National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 24, 2006

In reply refer to: A-06-19 through -23

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, DC 20591

On March 23, 2004, about 1918:34 central standard time, an Era Aviation Sikorsky S-76A++ helicopter, N579EH, crashed into the Gulf of Mexico about 70 nautical miles (nm) south-southeast of Scholes International Airport (GLS), Galveston, Texas. The helicopter was transporting eight oil service personnel to the Transocean, Inc., drilling ship *Discoverer Spirit*, which was en route to a location about 180 miles south-southeast of GLS. The captain, copilot, and eight passengers aboard the helicopter were killed, and the helicopter was destroyed by impact forces. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 135 on a visual flight rules flight plan. Night visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determined that the probable cause of this accident was the flight crew's failure to identify and arrest the helicopter's descent for undetermined reasons, which resulted in controlled flight into terrain (CFIT).[1]

Cockpit Systems

<u>Terrain Awareness and Warning System</u>

A terrain awareness and warning system (TAWS) has the ability to look ahead of an aircraft to detect the terrain or other obstructions along a flightpath. However, none of the S-76A helicopters in Era Aviation's fleet were equipped with a TAWS or were required to be so equipped.

At the time of the Federal Aviation Administration's (FAA) March 2000 final rule requiring that a TAWS be installed aboard all turbine-powered airplanes configured with six or more passenger seats, TAWS technology had not been specifically developed for the unique flightpaths of rotorcraft compared with fixed-wing aircraft (that is, lower altitudes and the ability

[1] For more information, see *Controlled Flight Into Terrain, Era Aviation, Sikorsky S-76A++, N579EH, Gulf of Mexico, About 70 Nautical Miles South-Southeast of Scholes International Airport, Galveston, Texas, March 23, 2004*, Aircraft Accident Report NTSB/AAR-06/02 (Washington, DC: NTSB, 2006).

to land at off-airport sites). Thus, the installation of TAWS aboard helicopters at that time would have likely resulted in numerous false warnings; systems with this tendency typically prompt a lack of operator trust and result in the failure to respond to the systems' warnings. However, TAWS technology is now available for helicopters,[2] and this technology can include warnings for terrain, obstacles, landing gear, excessive bank and sink rates, tail low attitudes, and below glideslope (on an instrument approach).

A simulation by the manufacturer of TAWS for helicopters showed that, if a TAWS had been installed aboard the accident helicopter and the helicopter were descending toward the water at a rate of 150 feet per minute (fpm), the "caution terrain" alert would have occurred 97 seconds before impact at an altitude of about 240 feet, along with a water indication that changed from blue to yellow on the system's forward-looking terrain awareness display. The simulation also showed that the "warning terrain" alert would have occurred 84 seconds before impact at an altitude of about 210 feet, along with a water indication that changed from yellow to red on the forward-looking terrain awareness display. If the helicopter were descending toward the water at a rate of 250 fpm, the caution terrain alert would have occurred 68 seconds before impact at an altitude of about 270 feet, and the warning terrain alert would have occurred 55 seconds before impact at an altitude of about 215 feet (along with the water indication color changes on the forward-looking terrain awareness display).

The Safety Board concludes that, if a TAWS had been installed aboard the accident helicopter, the system's aural and visual warnings should have provided the flight crew with ample time to recognize that the helicopter was descending toward the water, initiate the necessary corrective actions, and recover from the descent. Therefore, the Safety Board believes that the FAA should require all existing and new U.S.-registered turbine-powered rotorcraft certificated for six or more passenger seats to be equipped with a TAWS.

As part of its special investigation report on emergency medical services (EMS) aircraft accidents, the Safety Board issued Safety Recommendation A-06-15, which asked the FAA to require EMS operators to install TAWS on their aircraft.[3] It is important to provide the same level of safety for other helicopter operations, including the transportation of oil service personnel to and from offshore platforms.

Dual Digital Automatic Flight Control System

The accident helicopter was equipped with a Honeywell SPZ-7000 Dual Digital Automatic Flight Control System (DDAFCS). Although the Safety Board found no evidence to indicate that the SPZ-7000 contributed to this accident, the Board noted three characteristics about this flight control system that have safety-of-flight implications if pilots are not familiar with the system.

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[2] For example, Honeywell's Mark XXII enhanced ground proximity warning system, which was certified in 2001, contains an obstacle database that includes locations of more than 5,000 oil platforms and structures in the Gulf of Mexico. Also, during its visit to Petroleum Helicopters, the Safety Board learned that the company equipped its helicopters with TAWS upon customer request.

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

First, the SPZ-7000 does not provide an indication on the attitude direction indicators (ADI) showing which flight director (FD1 or FD2) has been engaged. The SPZ-7000 has two independent flight control computers; one computer provides commands to the autopilot and flight director at the pilot's station, and the other computer provides commands to the autopilot and flight director at the copilot's station (referred to as a split cockpit). Thus, it is possible for the pilot and copilot ADIs to simultaneously present a different set of pitch and roll command cues.[4] This situation can be beneficial if the nonflying pilot wants to program the flight director in advance of the subsequent phase of flight. However, only one pilot station can be coupled at a time, and a lack of pilot awareness regarding which set of command cues are coupled to the autopilot can lead to automation mode confusion.[5]

Two indications in the cockpit provide the pilot with direct feedback regarding the flight director status: the FD1/2 button on the autopilot controller on the center pedestal, which shows the flight director that has been engaged, and the copilot flight director (CPLT FD) light, which illuminates on the caution/advisory panel on the center of the front instrument panel when FD1 is selected. No similar light illuminates when FD2 is selected, and the only indication in front of the pilots that FD2 is selected is the absence of illumination of the CPLT FD light. Neither the FD1/2 button nor the CPLT FD light is located near either pilot's ADI or the flight director mode selector, where other indications regarding flight director mode selections are presented.

Second, the SPZ-7000 does not annunciate the coupling status on the front instrument panel and does not provide an aural alert when the autopilot and flight director have become decoupled. As a result, the only direct indication of the coupling status is the illumination, or absence of illumination, of the couple light on the autopilot controller on the center pedestal.

Although indirect indications of the flight director source and coupling status can be determined through monitoring cockpit instrumentation, the possibility of automation mode confusion increases when pilots are required to search multiple locations for information pertaining to the same system.[6] Displays for many newer flight control systems, including those used on the Sikorsky S-92 and Agusta AB-139 helicopters, annunciate the flight director source and the coupling status directly on the ADIs.

Third, when only one flight director mode (either pitch or roll) is selected, both pitch and roll command cues appear simultaneously on the SPZ-7000, but no annunciation appears on the ADIs regarding the source of guidance for the unselected command cue. Because the SPZ-7000 allows for independent engagement of flight director mode selections (referred to as split-axis engagement), the system can be coupled to the longitudinal (pitch), lateral (roll), and vertical axes individually, two at a time, or all three simultaneously. The ability to engage only one or

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[4] In contrast, many of the flight control systems currently in use in transport-category fixed-wing aircraft have dual but dependent flight control computers. In such systems, only one set of commands guides flight director command cues, which are presented simultaneously for both pilot stations.

[5] Automation mode confusion is a lack of awareness of the current mode of an automated system. It can result from inadequate feedback about the automated system's actions and intentions.

[6] R. Parasuraman and V. Riley, "Humans and Automation: Use, Misuse, Disuse, Abuse," *Human Factors*, Vol. 39, No. 2 (1997): 230-253.

two axes, instead of all three, can be beneficial in certain circumstances, such as search and rescue, when a pilot may engage a roll function on the flight director mode selector (such as heading) but need to make pitch control inputs to maintain a certain height above varying terrain. However, the simultaneous presentation of command cues for both selected and unselected axes allows for the possibility of pilot misinterpretation of the command cue for the unselected axis. Specifically, a pilot may be unaware that a flight director mode has not been selected for both axes (because of the presence of two command cues)[7] and thus not realize that the command cue for the unselected axis is not synchronized to a selected pitch or roll function.

Even if a pilot were aware that a flight director mode had not been selected for both axes, the lack of an annunciation on the ADIs regarding the source of guidance for the unselected axis might also result in pilot misinterpretation of the command cue. The source of guidance for an unselected command cue varies between flight control system models and may or may not be synchronized to the helicopter's attitude. For the SPZ-7000, the command cue for an unselected axis is synchronized to the helicopter's attitude. As a result, the command cue for the unselected axis will indicate a deviation from attitude rather than a deviation from altitude (when a flight director roll function is selected) and heading (when a flight director pitch function is selected).

Some of the FAA's observations of the SPZ-7000 DDFACS[8] were consistent with those made by the Safety Board. Specifically, the FAA found that (1) no aural or visual annunciations occurred for a pilot-induced decouple, (2) the only cues that the flight director was not coupled on the selected side were the lack of flight director mode selections and the lack of flight director mode annunciations on the ADIs, (3) both pitch and roll command cues were displayed when only one axis was selected, and (4) the decoupling indications were not particularly compelling.

Although the SPZ-7000 is no longer in production, it is still in use on numerous helicopters.[9] The SPZ-7000's successor is the SPZ-7600, which is installed in S-76C helicopters.[10] Although the SPZ-7600 has many of the same components and operations as the SPZ-7000, the SPZ-7600 has key differences regarding coupling status annunciation, which promotes pilot mode awareness. For example, although the SPZ-7000 and the SPZ-7600 both have a decouple (DCPL) warning indicator on the digital automatic flight control system caution panels (which are in direct view of the pilots and are next to the ADIs) to indicate when the autopilot and flight director have become decoupled, the SPZ-7000 DCPL warning indicators illuminate only during abnormal operations, whereas the SPZ-7600's DCPL warning indicators illuminate during both normal and abnormal operations. Also, although both the SPZ-7000 and

[7] Pitch and roll command cues are displayed in either a dual- or a single-cue format. For the dual-cue format, pitch attitude is represented by a horizontal command bar, and roll attitude is represented by a vertical command bar. For the single-cue format, pitch and roll guidance is integrated into angular bars in the shape of a chevron.

[8] As a result of the Safety Board's investigation of this accident and to ensure the safety of the S-76 fleet, the FAA evaluated the SPZ-7000 DDAFCS to determine whether "hazardously misleading" flight director data were being presented on electronic flight instrument system displays. The evaluation was conducted during February 2005 in an S-76A simulator and helicopter that were similarly configured to the accident helicopter. The FAA provided notes about its evaluation to the Board.

[9] According to a Honeywell official, more than 300 SPZ-7000s were manufactured.

[10] A Honeywell official stated that more than 850 SPZ-7600s have been manufactured to date.

the SPZ-7600 are not manufactured with an aural alert to indicate system decoupling, operators of helicopters that are equipped with the SPZ-7600 can install an after-market product that provides this alert to the pilots' headsets, the cabin, or both.

The SPZ-7600 also has a key difference regarding command cue guidance for the dual-cue format. With the SPZ-7000, both command cues appear simultaneously when only one axis is engaged. However, with the SPZ-7600 dual-cue format, the command cue for only the selected axis will appear on the pilots' ADIs. Specifically, if a flight director roll function, such as heading, is selected and no flight director pitch function is engaged, only the vertical command bar (roll attitude) will appear. Likewise, if a flight director pitch function, such as altitude, is selected and no flight director roll function is engaged, only the horizontal command bar (pitch attitude) will appear. Thus, with the SPZ-7600 dual-cue format, pilots cannot misinterpret command cue guidance for the unselected axis, which also promotes pilot mode awareness.

Despite the improvements present in the SPZ-7600 (compared with the SPZ-7000), two issues exist with the single-cue format for that system. One issue is that the guidance for the unselected axis is still presented without annunciation. As a result, pilots could still misinterpret the status of the command cue for the unselected axis when using the SPZ-7600 single-cue format. The other issue is that the command cue for the unselected axis for the SPZ-7600 is not synchronized to attitude (as with the SPZ-7000); instead, the single-cue format symbol maintains a centered or neutral position regardless of pilot input. Thus, pilots may mistake a centered (pitch attitude) or neutral (roll attitude) command cue as feedback that the aircraft is either on a commanded flightpath or is synchronized to attitude (as with the SPZ-7000).[11]

Pilot mode awareness is a critical aspect associated with reducing errors from the use of automated flight control systems.[12] During postaccident interviews, Era Aviation pilots (including the chief pilot and director of training) were not able to fully explain the flight director and coupling status annunciations and command cue presentations associated with the SPZ-7000 and SPZ-7600.[13] Additional training on these systems could help improve pilot understanding of the systems' capabilities, which is especially critical for pilots who operate both the SPZ-7000 and SPZ-7600. The Safety Board concludes that additional pilot training on the SPZ-7000 and SPZ-7600 DDAFCSs would promote automation mode awareness for pilots operating helicopters equipped with these systems. Therefore, the Safety Board believes that the FAA should ensure that all operators of helicopters equipped with either the SPZ-7000 or SPZ-7600 DDAFCSs provide training that includes information on flight director and coupling status

[11] Displays for some newer flight control systems annunciate the source of guidance for the unselected axis (for example, "ROLL" or "PTCH") when the unselected axis is synchronized to attitude.

[12] U.S. Department of Transportation, Federal Aviation Administration, *Report on the Interfaces Between Flightcrews and Modern Flight Deck Systems* (Washington, DC: FAA, 1996).

[13] Era Aviation's simulator coordinator (who was also an S-76A check airman) stated that, before the accident, coupling indications and related issues were not a focus of the DDAFCS portion of ground or simulator flight training. He also stated that, after the accident, Era Aviation focused the DDFACS portion of the training on improving a pilot's situational awareness regarding the system and decreasing the possibility of confusion between pilots.

annunciations; the command cue presentations when only the pitch or the roll mode is engaged; and, if applicable, the differences between the SPZ-7000 and the SPZ-7600.

Tracking of Gulf of Mexico Helicopter Flights

The FAA cannot currently provide flight-tracking services for low-flying aircraft in the Gulf of Mexico beyond the capabilities of existing FAA land-based radar sites. For example, during the accident flight, radar data were available until the helicopter was about 58 nm southeast of the Houston airport surveillance radar-9 radar site, which provides maximum radar coverage of about 60 nm. The helicopter flew for another 18 minutes, traveling an additional 35 nm to the southeast, but no radar data were available for that portion of the flight. In addition to the lack of radar data for low-flying aircraft in the Gulf of Mexico, only helicopter dispatchers are aware of the status of their respective company's flights because there is no direct communication between pilots of such aircraft and air traffic controllers.[14]

The FAA's Safe Flight 21 Gulf of Mexico initiative was developed to determine whether automatic dependent surveillance–broadcast (ADS-B) technology would be effective in providing pilots with navigation, air traffic, terrain, and weather information in the cockpit and enabling air traffic controllers and operators to provide surveillance (including position and altitude) of low-flying aircraft in those areas with limited or no radar coverage. The ADS-B infrastructure included ground-based transceivers, weather sensors, and communications outlets that would be used along with ADS-B monitors installed by operators on aircraft that fly in the Gulf of Mexico.

ADS-B technology had already been successfully deployed in Alaska as part of the Safe Flight 21 Capstone program. The FAA's Capstone Web site indicated that, according to a 2004 safety study by the University of Alaska, the accident rate for aircraft under the Capstone program had decreased by 47 percent from 2000 to 2004. Also, according to a 2003 safety study contracted by the Capstone program,[15] the ADS-B technology used in the Capstone program would have been effective in preventing about 80 percent of the en route CFIT accidents that occurred in southwest Alaska (the Phase I Capstone area) between 1990 and 1999.[16]

The Capstone program and the Safe Flight 21 Gulf of Mexico initiative were both intended to benefit pilots of low-flying aircraft in areas of limited radar coverage. The third and final phase of the Capstone program is currently being developed with funding for site surveys (but not for construction of the sites). However, in November 2005, the FAA indicated that

[14] For some helicopter operators, the status of their company's flights is transmitted only intermittently (as with Era Aviation, whose pilots provide dispatchers with position reports every 15 minutes.) As a result, no continuous flight tracking is provided for such flights.

[15] University of Alaska Anchorage, *Capstone Phase I Interim Safety Study, 2002* (Anchorage, Alaska: University of Alaska, 2003).

[16] According to the study, the ADS-B technology should prevent en route CFIT accidents by providing the pilot with information about the aircraft's proximity to high ground. Specifically, the technology compares information about nearby terrain (stored in an on-board database) with the aircraft's altitude and global positioning system location and then presents the information on a cockpit display. Terrain that is 500 feet or less below the aircraft is shown in yellow, and terrain that is level with or higher than the aircraft is shown in red.

implementation of the Safe Flight 21 Gulf of Mexico initiative would not begin until fiscal year 2013. As a result, helicopter pilots transporting oil service personnel to and from offshore platforms would not be afforded the same level of safety as general aviation pilots operating in Alaska.

ADS-B technology has many potential benefits for flight operations in the Gulf of Mexico. For example, if the ADS-B infrastructure had been operational in the Gulf of Mexico at the time of the accident, (1) the Era Aviation dispatcher would have had better flight-tracking and communication capabilities and thus could have monitored the accident helicopter's flightpath and provided an alert to the flight crew about the descent and (2) the pilots would have received a warning in the cockpit about the descent. Also, ADS-B technology has many potential benefits for search and rescue operations in the Gulf of Mexico. For example, in September 2005, a Houston Helicopters S-76A helicopter was ditched in the Gulf of Mexico after an in-flight fire.[17] The 2 pilots and 10 passengers escaped from the helicopter but remained in the water for about 7 hours until they were located by U.S. Coast Guard personnel using night vision goggles.[18] ADS-B technology would have facilitated the search and expedited the rescue of the helicopter occupants. In addition, ADS-B technology would benefit accident investigations because information on an aircraft's airspeed, altitude, and position (that is, whether the aircraft was turning, climbing, or descending) would be available to investigators.

In January 2006, the FAA announced that the Safe Flight 21 program was being transitioned to the National ADS-B Program. At that time, the FAA proposed fiscal year 2007 for the start date for implementation of the program and fiscal year 2010 as the target date for completion of the first segment of ADS-B infrastructure deployment. On March 1, 2006, the FAA informed the Safety Board verbally that the Gulf of Mexico would be among those areas in the first segment of ADS-B infrastructure deployment; however, this information has not been confirmed.

It is critical that the milestones for the National ADS-B Program in the Gulf of Mexico are achieved on or ahead of time and that the fiscal year 2010 completion date for ADS-B deployment in the Gulf of Mexico not slip. This matter is especially important given the number of passengers and flights in the region (in 2004, more than 2.3 million passengers were transported aboard 1.3 million flights) and the inherent risks of offshore helicopter operations, as indicated by the FAA's Aeronautical Information Manual, section 10-2-1, "Offshore Helicopter Operations," which states the following:

> The offshore environment offers unique applications and challenges for helicopter

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[17] For more information about this accident, see DFW05MA230 at the Safety Board's Web site at <http://www.ntsb.gov>.

[18] The pilot of the helicopter declared "MAYDAY" but did not provide position information. Pilots of several aircraft in the area overheard the emergency distress call and immediately notified various FAA facilities of the situation. A ground search for the helicopter was then conducted based on the reported locations of the aircraft that had overheard the emergency distress call. After the helicopter was overdue at its destination by more than 2 hours, the company coordinated with the FAA and the Coast Guard to determine the helicopter's likely location, and the Coast Guard then began its search for the helicopter. Because of damage to the communication infrastructure from Hurricane Katrina, company and FAA communications were not available for the flight.

> pilots. The mission demands, the nature of oil and gas exploration and production facilities, and the flight environment (weather, terrain, obstacles, traffic), demand special practices, techniques and procedures not found in other flight operations.

Because of the limited radar services in the Gulf of Mexico, some helicopter operators, including Era Aviation, PHI, and Air Logistics, have purchased flight-tracking systems from commercial vendors. These commercial systems allow dispatchers to track aircraft in flight and the weather along the flightpath and to relay text messages to company pilots (and vice versa). Thus, as with ADS-B technology, a commercial flight-tracking system could have provided the Era Aviation dispatcher with information about the accident helicopter's descending altitude, which she could have communicated to the flight crew. However, the ADS-B technology would offer an additional level of safety for pilots flying at low altitudes in the Gulf of Mexico by providing them with navigation, air traffic, terrain, and weather information in the cockpit.

The Safety Board concludes that the National ADS-B Program technology would help Gulf of Mexico aircraft operators mitigate the inherent risks associated with offshore operations by providing pilots with terrain, weather, and other flight information in the cockpit and dispatchers with current location information. Therefore, the Safety Board believes that the FAA should ensure that the infrastructure for the National ADS-B Program in the Gulf of Mexico is operational by fiscal year 2010. The Safety Board further believes that, until the infrastructure for the National ADS-B Program in the Gulf of Mexico is fully operational, the FAA should require principal operations inspectors of Gulf of Mexico aircraft operators to inform the operators about the benefits of commercial flight-tracking systems and encourage the operators to acquire such systems.

Lack of Adequate Cockpit Voice Recorder Information for This Investigation

The accident helicopter was equipped with a cockpit voice recorder (CVR) that had been improperly installed. Specifically, the helicopter's CVR installation required that white notched switches (within the internal communications system units for the pilot and copilot stations) be set to the bottom position, but the switches were found set to the top position. The failure to set the switches to the correct position resulted in a lack of audio input to those CVR channels. The functional check of the CVR after installation did not detect the faulty installation.

The cockpit area microphone (CAM) was the only source of audio information recorded for the accident flight. However, because of the high noise level within the helicopter cockpit, the flight crew's conversation was mostly unintelligible. The lack of audio information significantly hindered the investigation of this accident.

On August 29, 2002, the Safety Board issued Safety Recommendation A-02-25, which asked that the FAA require operators to implement daily CVR test procedures to prevent the lack of CVR data after aviation accidents and incidents. On March 5, 2004, the Safety Board reiterated Safety Recommendation A-02-25 as a result of its investigation of the January 2003

Air Midwest Beech 1900D accident in Charlotte, North Carolina.[19] The Board's investigation of that accident found that the captain's and the copilot's audio information captured from the airplane's very high frequency radio systems was fair to poor quality.

In its response to Safety Recommendation A-02-25, the FAA stated that it issued Notice N8000.292, "Clarification of Recommendations for Cockpit Voice Recorder Testing," for operators of those airplanes equipped with CVRs that could be tested before the first flight of the day. The FAA indicated that the intent of the notice was to persuade the operators to configure the CVRs during future major maintenance cycles so that flight crews would be able to test them. The FAA also stated that it made a change to chapter 143, "Monitor Cockpit Voice Recorders," of FAA Order 8300.10, *Airworthiness Inspector's Handbook*. According to the FAA, the change tasked airworthiness aviation safety inspectors to evaluate maintenance programs that require maintenance technicians to perform a thorough test of the CVR at appropriate intervals. The Safety Board classified Safety Recommendation A-02-25 "Open—Acceptable Response" pending a permanent change to the FAA's operational requirements to ensure that a CVR functional test would be performed before the first flight of each day.

Although daily preflight testing of the CVR should catch most problems encountered with poor-quality audio recordings, a review of the actual audio recorded by the CVR would ensure that the entire CVR system (including the microphones, audio/communications panels, wiring, and CVR itself) was working properly. Such a review would reveal any problems with audio quality, CVR malfunction, or lack of audio signals to the CVR. The Safety Board recognizes that a review of downloaded audio data would not be feasible on a daily preflight basis, but this review could easily be accomplished periodically during a routine maintenance check of an aircraft.

A periodic maintenance check of a CVR could be similar to the periodic maintenance check that is performed on a flight data recorder (FDR), during which the FDR is downloaded and the data are analyzed to ensure that the required parameters are being recorded correctly. The FDR maintenance check is currently being accomplished with minimal impact on the amount of time that the recorder is removed from the aircraft. With the advent of solid-state recorders, the download can be accomplished without the operator having to perform any maintenance to the recorder to comply with the download requirement.

The Safety Board concludes that preflight testing and maintenance checks of an aircraft's CVR are both necessary to ensure that audio data from CVR recordings are adequate. Therefore, the Safety Board believes that the FAA should require all operators of aircraft equipped with a CVR to (1) test the functionality of the CVR before the first flight of each day as part of an approved aircraft checklist and (2) perform a periodic maintenance check of the CVR as part of an approved maintenance check of the aircraft. The CVR preflight test should be performed according to procedures provided by the CVR manufacturer and should include listening to the recorded signals on each channel to verify that the audio is being recorded properly, is

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[19] For more information, see National Transportation Safety Board, *Loss of Pitch Control During Takeoff, Air Midwest Flight 5481, Raytheon (Beechcraft) 1900D, N233YV, Charlotte North Carolina, January 8, 2003*, Aircraft Accident Report NTSB/AAR-04/01 (Washington, DC: NTSB, 2004).

intelligible, and is free from electrical noise or other interference. The periodic maintenance check of the CVR should include an audio test followed by a download and review of each channel of recorded audio. The downloaded recording should be checked for overall audio quality, CVR functionality, and intelligibility.

In addition, the FAA's actions in response to Safety Recommendation A-02-25—the issuance of Notice N8000.292 and the change to FAA Order 8300.10—are not adequate to ensure that a CVR, once installed, will operate as required because the CVR test detailed in the notice and the order might not contain sufficient instructions to detect all faulty recordings. For example, although the preflight test recommended in Safety Recommendation A-02-25 might have been sufficient to discover the problem with the CVR installed on the Air Midwest accident airplane, the preflight test would not have discovered the faulty CVR installed on the Era Aviation accident helicopter. Therefore, the Safety Board classifies Safety Recommendation A-02-25 "Closed—Superseded" as a result of the issuance of Safety Recommendation A-06-23.

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

> Require all existing and new U.S.-registered turbine-powered rotorcraft certificated for six or more passenger seats to be equipped with a terrain awareness and warning system. (A-06-19)
>
> Ensure that all operators of helicopters equipped with either the SPZ-7000 or SPZ-7600 dual digital automatic flight control systems provide training that includes information on flight director and coupling status annunciations; the command cue presentations when only the pitch or the roll mode is engaged; and, if applicable, the differences between the SPZ-7000 and the SPZ-7600. (A-06-20)
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> Ensure that the infrastructure for the National Automatic Dependent Surveillance–Broadcast Program in the Gulf of Mexico is operational by fiscal year 2010. (A-06-21)
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> Until the infrastructure for the National Automatic Dependent Surveillance–Broadcast Program in the Gulf of Mexico is fully operational, require principal operations inspectors of Gulf of Mexico aircraft operators to inform the operators about the benefits of commercial flight-tracking systems and encourage the operators to acquire such systems. (A-06-22)
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> Require all operators of aircraft equipped with a cockpit voice recorder (CVR) to (1) test the functionality of the CVR before the first flight of each day as part of an approved aircraft checklist and (2) perform a periodic maintenance check of the CVR as part of an approved maintenance check of the aircraft. The CVR preflight test should be performed according to procedures provided by the CVR manufacturer and should include listening to the recorded signals on each channel to verify that the audio is being recorded properly, is intelligible, and is free from

electrical noise or other interference. The periodic maintenance check of the CVR should include an audio test followed by a download and review of each channel of recorded audio. The downloaded recording should be checked for overall audio quality, CVR functionality, and intelligibility. (A-06-23)

In addition, the following previously issued recommendation (previously classified "Open—Acceptable Response") is classified "Closed—Superseded" as a result of the issuance of Safety Recommendation A-06-23:

> Require that all operators of airplanes equipped with a cockpit voice recorder (CVR) test the functionality of the CVR system prior to the first flight of each day, as part of an approved aircraft checklist. This test must be conducted according to procedures provided by the CVR manufacturer and shall include, at a minimum, listening to the recorded signals on each channel to verify that the audio is being recorded properly, is intelligible, and is free from electrical noise or other interference. (A-02-25)

Acting Chairman ROSENKER and Members ENGLEMAN CONNERS, HERSMAN, and HIGGINS concurred in these recommendations.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman

Safety Recommendation Reiteration List

SR Number	Reiteration Number	Report Number	Report Date	Accident Description	Accident City	Accident State	Accident Date
A-06-023	1	AAR-09-05	7/28/2009	Crash of Cessna 500, N113SH, Following an In-Flight Collision with Large Birds	Oklahoma City	OK	3/4/2008