

(b) Airworthiness ASIs: Have experience in the maintenance of helicopters used in Emergency Medical Services Operations. If no candidate exists with HEMS maintenance experience, an inspector with helicopter maintenance experience should be selected.

(2) Regional HEMS resources will serve as the focal point for standardization of regional HEMS certification and surveillance efforts. Assigned inspectors must be able to participate in monthly telecons and meetings with other regional resources and headquarters HEMS personnel.

b. Flight Standards District Offices. Accomplish the following inspections, with emphasis on the specific areas identified with each inspection and the general emphasis on the areas discussed in paragraph 4:

(1) Operations.

(a) Principal operations inspectors (POI) assigned to HEMS operators should accomplish the following inspections on assigned certificate holders:

1. Conduct one Training Program Inspection (PTRS Code 1626) for each approved training program for each HEMS operator. Emphasis should be placed on night and low visibility operations training and procedures, controlled flight into terrain (CFIT) avoidance, and recovery from inadvertent instrument meteorological conditions (IMC).

2. Conduct one Base Inspection (PTRS Code 1616) for each HEMS base of operations within the CHDO's geographic area. Emphasis should be placed on operational control, management, communications, crew rest areas, weather and aeronautical data collection and dissemination systems, maintenance control, and crew scheduling.

3. Conduct one Flight Locating Inspection (PTRS Code 1636) for each HEMS flight locating system within the CHDO's geographic area. Emphasis should be placed on operational control, coordination with management, communications, weather and aeronautical data availability and use, and risk assessment and decision making procedures.

4. Conduct one Ramp Inspection (PTRS Code 1622) for each make and model of EMS helicopter operated at each HEMS base in the CHDO's geographic area. Emphasis should be placed on internal and external lighting (including cockpit windshield and window glare at night), night flying equipment, aeronautical information (charts, airport/facility directories, etc.), communications and navigation equipment, attitude flight instruments, medical equipment installation, use of minimum equipment lists (MEL), maintenance discrepancy reporting, and special equipment (radio altimeters, NVGs, TAWS, etc.).

5. Conduct one facility inspection (PTRS Code 1635) for each HEMS base hospital heliport within the CHDO's geographic area. Emphasis should be placed on safety

equipment, communications equipment, access to weather information, heliport security, marking and lighting, approach and departure paths, and obstructions. (It is recommended that this inspection include a night evaluation of heliport and nearby obstruction lighting.)

NOTE: If the POI is not helicopter rated, it is recommended that he/she be assigned a helicopter rated ASI to assist in the inspections. For inspections of operations using NVGs, it is recommended that the POI consult with an NVG National Resource Inspector (NVG NRI). Contact AFS-820 at (202) 267-8212 for the list of NVG national resource inspectors.

(b) FSDOs with HEMS operations conducted by certificate holders based outside their area (another FSDO is the CHDO) shall ensure that the following inspections are accomplished by helicopter-rated Operations ASIs on certificate holder facilities located within the FSDO's geographic area.

NOTE: For inspections of operations using NVGs, see the NVG NRI guidance above.

1. If training is conducted away from the certificate holder's main base, conduct one Training Program Inspection (PTRS Code 1626) for each approved training program conducted in the FSDO's geographic area, for each HEMS operator. Emphasis should be placed on night and low visibility operations training and procedures, CFIT avoidance and recovery from inadvertent IMC.

2. Conduct one Base Inspection (PTRS Code 1616) for each HEMS base of operations within the FSDO's geographic area. Emphasis should be placed on operational control, management, communications, crew rest areas, weather and aeronautical data collection and dissemination systems, maintenance control, and crew scheduling.

3. Conduct one Flight Locating Inspection (PTRS Code 1636) for each HEMS flight locating system within the FSDO's geographic area. Emphasis should be placed on operational control, coordination with management, communications, weather and aeronautical data availability and use, and risk assessment and decision making procedures.

4. Conduct one Ramp Inspection (PTRS Code 1622) for each make and model of EMS helicopter operated at each HEMS base in the FSDO's geographic area. Emphasis should be placed on internal and external lighting (including cockpit windshield and window glare at night), night flying equipment, aeronautical information (charts, airport/facility directories, etc.), communications and navigation equipment, attitude flight instruments, medical equipment installation, use of the MELs, maintenance discrepancy reporting, and special equipment (radio altimeters, NVGs, TAWS, etc.).

5. Conduct one facility inspection (PTRS Code 1635) for each HEMS base hospital heliport within the FSDO's geographic area. Emphasis should be placed on safety equipment, communications equipment, access to weather information, heliport security, marking and lighting, approach and departure paths, and obstructions. (It is recommended that this inspection include a night evaluation of heliport and nearby obstruction lighting.)

(2) Airworthiness.

(a) Principal maintenance inspectors (PMI) and principal avionics inspectors (PAI) assigned to HEMS operators should accomplish the following inspections on assigned certificate holders:

1. Conduct one Training Program Inspection (PTRS Code 3306/5306) for each program for each HEMS helicopter make/model being operated. Emphasis should be placed on the type of technical training being provided for each make/model helicopter (in-house, on-the-job training (OJT), manufacturers, etc.) to the maintenance technicians for which they have responsibility.

2. Conduct one Base Inspection (PTRS Code 3619 or 3620, 5619, or 5620) for each HEMS base or subbase of operations within the CHDO's geographic area of responsibility. Emphasis should be placed on aircraft maintenance control procedures, controls for maintenance records, inspection procedures including scheduling and unscheduled procedures, technical data, equipment, and general operations manual procedures relating to maintenance activities.

3. Conduct one Ramp Inspection (PTRS Code 3627/3628 or 5627/5628) for each make/model helicopter being operated at each base within the CHDO's geographic area. Emphasis should be placed on type of inspection program for aircraft, conformity approvals for equipment installed (Supplemental Type Certificate (STC), Field Approval, etc.), weight and balance program for each make/model, MEL procedures, maintenance technical data used at each base for adequacy and currency (applicable to each make/model maintained at base), and a review of the aircraft records. If NVGs are used, inspect for FAA approval (STC) for NVG compatible cockpit lighting and NVG Instructions for Continued Airworthiness (ICA) being used to maintain the goggles and cockpit lighting. Additional ASI guidance is provided in Order 8300.10, Volume 3, Chapter 7, Inspect Aircraft Used for Air Ambulance.

4. Conduct one Spot Inspection (PTRS Code 3628/5628) on one helicopter at each base within the CHDO's geographic area. Emphasis should be on observation and analysis of in-progress maintenance operations for compliance with the specific methods, techniques, and practices in the operator's inspection and maintenance programs.

(b) FSDOs with HEMS operations conducted by certificate holders based outside their area (another FSDO is the CHDO) shall ensure that the following inspections are accomplished by Airworthiness (Avionics and Maintenance) ASIs on certificate holder facilities located within the FSDO's geographic area.

1. Conduct one subbase inspection (PTRS Code 3620/5620) for each HEMS subbase of operations within the FSDO's geographic area of responsibility. Emphasis should be placed on aircraft maintenance control procedures, controls for maintenance records, inspection procedures including procedures for scheduled and unscheduled maintenance, technical data, equipment, and general operations manual procedures relating to maintenance activities and refueling if used at base.

2. Conduct one Ramp Inspection (PTRS Code 3627/5627) for each make/model EMS helicopter operated at each HEMS base in the FSDO geographic area of

responsibility. Emphasis should be placed on type of inspection program for aircraft, conformity approvals for equipment installed (STC, Field Approval, etc), weight and balance program for each make/model, MEL procedures, maintenance technical data used at each base for adequacy and currency (applicable to each make/model maintained at base), and a review of the aircraft records. If NVGs are used, inspect for FAA approval for NVG compatible cockpit lighting and NVG ICAs being used to maintain the goggles and cockpit lighting.

NOTE: Additional ASI guidance is provided in Order 8300.10, Volume 3, Chapter 7, Inspect Aircraft Used for Air Ambulance.

6. PROGRAM TRACKING AND REPORTING SUBSYSTEM (PTRS). To document these special emphasis inspections:

a. Open a PTRS record, use the codes 1030, 3030, or 5030, as applicable.

(1) Enter "N8000HEMS" in the "National Use" field (without quotes).

(2) After the special emphasis inspections required by this notice are completed, close out the PTRS.

b. For each specific inspection required by this notice,

(1) Open a PTRS record using the code appropriate for the inspection.

(2) Enter "N8000HEMS" in the "National Use" field (without quotes).

(3) Close the PTRS record when the inspection is completed.

7. DISPOSITION. This notice will not be incorporated into FAA Order 8300.10, Airworthiness Inspector's Handbook; Order 8400.10, Air Transportation Operations Inspector's Handbook; or Order 8700.1, General Aviation Operations Inspector's Handbook. Questions concerning this notice should be directed to the Air Carrier Operations Branch, AFS-220, at (202) 267-9518; Aircraft Maintenance Division, AFS-300, (202) 267-3546; or the Commercial Operations Branch, AFS-820, at (202) 267-8212.

/s/
John M. Allen for
James J. Ballough
Director, Flight Standards Service

Appendix G

Previous EMS Helicopter Safety Recommendations

On February 29, 1988, the Safety Board issued a safety study exploring the rapidly growing commercial EMS industry and its operations, focusing on the influence of weather, operations under instrument flight rules/visual flight rules, pilot and medical personnel training requirements, EMS helicopter design standards and reliability, EMS helicopter crashworthiness, and the influence of EMS helicopter program management on safety. As a result, the Safety Board issued 19 recommendations, which are summarized below.

The following recommendations were issued to the FAA.

<u>A-88-1</u>

> Amend the *Air Carrier Operations Inspectors Handbook* to provide specific guidance to principal operations inspectors on review and approval of initial and recurrent training requirements for emergency medical service helicopter pilots. This guidance should include minimum levels of instruction on poor weather operations, meteorological conditions, and demonstrated control of the aircraft in simulated instrument meteorological conditions. This guidance should also specify the minimum training acceptable for accident scene operations, including takeoff and landing.

The FAA revised FAA Order 8400.10, *Air Transportation Operations Inspector's Handbook*, which contained four chapters on air ambulance operations and addressed the areas in the recommendation, and distributed it in mid 1992. Even though the handbook did not establish minimum amounts of training in these subject areas, conversations with the FAA assured staff that training to a level of proficiency is appropriate. The recommendation was classified "Closed—Acceptable Action" on April 3, 1992.

<u>A-88-2</u>

> Require that the material being developed for the *Emergency Medical Service (EMS) Pilot Supplement to the Aeronautical Decision Making Manual for Helicopter Operators* be incorporated into EMS pilot initial and recurrent training.

The FAA published a draft AC in October 1988 providing guidance regarding aeronautical decision-making for EMS pilots. While not regulatory, the Safety Board accepted the FAA's action and classified the recommendation "Closed—Acceptable Alternate Action" on October 1, 1990.

<u>A-88-3</u>

> Amend 14 *Code of Federal Regulations* 135.205 Paragraph (B), visual flight rules (VFR): Visibility Requirements, to restrict emergency medical service helicopters to a day VFR visibility minimum of 1 mile.

The FAA issued AC 135-14A on June 20, 1991, addressing weather minimums. The weather minimums contained in the AC have the effect of a rule when issued on operation specifications, which the FAA issued for aeromedical helicopter operators on December 23, 1991. In its April 3, 1992, response, the Safety Board noted that incorporating the 1 mile visibility into operation specifications was an acceptable alternative to the recommended action and classified the recommendation "Closed—Acceptable Alternate Action."

A-88-4

> Review 14 *Code of Federal Regulations* 135.223, Instrument Flight Rules (IFR): Alternate Airport Requirements, to determine the feasibility of allowing the helicopter pilot, without designating an alternate airport, to file IFR with a lower destination weather forecast than is currently specified.

Based on an FAA study of the feasibility of changing the IFR alternate requirement for helicopters, the FAA did not believe that the elimination of the alternate requirement promotes aviation safety or could be justified by any objective data. Thus, the Safety Board classified the recommendation "Closed—Acceptable Action" on October 1, 1990.

A-88-5

> Develop procedures for priority handling of emergency medical service pilot calls to flight service stations requesting weather briefings for patient transfer flights.

The FAA revised the *Facility Operation and Administrative Handbook* 7210.3H, Paragraph 1603, to establish procedures for the priority handling of EMS pilot requests, emphasizing the importance of cooperation with organizations providing emergency medical operations to ensure prompt and efficient weather briefing services. Although the Safety Board continued to believe that enhanced capabilities for getting weather information without delay was needed, the recommendation was classified "Closed—Acceptable Action" on November 29, 1990.

A-88-6

> Amend 14 *Code of Federal Regulations* Part 91 and 135 to require that persons who intend to operate helicopters for emergency medical service activities obtain initial approval for this purpose from the appropriate Federal Aviation Administration district office, and require persons seeking such approval to present sufficient evidence to permit the evaluation of the following: That the interior modification of the helicopter is based on an engineering design [that] ensures that medical subsystems are designed and installed to prevent hazards to the aircraft and crew in the event of failure and that the modifications meet the intent of 14 *Code of Federal Regulations* 27.1309 and 29.1309; that the proposed portable medical equipment is suitable for the helicopter environment and poses no hazard to the helicopter and crew; and that the interior modification does not compromise the helicopter's crashworthiness.

The FAA issued AC 135-14 providing specific guidance on the installation and inspection of additional equipment on Part 135 EMS operations. This AC specifically references 14 CFR 135.9(a)(1)(iv) and states that the supporting structure to which equipment is attached must be designed to restrain all loads up to the ultimate inertia specified by FAA standards. The Safety Board classified this recommendation "Closed—Acceptable Action" on October 1, 1990.

A-88-7

> Develop minimum emergency medical service helicopter equipment installation and performance standards. These standards should include guidance on interior design, including but not limited to: crashworthiness, oxygen system design, patient location and restraint, and medical system design.

Based on the input received at a public meeting held by the FAA on April 20, 1988, the FAA determined that new standards for EMS equipment are not necessary and believed the recommendation could be addressed by adding information, titled "Emergency Medical System (EMS) Installation, Interior Arrangements and Equipment," to AC 27-1, Change 2 and AC 29-2A, Change 1. Although the Safety Board remained concerned about the use of older nonaviation-type oxygen systems, the Board classified this recommendation "Closed—Acceptable Alternate Action" on May 12, 1992, because the FAA's responses substantially fulfilled the intent of the recommendation.

A-88-8

> Require that shoulder harnesses be installed at all medical personnel and passenger seats on all helicopters when they are newly modified for emergency medical service (EMS) operations or when an existing EMS helicopter undergoes major interior modification or overhaul.

The FAA issued a final rule to require installation and use of shoulder harnesses at all seats of rotorcraft manufactured after September 16, 1992. Because this rule did not include shoulder harnesses in helicopters already in EMS use, the Safety Board classified the recommendation "Closed—Unacceptable Action" on July 8, 1992.

A-88-9

> Require that those personnel classified as required crewmembers operating emergency medical service helicopters wear protective clothing and equipment to reduce the chance of injury or death in survivable accidents. This clothing and equipment should include protective helmets, flame- and heat-resistant flight suits, and protective footwear.

In FAA Order 8400.10, *Air Transportation Operations Inspector's Handbook*, the FAA recommended that principal operations inspectors encourage their respective operators to use protective clothing but did not believe that there was sufficient justification or data to support regulatory changes. The FAA further noted that many EMS helicopter operators already use protective flight gear. Although the Safety Board believed that the change to Order 8400.10 was beneficial, it also believed that the revision carried less impact than a regulatory change and classified the recommendation "Closed—Unacceptable Action" on October 1, 1990.

A-88-10

> Develop and conduct a research program to measure the effect of Emergency Medical Service (EMS) pilot workload, shift lengths, and circadian rhythm disruptions on EMS helicopter pilot performance. This research program should be conducted in cooperation with the National Aeronautics and Space Administration [NASA], which has developed techniques to measure the influence of workload and fatigue on helicopter pilot performance. This research should include evaluation of one- and two-pilot crews. The results of this research should be used to evaluate the effectiveness of the current flight time/duty time regulation in providing EMS pilots adequate rest.

The FAA issued AC 135-14A to provide specific guidance on issues such as flight time and rest requirements, cockpit resource management, judgment and decision-making and flight operations procedures. The FAA believed that these regulations and guidelines were effective based on the improved safety record of EMS helicopter operations. Although the FAA stated that it would continue to monitor NASA's work, it did not foresee additional action. Thus, the Safety Board classified the recommendation "Closed—Acceptable Alternate Action" on October 28, 1994.

A-88-11

> Develop guidance for Emergency Medical Service (EMS) helicopter operators and hospitals operating EMS helicopter programs on recommended training for medical personnel who routinely fly on EMS helicopter missions. This guidance should be developed in conjunction with the American Society of Hospital-Based Emergency Aeromedical Services, and the Helicopter Association International. Topics that should be addressed include: flight crew and medical personnel coordination and communication including terminology to be used; helicopter emergency fuel and systems shutdown, landing zone safety and obstacle avoidance, air traffic recognition and avoidance, and radio communication; and emergency training on the topics listed in 14 *Code of Federal Regulations* 135.331, Crewmember Emergency Training.

The FAA incorporated guidance regarding coordination between EMS flight crewmembers and medical personnel into AC 135-14. Accordingly, the recommendation was classified "Closed—Acceptable Action" on October 1, 1990.

In addition to the recommendations to the FAA, the Safety Board also issued recommendations resulting from the study to other entities. The Safety Board recommended the following to the American Society of Hospital-Based Emergency Aeromedical Services (ASHBEAMS):

A-88-12

> In coordination with the Helicopter Association International, provide specific guidance to each member emergency medical service (EMS) helicopter program

> on the need for and methods to develop a safety committee composed of representatives from the hospital EMS program administration, the commercial EMS helicopter operator, the pilot and medical personnel, helicopter dispatch (if applicable), and local public safety/emergency response agencies. The safety committee should meet monthly, with management representatives from the operator and hospital attending frequently. One objective of the safety committee should be the elimination of any negative influence caused by competition between EMS helicopter services that operate in the same area.

> A-88-13
>
> Develop guidance for hospital emergency medical service (EMS) program administrators on safety issues involved in helicopter EMS operations. Topics addressed should include pilot-in-command authority, marginal weather operations, and pilot-crewmember coordination and communication.

The Association of Air Medical Services (AAMS)[5] published "Minimum Quality Standards and Safety Guidelines" in July 1991 and also developed an accreditation program for air medical services. Based on this response, Safety Recommendations A-88-12 and -13 were classified "Closed—Acceptable Action" on February 22, 1994.

The Safety Board further recommended to ASHBEAMS:

> A-88-14
>
> Encourage members who operate emergency medical service (EMS) programs to provide medical personnel who routinely fly EMS helicopter missions with protective clothing and equipment to reduce the chance of injury or death in survivable accidents. This clothing and equipment should include protective helmets, flame- and heat-resistant flight suits, and protective footwear.

AAMS responded that it issued a mission statement encouraging members to consider crash survivability issues but to put a greater emphasis on accident prevention. The Safety Board classified this recommendation "Closed—Acceptable Action" on January 19, 1990.

The Safety Board also issued to ASHBEAMS:

> A-88-15
>
> Develop guidance for members who operate emergency medical service (EMS) programs on recommended training for medical personnel who routinely fly on EMS helicopter missions. This guidance should be developed in conjunction with the FAA, and the Helicopter Association International. Topics that should be addressed include: flight crew and medical personnel coordination and communication including terminology to be used; helicopter emergency fuel and systems shutdown, landing zone safety and obstacle avoidance, air traffic recognition and avoidance, and radio communication; and emergency training on

[5] ASHBEAMS was renamed in 1988.

the topics listed in 14 *Code of Federal Regulations* 135.331, Crewmember Emergency Training.

AAMS responded that, in 1988, it completed the "Air Medical Crew – National Standard Curriculum," which contained subjects listed in the recommendation, as well as other subjects pertinent to the air medical environment. Thus, the recommendation was classified "Closed—Acceptable Action" on January 19, 1990.

The Safety Board also issued the following recommendations to Helicopter Association International:

<u>A-88-16</u>

Encourage all members who operate commercial emergency medical service (EMS) helicopters to develop visual flight rules weather minimums for each EMS helicopter program based on local terrain and weather patterns. These weather minimums should be communicated to the pilots in writing, and deviation below the program minimums should be prohibited.

<u>A-88-17</u>

In coordination with the American Society of Hospital-Based Emergency Aeromedical Service, encourage members that operate commercial emergency medical service (EMS) helicopters to establish safety committees at each EMS program composed of representatives from the hospital EMS program administration, the commercial EMS helicopter operator, the pilot and medical personnel, helicopter dispatch (if applicable), and local public safety/emergency response agencies. One objective of the safety committee should be the elimination of any negative influence caused by competition between EMS helicopter services that operate in the same area.

<u>A-88-18</u>

Develop guidance for members who operate emergency medical service (EMS) programs on recommended training for medical personnel who routinely fly on EMS helicopter missions. This guidance should be developed in conjunction with the FAA and the American Society of Hospital-Based Emergency Aeromedical Service. Topics that should be addressed include: flight crew and medical personnel coordination and communication including terminology to be used; helicopter emergency fuel and systems shutdown, landing zone safety and obstacle avoidance, air traffic recognition and avoidance, and radio communication; and emergency training on the topics listed in 14 *Code of Federal Regulations* 135.331, Crewmember Emergency Training.

The Safety Board did not receive any correspondence from Helicopter Association International and classified recommendations A-88-16, -17, -18 "Closed—Unacceptable Action—No Response" on April 24, 2001.

Finally, as a result of the study, the Safety Board recommended that the National Aeronautics and Space Administration:

A-88-19

> Develop and conduct a research program in cooperation with the Federal Aviation Administration to measure the effect of emergency medical service (EMS) pilot workload, shift lengths, and circadian rhythm disruptions on EMS helicopter pilot performance.

In 1988, NASA had begun to gather a pilot workload database of EMS operations and, by 1994, had conducted research into special human performance issues in EMS helicopter operations. As a result of this research, a computer-based preflight risk assessment system was developed and disseminated to the EMS industry. In addition, the Aviation Safety Reporting System performed a structured callback based on EMS reports and an analysis of incident data. Although the Safety Board envisioned a more structured program addressing the particular challenges of pilot workload, shift lengths, and circadian rhythm disruption, the Board determined that the NASA program was an acceptable alternative. Thus, the Safety Board classified Safety Recommendation A-88-19 "Closed—Acceptable Alternate Action" on March 12, 2001.

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