Docket No. SA-530

Exhibit No. 2 - E

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

NTSB Safety Recommendation Letter Concerning

Safety Recommendations A-07-111 and -112

(7 Pages)

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: December 21, 2007

In reply refer to: A-07-111 and -112

Honorable Robert A. Sturgell
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

Helicopter emergency medical services (HEMS) flights typically operate under visual flight rules (VFR) and at low altitudes. When flying during night conditions, HEMS pilots must be especially diligent in avoiding controlled flight into terrain (CFIT) because a lack of visual ground references during night flight can render a pilot susceptible to visual illusions and other conditions that can make it difficult to judge the helicopter's attitude and actual height above the terrain. Helicopter pilots flying at low altitudes would have little time to recognize and recover from such illusions or other disorienting factors that could place them at risk of CFIT. A pilot's reliance on cockpit instruments, particularly radar altimeters (also known as radio altimeters), combined with an outside visual scan, is imperative during night flight to ensure the flight's safe altitude above terrain.

Accidents Involving Controlled Flight Into Terrain During Low-Altitude Night Flight

The National Transportation Safety Board has investigated two recent HEMS CFIT accidents that involved low-altitude flight during night visual meteorological conditions (VMC) and that revealed safety issues related to the operability and use of radar altimeters. On January 10, 2005, about 2311 eastern standard time, a Eurocopter EC 135 P2 helicopter, N136LN, operated by LifeNet, Inc., crashed into the Potomac River near Oxon Hill, Maryland, after transporting a patient to a hospital.[1] The certificated commercial pilot and the flight paramedic were killed, and the flight nurse received serious injuries. The VFR positioning flight was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91 during night VMC.

[1] For more information, see *Crash into Potomac River, LifeNet, Inc., Eurocopter EC-135 P2, N136LN, Oxon Hill, Maryland, January 10, 2005,* Aviation Accident Brief NTSB/AAB-07/04 (Washington, DC: NTSB, 2007), available on the National Transportation Safety Board's Web site at <http://www.ntsb.gov/publictn/2007/AAB0704.pdf>.

The pilot flew the helicopter southbound over the Potomac River and crossed over the Woodrow Wilson Bridge at a reported Mode C altitude of 200 feet above mean sea level (msl).[2] About that time, an air traffic controller issued a traffic advisory to the pilot, and the pilot acknowledged that the traffic was in sight. The helicopter then entered a gradual, descending right turn and maintained the descending turn for about 14 seconds until it impacted the water. According to the flight nurse, after the helicopter flew over the southern half of the Woodrow Wilson Bridge, the next thing he recalled was being submerged in water with his seatbelt on and his helmet off.

The helicopter's route included low-altitude flight over the river, and the night conditions were dark and moonless. The pilot's southbound flight route over the Potomac River included well-lit shore areas north of the Woodrow Wilson Bridge; however, the areas south of the bridge had low ambient lighting. Other professional pilots, who were familiar with the route, described the area near the accident site as a "black void" because the shoreline there lacked physical lighting. Some of these pilots stated that flying that route at night was like flying into instrument meteorological conditions and that radar altimeters are necessary to ensure altitude awareness.

On the night of the accident, the accident helicopter's radar altimeter was inoperative. The minimum equipment list (MEL) for the helicopter allowed it to be flown with an inoperative radar altimeter with no flight restrictions.[3] The night before the accident, however, the helicopter's radar altimeter was functional, and the accident pilot successfully flew a route nearly identical to the accident route; the helicopter crossed the Woodrow Wilson Bridge at an altitude of about 200 feet msl and then continued southbound over the river.

The Safety Board determined that the probable cause of the accident was the pilot's failure to identify and arrest the helicopter's descent, which resulted in CFIT. Contributing to the accident were the dark night conditions, limited outside visual references, and the lack of an operable radar altimeter in the helicopter.

On April 20, 2004, about 2343 central daylight time, a Bell 206L-1 helicopter, N137AE, operated by Air Evac Life Team, collided with terrain in Boonville, Indiana, while transporting a patient from one hospital to another.[4] The patient was killed, and the pilot, the paramedic, and the nurse were seriously injured. The VFR flight was operated under 14 CFR Part 135 during night VMC.

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[2] A Mode C transponder transmits the helicopter's identification and altitude information in response to interrogation signals received from ground-based radar equipment. Mode C information, if available, provides the helicopter's altitude above msl in 100-foot increments. The elevation of the river in the vicinity of the accident site is about 10 feet above msl.

[3] The MEL permits operations with inoperative items of equipment for the minimum period of time necessary until the equipment is repaired. According to the operator's FAA-approved MEL for the accident helicopter, the helicopter could be dispatched with an inoperative radar altimeter, provided that the radar altimeter was repaired within 10 calendar days, excluding the day the malfunction was recorded in the aircraft maintenance records. The maintenance logbook recovered from the helicopter included an entry made on the date of the accident that recorded the inoperative radar altimeter.

[4] For more information about this accident, see CHI04FA107 at the Safety Board's Web site at <http://www.ntsb.gov/ntsb/query.asp>.

A review of air traffic control audio recordings revealed that, between 2328 and 2339, the pilot made 12 radio transmissions; most of which were attempts to contact an approach controller at a tower facility that had closed at 2300. About 4 minutes after the last attempted transmission, the helicopter collided with up-sloping terrain, in a level attitude, in an area that contained very few ground structures to provide reference lighting. During postaccident interviews, the pilot stated that he remembered picking up the patient and that the next thing he remembered was the helicopter tumbling. The flight nurse and paramedic stated that they did not recall any indication of a problem before impact.

The local altimeter setting that was current for the time and location of the accident flight was 29.77 inches of mercury (Hg). However, examination of the cockpit revealed that the barometric altimeter[5] was set at 30.08 inches of Hg,[6] which resulted in the altimeter indicating about 310 feet higher than the actual altitude of the helicopter. According to the operator's Federal Aviation Administration (FAA)-approved MEL for the helicopter, the radar altimeter was not required equipment for the flight.[7] The pilot who flew the helicopter before the accident flight reported that its radar altimeter was operating erratically. This pilot and the mechanic who maintained the helicopter both stated that the accident pilot was informed of the problem. Bench testing of the radar altimeter after the accident failed to duplicate the reported erratic operation. However, the decision height (DH) "bug"[8] on the radar altimeter was found set to about 60 to 75 feet. At the time of the accident, company policy was to set the DH bug to 500 feet during visual night operations.

The Safety Board determined that the probable cause of the accident was the pilot's inadequate planning/decision, which resulted in his failure to maintain terrain clearance. Contributing factors were the pilot's inadequate preflight planning, his diverted attention, and the dark night conditions.

Previous Safety Recommendation Regarding Radar Altimeters and Other Technology

The Safety Board previously issued a safety recommendation regarding radar altimeters and flat light or whiteout conditions,[9] which are similar to night VMC because these conditions

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[5] The barometric altimeter displays altitude based on static pressure, as measured by the static port on the helicopter. The information displayed on radar altimeters is instantaneous and more accurate than the information provided by barometric altimeters.

[6] The setting observed on the barometric altimeter corresponded with the setting that would have been appropriate for the location and time of a flight that the accident helicopter flew the previous day.

[7] Like the previously mentioned accident helicopter, this helicopter's MEL allowed for radar altimeter repairs to be deferred for 10 calendar days. The mechanic stated that he was first informed of the radar altimeter problems 2 days before the accident.

[8] On a radar altimeter, a bug is a feature that allows the pilot to preselect a reference altitude for the alerter function. For example, the pilot may set a low-altitude (or DH) reference bug so that the alerter function will visually and/or aurally alert the pilot when the helicopter approaches and then descends below the selected altitude.

[9] According to the safety recommendation letter, "flat light is the diffuse lighting that occurs under cloudy skies especially when the ground is snow covered. Under flat light conditions, there are no shadows cast, and the topography of snow-covered surfaces is impossible to judge. Flat light greatly impairs a pilot's ability to perceive depth, distance, altitude, or topographical features when operating under VFR. Whiteout is a similar phenomenon. Under these conditions, pilots may become spatially disoriented, unable to maintain visual reference with the ground, and unaware of their actual altitude."

are also conducive to illusions and other challenges that make it difficult for a pilot to maintain awareness of the aircraft's actual height above terrain. On October 7, 2002, following a series of helicopter CFIT accidents that occurred during flat light or whiteout conditions, the Board issued Safety Recommendation A-02-35, which asked the FAA to do the following:

> 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 its initial response, dated January 7, 2003, the FAA stated that it recognized that a radar altimeter may provide benefits in a whiteout or flat light condition and that it would evaluate the effectiveness and impact of regulatory action to require the equipment. However, in followup correspondence, dated September 6, 2005, the FAA stated that increased safety can be achieved through training on awareness of whiteout and flat light conditions, avoidance of those conditions, and the use of procedures for recovery from inadvertent entry into those conditions. The FAA stated that it would take no further action, and, as a result, on March 3, 2006, the Safety Board urged the FAA to reconsider and classified Safety Recommendation A-02-35 "Open—Unacceptable Response."

However, the FAA's September 6, 2005, letter included some positive indications of the possibility of requiring radar altimeters for HEMS operations. The FAA stated that an aviation rulemaking committee (ARC) discussed "establishing a requirement for ... [radar] altimeters in helicopters and will recommend the installation in aeromedical operations." The FAA also stated that it would solicit comments on whether radar altimeters should be installed in all helicopters conducting commercial passenger-carrying operations when it publishes a notice of proposed rulemaking (NPRM) for revisions to Part 135.

The Safety Board notes, however, that 2 years have passed since the FAA mentioned the ARC's activities with regard to radar altimeters for HEMS operations and that no action has been taken. Further, because the NPRM for the revisions to Part 135 has yet to be published, the FAA has not solicited comments about potential requirements for radar altimeters on commercial passenger-carrying helicopters.

The Safety Board also previously issued a safety recommendation related to other technology that might help avoid CFIT accidents. In its 2006 Special Investigation Report (SIR) on emergency medical services (EMS) operations,[10] the Board acknowledged the FAA's positive comments about radar altimeters and stated that other technology, such as terrain awareness and warning systems (TAWS),[11] could also help pilots of EMS aircraft (both helicopter and fixed-wing) avoid CFIT accidents. On February 7, 2006, the Board issued Safety Recommendation A-06-15, which asked the FAA to do the following:

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[10] National Transportation Safety Board, *Emergency Medical Services Operations*, Special Investigation Report NTSB/SIR-06/01 (Washington, DC: NTSB, 2006).

[11] Although similar in purpose, TAWS functionality is different from that of a radar altimeter. A radar altimeter uses the reflection of radio waves from the ground to determine the height of an aircraft above the surface. TAWS assists the pilot in terrain avoidance by "looking ahead" of the aircraft and providing the pilot terrain information, alerts, and other features through the combined use of radar altitude, airspeed, global positioning system data, terrain memory data, and other criteria.

> 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.

Because the Safety Board issued this recommendation for TAWS installations (some of which, particularly for helicopters, incorporate a radar altimeter component), it did not issue a separate recommendation for radar altimeters. In response, the FAA indicated that, before it could require that HEMS be equipped with TAWS, a technical standard order (TSO) was needed to specify an acceptable TAWS for helicopters. The FAA has asked an industry group to develop a specification that will form the basis for such a TSO. On the basis of the FAA's efforts and pending the FAA's issuance of a TSO and a requirement mandating the installation and use of TAWS in all EMS flights, the Board classified Safety Recommendation A-06-15 "Open—Acceptable Response" on April 3, 2007.

The Safety Board commends the FAA's efforts in response to this safety recommendation; however, the Board also recognizes that operational performance standards for helicopter TAWS and a TSO based on these standards will take time to develop, whereas radar altimeters are an available proven technology for helicopter installations.

Safety Benefits of Radar Altimeters for Low-Level Night Flight

Although the primary use of the radar altimeter is to set the DH bug during an instrument approach, the radar altimeter can also be used to increase altitude awareness to help prevent a pilot from inadvertently descending the helicopter below a set height during hovering operations and low-altitude cruise flight. The two previously described HEMS accidents demonstrate that radar altimeters are needed to maintain ground clearance when visual references to terrain are limited during night conditions. During low-altitude flight, a functioning radar altimeter provides a pilot with constant information about the helicopter's height above ground level (agl) and has an alerter function that can visually and/or aurally alert a pilot when the helicopter approaches and then descends below a preselected altitude (such as 500 feet agl for night VFR cruise flight or the DH during instrument approaches). This information is valuable when combined with position information, terrain elevation, and obstacle information and can enhance a pilot's situational awareness.[12]

As stated previously, the FAA has advocated the use of radar altimeters during HEMS night operations. On September 27, 2005, the FAA issued Notice N8000.307, "Special Emphasis Inspection Program for [HEMS]" to provide guidance for aviation safety inspectors to emphasize pilot and flight crew knowledge of all installed aircraft equipment, including communications, navigation, and any special equipment, such as radar altimeters. Further, in January 2006, the FAA issued Notice N8000.293, "[HEMS] Operations," to provide guidance for principal inspectors regarding HEMS operators for whom they have oversight responsibilities. The notice recognized that a significant number of HEMS accidents were attributed to CFIT and night

[12] U.S. Department of Transportation, Federal Aviation Administration, *Helicopter Emergency Medical Services (HEMS) Loss of Control (LOC) and Controlled Flight into Terrain (CFIT) Avoidance Programs*, Flight Standards Handbook Bulletin for Air Transportation (HBAT) 06-02A (Washington, DC: FAA, 2006).

operations and that FAA principal inspectors should encourage HEMS operators to "emphasize the use of a radar altimeter for night operations" as a means to help mitigate accident risk factors.

Although the FAA recognizes the safety benefits of radar altimeters, the Safety Board notes that the FAA does not require their installation for HEMS operations and that HEMS operators' FAA-approved MELs can allow for inoperative radar altimeters.[13] For example, the two previously referenced accident helicopters were flying with inoperative or erratically operative radar altimeters in accordance with their respective MELs. These accidents likely could have been prevented if the helicopters' radar altimeters were operative and used by the pilots as tools to avoid CFIT. Because of the complexity of flying in night conditions, radar altimeters can provide invaluable and potentially life-saving information to flight crews, particularly when they are flying at low altitudes.

On the basis of estimates provided by FAA and industry personnel, a large percentage of helicopters used in HEMS operations currently have radar altimeters installed.[14] However, the Safety Board is concerned that some HEMS helicopters might not be equipped with radar altimeters and that, if so equipped, they are not required to be operable under the operators' MELs. The Safety Board concludes that radar altimeters enhance the safety of HEMS operations and that the use and operability of radar altimeters is crucial in maintaining spatial orientation and safe height above the ground during night operations. Therefore, the Safety Board believes that the FAA should require HEMS operators to install radar altimeters in all helicopters used in HEMS night operations. Further, the Safety Board believes that the FAA should ensure that the MELs for helicopters used in HEMS operations require that radar altimeters be operable during flights conducted at night.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration should:

> Require helicopter emergency medical services (HEMS) operators to install radar altimeters in all helicopters used in HEMS night operations. (A-07-111)
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> Ensure that the minimum equipment lists for helicopters used in helicopter emergency medical services operations require that radar altimeters be operable during flights conducted at night. (A-07-112)

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[13] In contrast, the United Kingdom's Civil Aviation Authority (CAA) has required radar altimeters in public transport helicopters since 1985. Also, on January 24, 2002, the CAA issued airworthiness information leaflet (AIL) AIL/0114, "Radio Altimeters for Helicopters," that discussed the requirement for radar altimeters for all flights of more than 3 minutes over water. AIL/0114 was subsequently incorporated into the CAA's CAP562, *Civil Aircraft Airworthiness and Inspection Procedures*, "Leaflet 11-35, Radio Altimeters for Helicopters."

[14] During the Safety Board's investigation of the January 10, 2005, accident in Oxon Hill, FAA inspectors from the local flight standards district office and headquarters indicated to Board investigators that many HEMS operators used helicopters that were already equipped with radar altimeters and that the numbers were increasing. However, the FAA did not have data for what percentage of HEMS helicopters was so equipped. Subsequently, a representative of the Association of Air Medical Services (AAMS), a voluntary, nonprofit organization, indicated to a Board investigator that more than half of its members used helicopters equipped with radar altimeters. However, because AAMS membership is not mandatory, these data may not be reflective of the industry as a whole.

In your response to this letter, please refer to Safety Recommendations A-07-111 and -112. If you need additional information, you may call (202) 314-6177.

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred with these recommendations. Member Higgins filed a concurring statement, which is attached to the Aircraft Accident Brief for this accident.

[*Original Signed*]

By: Mark V. Rosenker
Chairman