



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: SEP 24 2009

In reply refer to: A-09-87 through -96

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Calendar year 2008 was the deadliest year on record for the helicopter emergency medical services (HEMS) industry, with 12 accidents¹ (8 fatal accidents) and 29 fatalities. As a result of this increase in fatal accidents involving HEMS operations, the National Transportation Safety Board (NTSB) placed the issue of HEMS safety on its *Most Wanted List of Transportation Safety Improvements* on October 28, 2008, and also conducted a 4-day public hearing to critically examine safety issues concerning this industry.² Based on testimony given at this hearing, in addition to findings from recent HEMS accidents,³ the NTSB believes the Federal Aviation Administration (FAA) needs to take action to prevent additional accidents. These actions include improved pilot training; collection and analysis of flight, weather, and safety data; development of a low-altitude airspace infrastructure; and the use of dual pilots, autopilots, and night vision imaging systems (NVIS). Additional recommendations have been addressed to the Department of Health and Human Services' Centers for Medicare & Medicaid Services (CMS), the Department of Homeland Security's Federal Interagency Committee on Emergency Medical Services (FICEMS),⁴ and 40 public HEMS operators.

HEMS operations provide an important service to the public by transporting seriously ill patients and donor organs to emergency care facilities, often from remote areas not served by adequate facilities. These operations, which comprise an estimated 750 helicopters, 70 commercial operators, and 60 hospital-based programs, are unique and complex, mixing

¹ The NTSB classifies a HEMS accident as one in which the accident flight involved an aircraft dedicated to or configured for air medical operations and piloted by an EMS crew.

² The NTSB's public hearing took place February 3–6, 2009. For details, see the NTSB website at <<http://www.nts.gov/events/Hearing-HEMS/default.htm>>.

³ See the NTSB website at <http://www.nts.gov/Publictn/A_Acc1.htm> for accident investigation reports. The public may view and download docket contents at <http://www.nts.gov/info/foia_fri-dockets.htm>. Details of the recent HEMS accidents that are used to support the recommendations contained in this letter are cited later in the section of this letter titled "Recent EMS Accidents."

⁴ FICEMS is an advisory committee whose function is to provide guidance and coordination on EMS. No federal agency is currently responsible for EMS oversight at the national level.

highly advanced medical care with the technical challenge of safely operating helicopters 24 hours a day.⁵ Each year, approximately 400,000 patients and transplant organs are safely transported by helicopter. However, the pressure to conduct these operations safely and quickly in various environmental conditions (for example, in inclement weather, at night, or at unfamiliar landing sites for helicopter operations) increases the risk of accidents when compared to other types of commercial flight operations.

Previous NTSB Actions: Safety Study, Special Investigation, and Public Hearing

The NTSB has a long-standing interest in the safety of emergency medical services (EMS) aviation operations. In 1988, the NTSB conducted a safety study of commercial HEMS operations. That study evaluated 59 HEMS accidents and resulted in the NTSB issuing 19 safety recommendations to the FAA and to the air medical transportation industry.⁶ However, the late 1990s and early 2000s saw a rapid growth of HEMS operations and the number of accidents began to rise. Prompted by this rise, the NTSB completed a special investigation in January 2006 that analyzed 41 HEMS accidents and 14 airplane EMS accidents that had occurred during the previous 3 years, claiming 54 lives; of these fatalities, 39 occurred during HEMS operations.⁷ In this *Special Investigation Report on Emergency Medical Services Operations*,⁸ the NTSB identified the following recurring safety issues: less stringent requirements for EMS operations conducted without patients on board; the absence of aviation flight risk evaluation programs for EMS operations; a lack of consistent, comprehensive flight dispatch procedures for EMS operations; and a lack of requirements to use technologies such as terrain awareness and warning systems (TAWS) and NVIS to enhance EMS flight safety. As a result, the NTSB adopted the following four safety recommendations, which are currently included on the NTSB's Most Wanted List:

- Require all emergency medical services operators to comply with 14 *Code of Federal Regulations* (CFR) Part 135 operations specifications during the conduct of all flights with medical personnel onboard. (A-06-12) (Status: Open—Unacceptable Response)
- 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

⁵ Estimates provided by the Association of Air Medical Services.

⁶ Most of these recommendations to the FAA were closed as a result of the June 20, 1991, issuance of FAA Advisory Circular (AC) 135-14A, "Emergency Medical Services/Helicopter (EMS/H)," which addressed equipment, training, crew resource management, decision-making, flight-following procedures, weather minimums, and the development of safety programs for HEMS flights operating under 14 *Code of Federal Regulations* (CFR) Part 135. Although the NTSB 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 with a status of acceptable.

⁷ Accident rates would have been a better metric for evaluation, but HEMS operators are not required to report exposure data. Consequently, only raw counts were available.

⁸ *Special Investigation Report on Emergency Medical Services Operations*, NTSB/SIR-06/01 (Washington, DC: National Transportation Safety Board, 2006). The full report can be accessed at the NTSB website at <http://www.ntsbt.gov/publicctn/2006/SIR0601.pdf>.

flight risks, and consultation with others trained in EMS flight operations if the risks reach a predefined level. (A-06-13) (Status: Open—Unacceptable Response)

- 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) (Status: Open—Acceptable Response)
- 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) (Status: Open—Unacceptable Response)

As noted above, 2008 was the deadliest year on record, with 8 fatal accidents and 29 fatalities, up from 2 fatal accidents and 7 fatalities in 2007. During its February 2009 public hearing, the NTSB heard testimony⁹ describing the perspectives of nearly every facet of the HEMS industry, including large and small companies, companies that conduct visual flight rules (VFR) and instrument flight rules (IFR) operations, hospital programs, and those who oversee HEMS operators. The hearing called upon 41 expert witnesses representing 8 HEMS operators, 12 associations, 6 manufacturers, and 4 hospitals. The witnesses participated as part of 12 panels¹⁰ that addressed particular safety issues.¹¹

By taking a comprehensive look at the HEMS industry, the hearing sought to obtain a more complete understanding of why this industry has grown rapidly in recent years and explored its increasingly competitive environment. Topics examined were flight operations procedures including flight planning, weather minimums, and preflight risk assessment, as well as safety-enhancing technology such as TAWS and NVIS. Flight recorders and associated flight operations quality assurance programs were also discussed. Training, including use of flight simulators, was discussed at length, as well as corporate and government oversight of HEMS operations.

Recent HEMS Accidents

Of the 12 HEMS accidents that occurred in 2008, the following 6 (listed chronologically) best illustrate the safety issues addressed in this recommendation letter:

⁹ See the NTSB website at <http://www.nts.gov/events/Hearing-HEMS/HEMS_Summary.pdf> for a summary of the public hearing testimony.

¹⁰ The 12 sessions included Current EMS Models and Reimbursement Structures; State Oversight and Competition; Patient Transport Request Process; Flight Dispatch Procedures; Safety Equipment and Flight Recorders; Flight Operations Procedures and Training; Corporate Oversight; Safety Management Systems; and FAA Oversight.

¹¹ Additionally, several organizations designated as parties to the public hearing had an opportunity to question the witnesses directly. The parties, who were designated for their technical expertise in their respective fields, were the FAA; Association of Air Medical Services; Helicopter Association International (HAI); National EMS Pilots Association; Professional Helicopter Pilots Association; Air Methods (representing a relatively large operator); and CareFlite (representing a relatively small operator).

- **South Padre Island, Texas (DFW08FA062).**¹² On February 5, 2008, a Eurocopter AS350B2 impacted water and was destroyed. The airline transport pilot, flight nurse, and flight paramedic sustained fatal injuries. The flight was en route to pick up a patient at an emergency landing zone in a parking lot. The NTSB determined that the probable cause of this accident was the pilot's failure to maintain aircraft control, resulting in the helicopter impacting the water. Factors contributing to the accident were the pilot's inadvertent flight into instrument meteorological conditions (IMC), the low ceiling, dark night conditions, and the pilot's lack of recent instrument flying experience.
- **La Crosse, Wisconsin (CHI08FA128).** On May 10, 2008, a Eurocopter EC 135 T2+ was destroyed during an in-flight collision with trees. Night visual meteorological conditions (VMC) prevailed. The pilot, physician, and flight nurse sustained fatal injuries. The flight departed La Crosse Municipal Airport, La Crosse, Wisconsin, and was destined for the University of Wisconsin Hospital heliport in Madison, Wisconsin. The accident remains under investigation.
- **Huntsville, Texas (DEN08FA101).** On June 8, 2008, a Bell 407 was destroyed when it impacted a heavily forested area during a night VMC flight. The pilot, flight nurse, flight paramedic, and passenger were fatally injured. The NTSB determined that the probable cause of this accident was the pilot's failure to identify and arrest the helicopter's descent, which resulted in its impact with terrain. Contributing to the accident was the limited outside visual reference due to the dark night conditions.
- **Flagstaff, Arizona (DEN08MA116A/B).** On June 29, 2008, two Bell 407 helicopters collided in midair while approaching the Flagstaff Medical Center helipad. Both helicopters were destroyed, and all seven persons aboard the two aircraft were fatally injured. Day VMC prevailed. The NTSB determined that the probable cause of this accident was both helicopter pilots' failure to see and avoid the other helicopter on approach to the helipad. Contributing to the accident were the failure of the pilot of one of the helicopters to follow arrival and noise abatement guidelines and the failure of the pilot of the other helicopter to follow communications guidelines.
- **District Heights, Maryland (MIA08MA203).** On September 27, 2008, an Aerospatiale (Eurocopter) AS365N1, registered to and operated by the Maryland State Police, on a public EMS flight, was substantially damaged when it collided with trees and terrain in a park during an instrument approach. The commercial pilot, one flight paramedic, one field provider, and one of two automobile accident patients being transported were fatally injured. Night VMC conditions prevailed for the departure; however, the flight encountered IMC en route to the hospital and diverted to Andrews Air Force Base. This accident remains under investigation.
- **Aurora, Illinois (CEN09MA019).** On October 15, 2008, a Bell 222 was destroyed when it struck a radio station tower and then impacted the ground. Night VMC

¹² NTSB accident numbers are included to facilitate use of the NTSB Aviation Accident Database and Synopses site, which can be accessed at <<http://www.nts.gov/ntsb/query.asp>>.

prevailed in the area of the accident site. All four occupants, including the pilot, a flight paramedic, a flight nurse, and the 14-month-old patient, were fatally injured. The accident remains under investigation.

These six accidents have been specifically cited, where applicable, in this letter's discussion of each safety issue. More detailed flight histories are provided within each investigation report.

Pilot Flight Training

Testimony taken during the public hearing revealed that pilots who provide and/or receive HEMS flight training believe that scenario-based training could prevent many of the HEMS accidents that occur today. Additionally, FAA witnesses testified that the FAA's analysis of HEMS accidents over the past several years indicates that the causes were predominantly associated with flying at night, inadvertent flight into IMC, and controlled flight into terrain (CFIT). NTSB accident investigations are consistent with the FAA's analysis. As a result of that analysis, the FAA developed guidance materials for HEMS operators that targeted those three areas; however, the FAA imposed no additional HEMS training requirements. Testimony also indicated that no requirements for instrument proficiency training currently exist for HEMS pilots and that the most common flight training that they receive is preparation to pass an annual VFR checkride, despite the fact that most HEMS accidents involve inadvertent flight into IMC. As a result, most HEMS pilots have not had adequate training to recognize the conditions that indicate when they are encountering IMC, how to effectively avoid IMC encounters, or how to escape safely should they encounter IMC.

The circumstances of some of the accidents discussed above demonstrate that increased training, targeted to the risks identified by the FAA and the NTSB, could likely have prevented these accidents. For example, witness statements and wreckage evidence indicate that the South Padre Island accident flight in February 2008 was consistent with a loss of control after an encounter with IMC resulting in a high-speed, port-side, inverted impact with water. A review of the pilot's experience showed that his most recent actual instrument experience was in 1997 when he completed an instrument competency check in a single-engine airplane. The only instrument helicopter experience entered in the pilot's logbook within the previous 10 years was two entries of simulated instrument time: 0.8 hour in December 2005 and 0.2 hour in September 2007. Had the pilot completed recent training in conducting flight at night and in instrument conditions, or scenario-based training to approach a remote landing site in those conditions, he likely would have been better able to identify and arrest the helicopter's descent.

The District Heights accident in September 2008 is another example of an accident pilot likely not receiving adequate training for the type of circumstances that he encountered. While conducting an instrument landing system approach, the pilot reported that he was not receiving the glideslope and requested a surveillance radar approach, which the controller was unable to provide. Shortly thereafter, the helicopter's rate of descent increased rapidly to more than 2,000 feet per minute, and the helicopter continued to descend until it impacted terrain. Although the pilot met the recent experience requirements to act as pilot-in-command under IFR, the investigation so far has revealed that he was not proficient in performing nonprecision approaches. If the pilot had received more recent and targeted instrument training in night

conditions, he might have been better prepared to conduct what effectively became a nonprecision approach during the accident flight.

The NTSB recognizes that requirements for additional training can be costly, especially for small HEMS operators. However, as public hearing testimony indicated, the availability of new helicopter flight training devices (FTD), including simulators, has increased greatly over the past few years.¹³ Simulators and FTDs are not only cheaper to operate than training in actual helicopters; they also allow pilots to practice procedures and maneuvers that they would never perform in a helicopter except in an emergency. Hearing witnesses contended that scenario-based training in a simulation environment provides the best opportunity for crewmembers to practice skills that are not demanded on a routine basis.

Simulators and FTDs are beneficial in several ways. In addition to enabling pilots to train in skills that are too risky to perform in a real helicopter, simulators and FTDs can, unlike real helicopters, be used anytime, day or night, and in any kind of weather. Simulators and FTDs can also allow training for a complete flight, including an emergency. Further, simulated flights can be tailored to a specific type of flight operation, such as interfacility HEMS flights (that is, hospital to hospital) and remote helispot landings and takeoffs. For example, simulator and FTD training can be very useful for scenarios involving avoidance of, or response to, IMC, which has been cited as a factor in numerous HEMS accidents.

The Professional Helicopter Pilots Association/Office of Professional Employees International Union, AFL-CIO (PHPA/OPEIU),¹⁴ in its written submission to the NTSB's HEMS public hearing, identified a deficient training environment for HEMS as its number one safety issue. The PHPA/OPEIU stated the following:

Since there are presently very few two-pilot HEMS operations ... better guidelines for new HEMS pilot training are needed to ensure that solo pilots are properly prepared for the job.... Beyond new employee training, better guidance for routine refresher training in perishable skills is needed. Such training should go beyond simple emergency procedure training and use realistic HEMS scenarios that have specific training objectives. These training flights would ideally be performed several times per year ...¹⁵

FAA witnesses also acknowledged the benefits of simulators and FTDs during the public hearing and encouraged their use to improve safety. FAA witnesses testified that instrument flight training that leads to proficiency in IMC flight enhances a pilot's ability to fly safely at night and in VFR conditions. Nevertheless, FAA witnesses testified that they are reluctant to

¹³ At one time, a shortage of single-engine FTDs prevented their use in helicopters; however, many more of these devices are now available, as in the Bell 206, Bell 407, and Aerospatiale A-Star helicopters. Simulators are now available at various levels: the higher the fidelity (that is, the more realistic it is), the higher its classification. The highest level devices, Level 7, allow crewmembers to receive the maximum amount of training credit from an FTD and qualify for nearly all parts of a Part 135 checkride.

¹⁴ The PHPA/OPEIU is a labor union that represents most HEMS pilots, including those that fly for Air Methods, Inc., and PHI, Inc., two of the largest HEMS operators in the country. The PHPA was designated as a party to the NTSB HEMS public hearing.

¹⁵ The PHPA/OPEIU further stated that "These guidelines should be developed considering the amount of single pilot experience, night experience, and experience in aircraft type along with other appropriate factors as to arrive at a template for training based on the individual pilots' needs, as opposed to "cookie cutter" training programs that vary from operator to operator."

require the use of these devices out of concern that some smaller HEMS operators could be forced out of business by the cost of such a requirement, thereby reducing critical services to remote communities. The NTSB is concerned that the absence of a requirement for additional and specific training for HEMS pilots will allow many operators to continue to accept HEMS flight assignments that may involve flight into conditions for which they are not adequately trained. Therefore, the NTSB recommends that the FAA develop criteria for scenario-based HEMS pilot training that includes inadvertent flight into IMC and hazards unique to HEMS operations, and determine how frequently this training is required to ensure proficiency. The NTSB further recommends that once the actions recommended in Safety Recommendation A-09-87 are completed, the FAA require HEMS pilots to undergo periodic FAA-approved scenario-based simulator training, including training that makes use of simulators or FTDs.

Safety Management Systems

The NTSB notes that increasing numbers of operators in the aviation industry are incorporating a formal safety management system (SMS) into their operations. An effective SMS program formalizes a company's standard operating procedures (SOPs) and establishes methods for ensuring that those SOPs are followed. Guidance issued in November 2006 by the International Civil Aviation Organization (ICAO) in Annex 6, "Operation of Aircraft," states that after January 1, 2009, "[Member] States shall require, as part of their safety program, that an operator implements a[n SMS] acceptable to the State of the Operator...."¹⁶ In June 2006, the FAA published AC 120-92, "Introduction to Safety Management Systems for Air Operators," which states, in part, that "An SMS is essentially a quality management approach to controlling risk. It also provides the organizational framework to support a sound safety culture. For general aviation operators, an SMS can form the core of the company's safety efforts."¹⁷

During the HEMS public hearing, witnesses¹⁸ discussed the potential benefits and challenges of applying SMS to HEMS operations. Testimony revealed that a successful SMS program is one that incorporates proactive safety methods to evaluate a company's flight and maintenance operations to, at a minimum, identify safety hazards, ensure that remedial action necessary to maintain an acceptable level of safety is implemented, provide for continuous monitoring and regular assessment of the safety level achieved, and continuously improve the company's overall level of safety.

The circumstances of the Aurora accident demonstrate that an SMS program might have reduced the risks leading to that accident. The investigation revealed that the pilot had chosen a nonstandard flight route, at a low altitude, while en route to a hospital to drop off a patient. The

¹⁶ In a November 26, 2008, Information for Operators, the FAA stated that it would be filing a difference with ICAO with regard to the January 2009 deadline for SMS programs because the FAA has not yet developed regulations or policy for implementation of SMS by U.S. operators. These regulations and policies are currently under development.

¹⁷ The full text of AC 120-92 is available online at [http://rgl.faa.gov/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/6485143d5ec81aae8625719b0055c9e5/\\$FILE/AC%20120-92.pdf](http://rgl.faa.gov/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/6485143d5ec81aae8625719b0055c9e5/$FILE/AC%20120-92.pdf).

¹⁸ The SMS panel comprised the safety director of a large HEMS operator, the FAA SMS program manager, and the SMS coordinator for the International Helicopter Safety Team, an organization co-chaired by HAI and the FAA to reduce worldwide helicopter accidents by 80 percent in 10 years.

helicopter remained on this route until impacting at 734-foot-tall radio tower about 50 feet below the top of the tower. According to the operator's chief pilot, the en route segment to the hospital was typically performed well clear of the tower and at an altitude at least 1,000 feet above the ground. The accident investigation indicated that continuous monitoring and regular assessments involved in a formal SMS program would have helped to ensure that the pilot adhered in practice to the operator's established processes and procedures and likely would have prevented the accident aircraft from flying along a route of flight and at an altitude that placed it on a collision course with an obstacle.

During the public hearing, all witnesses on the SMS panel agreed that SMS would greatly benefit HEMS operators, no matter how large or small, and that SMS programs can be scaled to the size and characteristics of a specific operator. This view was supported in written submissions to the NTSB from Helicopter Association International (HAI), the Commission on Accreditation of Medical Transport Systems (CAMTS),¹⁹ and the General Accountability Office (GAO). Additionally, hearing testimony revealed that the International Helicopter Safety Team (IHST) has developed an SMS toolkit for small helicopter operators,²⁰ and other guidance, as mentioned above, is also available.

The NTSB concludes that SMS programs would provide HEMS operators a formal system of risk management, safety methods, and internal oversight programs that would improve safety and prevent accidents. Therefore, the NTSB recommends that the FAA require HEMS operators to implement an SMS program that includes sound risk management practices.

Flight Operations Monitoring Programs

NTSB public hearing testimony revealed that recent advances in avionics technology have produced a number of low-cost, lightweight flight data recording devices for helicopters. Such affordable, self-contained devices and associated data analysis tools have permitted even small operators to implement effective flight data monitoring (FDM) programs. Such data would be particularly useful in evaluating pilot performance in daily operations according to specific parametric operational standards, such as altitude, bank angle, pitch attitude, and airspeed limitations. Frequent downloading and analysis of these data can aid operators in implementing an SMS by identifying exceedences that occur during operations in order to implement corrective actions. In addition, periodic review of flight data from HEMS flights would provide information on aircraft proximity to terrain and weather that could assist in evaluating pilot performance to determine if pilots are conducting HEMS flights in accordance with company operating practices.

A flight operations monitoring program may have helped in preventing the Flagstaff midair collision. The Flagstaff investigation revealed that both operators were equipped with a type of flight-following equipment that was able to provide a track history of the flight for flight-following and dispatch purposes; however, no formal monitoring program was developed or used by either operator to identify possible trends in nonstandard operations. The investigation

¹⁹ CAMTS is a not-for-profit organization that accredits rotorwing, fixed wing, and ground transport services through a voluntary process. The association was designated a party to the NTSB public hearing.

²⁰ This toolkit can be downloaded at <<http://ihst.org/Portals/54/SMS-Toolkit.pdf>>.

revealed that several operators had complaints about other operators regarding communications and flight profiles while approaching the Flagstaff Medical Center helipad. Neither operator involved in the accident had a way of tracking such complaints reported to them.

After the accident, the management of one of the operators, whose pilot was cited as contributing to the accident because of his failure to follow arrival and noise abatement guidelines, indicated that they were surprised that their pilot had flown to the helipad from Flagstaff Airport in an essentially straight line of flight because they said that their pilots were trained to fly a different profile when approaching the helipad from the south. Additionally, the pilot from the other operator was cited as contributing to the accident due to his failure to follow communications guidelines that were in effect for operations approaching at the helipad. Had either operator had a formal flight operations monitoring program in effect, use of nonstandard procedures by either pilot might have led the operators to take corrective action that could have prevented the two helicopters from arriving at the same helipad on different approach angles that particular day.

During the HEMS public hearing, several witnesses concurred that the recording and analysis of routine flight data is key to reducing the accident rate. For example, in a joint statement submitted to the HEMS public hearing, HAI, the Association of Air Medical Services (AAMS), and the Air Medical Operators Association (AMOA) recommended the following:

[the] FAA, in coordination with Associations and those conducting air medical services, should establish requirements, procedures and standards for devices, technology, and procedures used to support air medical aircraft for the enhancement of Flight Operations Quality Assurance (FOQA) programs and subsequent accident investigations.

Similar sentiments were expressed in written testimony by PHPA, which stated that “a well designed and managed [FOQA] program can provide pilots with invaluable feedback to improve overall safety performance.”²¹

The installation of conventional flight data recorders (FDR) into helicopters has met resistance due to the penalties associated with their cost and weight. However, as previously mentioned, technology currently exists to build image and data recording devices that are relatively inexpensive and lightweight for installation on new and existing helicopters. Although these devices do not meet the current crashworthiness standards required for conventional FDRs by 14 CFR Part 121 for large transport aircraft, they are crash-resistant and can provide significant information for investigators to determine accident causation, as well as for operators in support of flight operations monitoring programs. During the public hearing, the FAA stated that it has not initiated regulatory action to require on-board recording devices for helicopters, despite recommendations by the NTSB. However, during the public hearing, the director of the FAA’s Flight Standards Service indicated a willingness to work with the HEMS industry to streamline approvals that would permit voluntary use of these low-cost recording devices. Several U.S. helicopter manufacturers (Bell and Eurocopter USA, for example) have programs underway to equip their new helicopters with on-board video/voice-data recording devices. The

²¹ In addition, the IHST’s highest priority recommendation in its “Safety Equipment” category of recommendations is to incorporate flight data monitoring in all helicopter operations.

NTSB notes that these devices are consistent with the standards adopted by the European Organization for Civil Aviation Equipment (EUROCAE).²²

Following its investigation of the July 27, 2007, Phoenix, Arizona, accident involving two electronic news gathering helicopters that collided in midair while maneuvering in Phoenix, Arizona,²³ neither of which was equipped with an FDR, the NTSB issued Safety Recommendation A-09-11 on February 9, 2009, which asked the FAA to do the following:

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

This recommendation is currently classified “Open—Acceptable Response.”

The NTSB concludes that the systematic monitoring of data from HEMS flights could provide operators with objective information regarding the manner in which their pilots conduct HEMS flights and that a periodic review of such information, along with other available information, such as pilot reports and medical crew feedback, could assist operators in detecting and correcting unsafe deviations from company operating practices. Therefore, the NTSB recommends that the FAA require HEMS operators to install flight data recording devices and establish a structured FDM program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues.

Reporting HEMS Operations Flight Hours

Accident and incident reports do not provide a meaningful indication of safety without reliable activity-related data. Responsible attempts to measure accident risk require the identification and monitoring of accident trends and exposure to accident risk, which depend on accurate flight activity data to be effective. Unlike Part 121 and scheduled Part 135 air carriers, on-demand Part 135 operators, including HEMS operators, are not required to report actual flight activity data to the Department of Transportation or the FAA. Instead, the FAA collects flight activity data from general aviation and on-demand Part 135 operators using its annual General

²² Government and industry representatives have been participating since 2007 in a EUROCAE working group to develop a flight recorder specification, “Minimum Operational Performance Specification for Lightweight Flight Recorder Systems” (ED-155). (Both the NTSB and the FAA are members of this working group.) When finalized, ED-155 is expected to address recent improvements in technology by establishing the minimum performance requirements for flight recorder systems that could be used on board smaller aircraft (such as the accident helicopter models). This specification targets a more affordable flight recorder for smaller aircraft than traditional cockpit voice recorders or FDRs and addresses the recording of audio, image, and parametric information.

²³ *Midair Collision of Electronic News Gathering Helicopters KTVK-TV, Eurocopter AS350B2, N613TV, and U.S. Helicopters, Inc., Eurocopter AS350B2, N215TV Phoenix, Arizona July 27, 2007*, Aviation Accident Report NTSB/AAR-09-02 (Washington, DC: National Transportation Safety Board, 2009).

Aviation and Air Taxi Activity and Avionics (GAATAA) Survey to query a voluntary sample of registered aircraft owners about their aircraft usage during the previous year. The GAATAA Survey is currently the only source for the activity estimates that the NTSB, the FAA, Congress, and industry can use to calculate the accident rates and statistics used to assess the safety of these flight operations in the United States. Valid activity data are necessary to compare the accident rates for different aircraft types and types of operations, to establish baseline measures that can be used to identify and track accident trends, and to assess the effectiveness of safety improvement efforts.

In its 2005 Safety Report *Current Procedures for Collecting and Reporting U.S. General Aviation Accident and Activity Data*,²⁴ the NTSB found that GAATAA Survey data did not exhibit strong correlations with other indicators of activity, suggesting that the activity data derived from the GAATAA Survey had not accurately portrayed changes in general aviation activity during the studied period. The NTSB concluded that an accurate and stable activity measure is needed to guide future attempts to portray the accident rate accurately, which is critical to formulating and evaluating general aviation safety initiatives. Since that report was published, the FAA has increased funding to the GAATAA Survey and made numerous improvements to survey methodology, including larger sample sizes and improved timeliness of survey mailings.²⁵ These improvements also include implementing a 100-percent sampling rate for helicopters and simplified reporting procedures for fleet operators. However, survey participation remains voluntary and the response rates for rotorcraft operations continue to be among the lowest of all aircraft types in the survey at 31 percent to 43 percent. These low rates reduce the reliability of the resulting activity estimates. The reason for these low response rates is unknown.

GAO is also on the record advocating for improved HEMS data. In February 2007, the GAO issued its report *Aviation Safety: Improved Data Collection Needed for Effective Oversight of Air Ambulance Industry*. The GAO used the research from this report in its submission of written testimony for the April 22, 2009, hearing on HEMS safety that was conducted by the House of Representatives' Subcommittee on Aviation, Committee on Transportation and Infrastructure. The GAO's testimony, *Aviation Safety: Potential Strategies to Address Air Ambulance Safety Concerns*, stated the following:

In response to our prior recommendation that FAA collect flight activity data, FAA surveyed all helicopter air ambulance operators in 2008, but fewer than 40% responded, thereby raising questions about the reliability of the information collected. The low response rate also suggests that many operators will not provide this information unless they are required to do so. Until FAA obtains complete and reliable information from all air ambulance operators, it will be unable to gain a complete understanding of the industry and determine whether its efforts to improve industry safety are sufficient and accurately targeted.

²⁴ This report can be found at <<http://www.nts.gov/publicatn/2005/SR0502.pdf>>.

²⁵ Federal Aviation Administration, *General Aviation and Air Taxi Activity and Avionics Survey, Appendix A: Methodology for the 2007 General Aviation and Part 135 Activity Survey*, available online at <[http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2007/media/FAA_2007_Appendix A_Methodology.doc](http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2007/media/FAA_2007_Appendix_A_Methodology.doc)>.

When questioned about the paucity of HEMS flight activity data during the HEMS public hearing, the director of the FAA's Flight Standards Service stated that he preferred that FAA staff act as "hunters" tracking down safety problems, rather than "gatherers" of data that might indicate where those problems lay. He claimed that implementing a requirement for HEMS operators to report flight hour activity was "problematic," and that the FAA had no current plans to develop such a requirement. "It's not [the FAA's] primary focus," he said, and other agencies "could attend to that as well or better than [the FAA] can."

The NTSB strongly disagrees with the FAA's view regarding the required collection of flight hour data for HEMS operators and concurs with the GAO. These data would constitute an important metric to identify aviation safety deficiencies, and the FAA is the most appropriate agency to ensure the collection of these data. Therefore, the NTSB recommends that the FAA require HEMS operators to report activity on at least an annual basis to include total hours flown, revenue flight hours flown, revenue miles flown, patient transports completed, and number of departures.

Weather Information for HEMS Operations

In response to its analysis of HEMS accidents over the past several years, and with the knowledge that weather is a significant factor in these accidents, the FAA developed a HEMS Low Altitude Flight Tool through the National Center for Atmospheric Research experimental Aviation Digital Data Service (ADDS). This tool is described in FAA Notice 8000.333, "Helicopter Emergency Medical Services (HEMS) Use of the Aviation Digital Data Service (ADDS) Experimental HEMS Tool."²⁶ However, the notice states the following:

Operators may not use this Tool in any way to support IFR operations. The only approved use of this Tool is in VFR operations and then only in the context of supporting a "no-go" decision. Operators may not use the Tool as the sole source for decisions to "Go." They may only use established primary products such as METARs [meteorological aerodrome reports], TAFs [terminal aerodrome forecasts], area forecasts, weather depiction charts, prognosis charts, etc., to make both "Go" and "No-Go" decisions.

Several parties to the HEMS public hearing stated that the ADDS weather tool was a valuable source of weather information and suggested that it be used as an official source of weather on par with established primary weather products such as METARs and TAFs. One operator stated that "one of the biggest challenges to HEMS operations is the availability of good weather sources" and that the scarcity of weather data between the departure point and the final destination prompted their use of the ADDS weather tool. A witness from Bell Helicopter (formerly, the manager of the FAA Rotorcraft Division in Fort Worth) testified that—

I cannot emphasize enough, the HEMS weather tool ought to be taken out of the experimental mode and put into full production and available. I mean, that is just the best thing in the world...I sit there and watch weather all over the country just to see how it's moving with that system and it's great. It just needs to be codified so it can be used.

²⁶ FAA information on this tool can be found at http://weather.aero/info/HEMS_FAA_DOC.pdf

The NTSB is aware that the ADDS weather tool has experienced intermittent funding problems, which is a factor in the FAA's delay in making it an official source. However, recognizing that improvements in disseminating weather data can help HEMS pilots make more informed decisions and conduct flights more safely, the NTSB believes that this tool should be established as an official tool for obtaining weather information as soon as practicable. An FAA witness at the HEMS public hearing indicated that the FAA is "actively working to make it an official tool." To date, however, the FAA has not established ADDS as an official tool for use by HEMS operators and other operators. Therefore, the NTSB recommends that the FAA permit the HEMS ADDS Tool to be used by HEMS operators as an official weather product.

Low-Altitude Infrastructure for HEMS Operations

Public hearing testimony indicated widespread industry consensus regarding the need for a low-altitude infrastructure for improving HEMS safety. For example, in their joint statement to the public hearing, AAMS, HAI, and AMOA recommended an initiative "...to study, establish, augment, and maintain a dedicated low-altitude helicopter IFR infrastructure to include associated approach and departure procedures which facilitates a seamless transition from visual flight rules (VFR) to IFR operations."

Other witnesses testified that the current airspace infrastructure is not conducive to efficient, low-altitude HEMS operations and that the absence of navigational routing and the strict regulatory IFR structure make local, low-altitude HEMS flights in metropolitan areas impractical and, in some cases, unsafe. As a result, some operators are forced to fly VFR only, or under less stringent Part 91 regulations. Additionally, testimony indicated that the number of weather reporting stations for low-altitude operations is not adequate and that those that do exist are not all tied into a central network for easy access by all pilots. Also, witnesses testified that no more than 10 percent of all HEMS flights are conducted in IMC and that the majority of HEMS operators conduct VFR operations only. However, an FAA witness asserted that flying under IFR is the most effective countermeasure against CFIT because of the positive control provided by the FAA's air traffic control system.

Recent HEMS accidents might have been prevented if the pilots had been able to fly in a structured low-altitude IFR environment or had access to additional weather data from remote locations. In the South Padre Island accident flight, for example, the pilot would have been better able to cope with an inadvertent entry into IMC because of the availability of an IFR return. Additionally, the pilot would not have felt pressure to attempt to maintain VFR-only flight if the option had been available for him to return to base under IFR.

The director of the FAA's Flight Standards Service testified that the FAA is working to implement the automatic dependent surveillance-broadcast (ADS-B)²⁷ throughout the National Airspace System (NAS) by 2013 as part of a low-altitude infrastructure that will facilitate safer, more efficient HEMS operations. He also stated that the FAA has funded grants for the Dallas/Fort Worth area to develop special approaches into hospitals. The NTSB is pleased with

²⁷ ADS-B is a surveillance system in which an aircraft is fitted with cooperative equipment in the form of a data link transmitter. The aircraft periodically broadcasts its GPS-derived position and other information such as velocity over the data link, which is received by a ground-based transceiver for use by air traffic control and other users.

these initiatives but is concerned that no action, other than development of ADS-B, has been taken to pursue the development of a nationwide infrastructure to support HEMS operations. Therefore, the NTSB recommends that the FAA conduct a systematic evaluation and issue a report on the requirements necessary for a viable low-altitude airspace infrastructure that can accommodate safe HEMS operations. The evaluation should consider improved collection and dissemination of weather data, the role of ADS-B, approaches to helipad and designated landing zones, and integration into the NAS. Include in the evaluation process HEMS operators, related industry associations, and hospitals, among others. Further, the NTSB recommends that once the evaluation and report as recommended in Safety Recommendation A-09-93 are completed, the FAA initiate action to develop this infrastructure.

Night Vision Imaging Systems

In its 2006 special investigation report, the NTSB concluded that, for 13 of the 55 accidents considered, NVIS might have helped the pilots more clearly observe obstacles and take evasive action to avoid them and prevent the accidents. The NTSB concluded that if used properly, NVIS could help EMS pilots identify and avoid hazards during nighttime operations. However, the NTSB stopped short of issuing a recommendation for a requirement because, at that time, NVIS was not feasible in some situations, such as populated areas with ambient light and numerous streetlights. Additionally, the costs, availability, and FAA certification policies and manpower were not mature enough to warrant a reasonable recommendation. However, the NTSB indicated that it would:

monitor the effectiveness of the FAA's recommendation [as stated in FAA Order 8000.293, "Helicopter Medical Services Operations," which directs FAA principal inspectors to encourage the use of NVIS] 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.

Information gathered during the HEMS public hearing revealed that NVIS technology has advanced over the past few years. Witnesses indicated that today's NVIS is effective in urban areas that emit manmade lighting and that law enforcement helicopter pilots in major cities have used NVIS successfully. Witnesses also contended that NVIS can be a critical part of a helicopter's safety equipment and that with proper training in its use, crews can use NVIS to significantly enhance situational awareness. NVIS includes night vision goggles (NVG), types of which are now available that meet the FAA's new NVG technical standard order (TSO).²⁸ FAA witnesses testified that the FAA has 15 inspectors qualified to certify NVG operations, that they are beginning to hire inspectors who will be dedicated to helicopter operations, and that those inspectors will be trained in the use of NVGs during initial training.

The use of NVIS might have helped the pilots involved in the Aurora and La Crosse accidents. Each of these accidents occurred at night and in VMC. Had the Aurora accident pilot been using NVIS, he likely would have seen the radio tower ahead of him and been able to avoid

²⁸ FAA Technical Standard Order-C164, "Night Vision Goggles," describes the minimum performance standards that 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 principal operations inspectors in the evaluation of operations, training, currency, and equipment after an operator's request to use NVIS.

the impact. In the La Crosse accident, the helicopter impacted trees along a ridgeline in a sparsely populated area approximately 4.5 miles southeast of the departure airport. Had this pilot been using NVIS, he would likely have been able to identify the ridgeline, negotiate the terrain, and avoid the accident.

The NTSB notes that, of all the initiatives discussed at the hearing to improve HEMS safety, requiring the use of NVIS has gained the strongest consensus. For example, in their joint statement to the HEMS public hearing, AAMS, HAI, and AMOA recommended “that all air medical operations at night be conducted using either NVGs or enhanced vision systems..., or be conducted under IFR in a timeline established by the FAA in coordination with the industry.” The GAO’s April 2009 testimony to the congressional Subcommittee on Aviation, Committee on Transportation and Infrastructure, also indicated that “the most frequently cited helicopter-appropriate technology was night vision goggles.” This conclusion was also reached by the PHPA at the same hearing; the PHPA recommended a requirement for NVIS to be “onboard and functioning in each aircraft in the current HEMS fleet as quickly as equipment can be purchased, aircraft modified, and crews trained.”

As previously stated, even the FAA’s own analysis of HEMS accidents over the past several years indicates that predominantly, the causes were associated with flying at night, inadvertent flight into IMC, and CFIT. The NTSB is pleased that the FAA has encouraged the use of NVIS in HEMS operations but recognizes that this stance is at odds with FAA testimony at the hearing that NVGs should not be required at this time because “it depends on the operation” and that “we have to be very careful [in] how we apply [that technology].” As a result, and as brought out in testimony, it is estimated that only about 30 percent of HEMS aircraft are equipped with NVIS. The NTSB believes that a significant number of HEMS nighttime accidents can be prevented by requiring operators to use NVIS. Therefore, the NTSB recommends that the FAA require HEMS operators to install NVIS and require pilots to be trained in their use during night operations.

Terrain Awareness Warning Systems

In its 2006 special investigation report, the NTSB concluded that, for 17 of the 55 accidents considered, a TAWS might have helped the pilots avoid terrain. The NTSB concluded 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. As a result, on January 26, 2006, the NTSB issued Safety Recommendation A-06-15, which recommended that the FAA “require emergency medical services (EMS) operators to install terrain awareness and warning systems [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.”

In June 2006, at the FAA’s request, the RTCA established a committee tasked with developing Helicopter TAWS (H-TAWS) standards. In March 2008, the commission completed a set of minimum operational performance standards for H-TAWS. On December 17, 2008, the FAA published TSO C194, “Helicopter Terrain Awareness and Warning System,” based on the commission standards. Issuance of the TSO is required before the FAA may begin rulemaking to require H-TAWS on EMS flights. On October 28, 2008, during the *Most Wanted List of Transportation Safety Improvements* Board Meeting, the NTSB determined that the continuing

delays in development of a final rule to require H-TAWS were not acceptable. Pending issuance of a final rule to mandate the installation and use of TAWS on all EMS flights, Safety Recommendation A-06-15 was classified “Open—Unacceptable Response.”²⁹

Testimony at the hearing revealed at least one available enhanced ground proximity warning system (EGPWS) that not only meets the recently issued FAA TSO on H-TAWS but would also satisfy A-06-15 if required by the FAA.³⁰ The testimony also revealed that most permanent obstacles, such as radio towers, can be contained within the H-TAWS database and that, to date, no helicopter accidents attributed to CFIT have involved a helicopter equipped with an operating H-TAWS. Despite this testimony, it is estimated that only 30 percent of the U.S. fleet of helicopters are equipped with H-TAWS.

In his April 2009 testimony to the congressional Subcommittee on Aviation, Committee on Transportation and Infrastructure, the director of the FAA’s Flight Standards Service stated the following:

We recognize that relying on voluntary compliance alone is not enough to ensure safe flight operations. In that regard, the FAA has initiated a formal rulemaking project that will address many of the HEMS initiatives and best practices put forth in the advisory circulars, orders and notices issued over the last several years [including HTAWS] ... The FAA Rulemaking Council has given approval to begin drafting a Notice of Proposed Rulemaking, which we are aiming to have published in late 2009 or early 2010.

The NTSB is pleased with the FAA’s efforts in regard to H-TAWS and will closely monitor its progress.

Dual-Pilot/Autopilot Use

A review of the NTSB Aviation Accident Database revealed that during the 8-year period from 2000–2008, 123 HEMS accidents occurred, killing 104 people and seriously injuring 42 more. All but nine of these accidents involved operations with only one pilot.³¹ Pilot actions or omissions, in some capacity, were attributed as the probable cause in 60 of the 123 accidents. Most of these 60 accidents might have been prevented had a second pilot and/or an autopilot been present.

Witnesses at the NTSB hearing described the risks for helicopter pilots working in the HEMS environment, which are greater than those in other types of flight operations. The airline industry, which has an accident rate much lower than that of the HEMS industry, conducts flights with two pilots who attend training regularly and are required to be evaluated during that training. Conducting flights with two pilots allows one pilot to fly the airplane while the other communicates on the radio, programs aircraft avionics, and runs checklists. The NTSB notes that some HEMS operators currently operate with two pilots. According to hearing testimony, the

²⁹ The NTSB formally apprised the FAA of the status this recommendation in a letter on January 23, 2009.

³⁰ A witness representing Honeywell stated that Honeywell currently has two H-TAWS systems available. One system costs between \$25,000 and \$30,000 per unit. A more capable system costs between \$100,000 and \$120,000 per unit depending on how the aircraft is equipped.

³¹ The remaining accidents were all training accidents, which involved two pilots each.

Canadian HEMS industry operates its helicopters with two pilots and has flown over 230,000 hours since 1977 with no fatal accidents. In addition, the New Jersey State Police, which flies its helicopters with two pilots, has had no accidents for the last 10 years.

The circumstances of several of the accidents discussed above suggest that the presence of two pilots might have prevented these accidents. In the District Heights accident, for example, a second pilot could have handled radio communications with air traffic control, reducing the pilot's workload and allowing him to concentrate on flying the helicopter. Additionally, after the controller denied the pilot's request for a surveillance radar approach, a second pilot may have suggested they declare an emergency or execute a missed approach and request a different approach rather than continue to descend. A second pilot could have also monitored the helicopter's altitude while on the approach to ensure terrain clearance.

In the South Padre Island accident, two pilots might have been able to entirely avoid their inadvertent entry into IMC. Even after inadvertently entering IMC, two pilots might have been better able to maintain control of the helicopter during the course reversal to return to home base. In the Huntsville accident, which occurred at night, impact signatures were consistent with a controlled descent into forested terrain. A second pilot or the use of an autopilot could have prevented this CFIT accident.

In the absence of a second pilot, use of an autopilot might enhance a pilot's ability to cope with high workload, such as in inadvertent flight into IMC. The NTSB notes that the FAA currently requires all 14 CFR Part 135 passenger-carrying operations conducted under IFR to have a "second-in-command" pilot and that the FAA sometimes allows an exception to the second-in-command requirement if an autopilot is used.³² Clearly, the FAA recognizes the advantages of using an autopilot or a second-in-command pilot in that type of operation. The NTSB believes that requiring a second pilot in HEMS operations, or the use of an autopilot, may prevent a significant number of HEMS accidents. Therefore, the NTSB recommends that the FAA require helicopters that are used in EMS transportation to be equipped with autopilots and that the pilots be trained to use the autopilot if a second pilot is not available.

Recommendations

The National Transportation Safety Board therefore recommends that the Federal Aviation Administration:

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

³² Title 14 CFR 135.101 and 135.105 currently require a "second in command" for all Part 135 IFR passenger operations. This includes both airplanes and helicopters. Section 135.105 allows the substitution of an autopilot instead of a second-in-command pilot.

Once the actions recommended in Safety Recommendation A-09-87 are completed, require helicopter emergency medical services pilots to undergo periodic FAA-approved scenario-based simulator training, including training that makes use of simulators or flight training devices. (A-09-88)

Require helicopter emergency medical services operators to implement a safety management system program that includes sound risk management practices. (A-09-89)

Require helicopter emergency medical services operators to install flight data recording devices and establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-09-90)

Require helicopter emergency medical services operators to report activity on at least an annual basis to include total hours flown, revenue flight hours flown, revenue miles flown, patient transports completed, and number of departures. (A-09-91)

Permit the helicopter emergency medical services (HEMS) Aviation Digital Data Service Weather Tool to be used by HEMS operators as an official weather product. (A-09-92)

Conduct a systematic evaluation and issue a report on the requirements necessary for a viable low-altitude airspace infrastructure that can accommodate safe helicopter emergency medical services (HEMS) operations. The evaluation should consider improved collection and dissemination of weather data, the role of automatic dependent surveillance-broadcast, approaches to helipad and designated landing zones, and integration into the National Airspace System. Include in the evaluation process HEMS operators, related industry associations, and hospitals, among others. (A-09-93)

Once the evaluation and report as recommended in Safety Recommendation A-09-93 are completed, initiate action to develop this infrastructure. (A-09-94)

Require helicopter emergency medical services operators to install night vision imaging systems and require pilots to be trained in their use during night operations. (A-09-95)

Require helicopters that are used in emergency medical services transportation to be equipped with autopilots and that the pilots be trained to use the autopilot if a second pilot is not available. (A-09-96)

In response to the recommendations in this letter, please refer to Safety Recommendations A-09-87 through -96. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion,

please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Member SUMWALT concurred in these recommendations.

A handwritten signature in black ink, appearing to read 'D. Hersman', with a long horizontal flourish extending to the right.

By: Deborah A.P. Hersman
Chairman