Air Methods®

DEFENDERS OF TOMORROW™

Accident Investigation Submission
NTSB Accident File: CEN15MA290

Operator: Air Methods Corporation

Model: AS350 B3e
Aircraft: N390LG

Date of Accident: July 3, 2015

Location of Accident: Frisco, Colorado

Report Date: September 15, 2016

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Table of Contents

Acronyms and Abbreviations

AAIP	Approved Aircraft Inspection Program
AD	Airworthiness Directive
AGL	Above Ground Level
AMC	Air Methods Corporation
CFR	Code of Federal Regulations
CRFS	Crash Resistant Fuel System
CWP	Caution and Warning Panel
EMS	Emergency Medical Services
FAA	Federal Aviation Administration
FARs	Federal Aviation Regulations
FOQA	Flight Operational Quality Assurance
FTD	Flight Training Device
GPS	Global Positioning System
HAA	Helicopter Air Ambulance
HIGE	Hover in Ground Effect
MEL	Minimum Equipment List
MOD	Modification
NTSB	National Transportation Safety Board
LOSA	Line Operations Safety Audit
OCC	Operational Control Center
SB	Service Bulletin
SIN	Safety Information Notice
PIC	Pilot In Command

VFR	Visual Flight Rules

1. INTRODUCTION

On July 3, 2015, at 1339 mountain daylight time, an Airbus Helicopters AS350 B3e helicopter, N390LG, operated by Air Methods Corporation (Air Methods), departed the Summit Medical Center helipad (91CO) in Frisco, Colorado for a public relations mission at the Boy Scouts of America's Spirit of Adventure Ranch in Gypsum, Colorado. The flight was conducted under the provisions of 14 Code of Federal Regulations Part 135 pursuant to an Air Methods' company flight plan. Day visual meteorological conditions prevailed. The aircraft subsequently impacted the upper west parking lot 360 feet southwest of the Summit Medical Center helipad (91CO) and a recreational vehicle located in the parking lot. A post crash fire ensued. The pilot was fatally injured and the two flight nurses onboard were seriously injured.[1]

Multiple witnesses observed the helicopter lift off, rotate counterclockwise and climb simultaneously.[2] Surveillance video which captured the initial liftoff showed the helicopter yaw to the left simultaneous to lifting off of the helipad.[3] The helicopter continued to spin counterclockwise several times before impacting the hood of a recreational vehicle and then the parking lot.[4] After impact, the helicopter came to rest on its right side oriented on a magnetic heading of 60°. Surveillance videos capturing the ground impact showed fuel flowing from the wreckage and the onset of a post crash fire shortly thereafter. The helicopter sustained substantial damage upon impact and was mostly consumed by the post crash fire.

Air Methods concluded the following regarding the loss of the pilot and the injuries to the flight nurses:

- The impact was survivable.
- The post-crash fire resulted in severe thermal injuries to the pilot and a flight nurse.

Air Methods proposes the following as the probable cause of the accident:

The probable cause of this accident was the loss of tail rotor control of the accident helicopter during takeoff. The cause of the loss of tail rotor control could not be determined based on available information and evidence.

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[1] Consistent with the definition of "serious injury" contained in NTSB Part 830.

[2] Based on available video surveillance footage, the NTSB estimates that the helicopter climb rate shortly after takeoff was 5.6 ± 0.5 feet per second. Toward the end of the analyzed first eight seconds of light, the climb rate reached the maximum value of 6.1 feet per second.

[3] It is further estimated based upon the NTSB's review of available video surveillance footage that the average yaw rate of the helicopter during the first twelve seconds of flight was 30 ± degrees per second, reaching the maximum value of 45 degrees per second toward the end of the twelve second period.

[4] It is estimated that the ground impact speed was 58 ± feet per second (40 ± 3 miles per hour). At that time, the pitch and roll angles were small.

2. BACKGROUND

2.1. Air Methods

Air Methods is a commercial, on-demand air transport operator specializing in Helicopter Air Ambulance (HAA) services and is the largest provider of air medical emergency transport services in the United States. The company was established in 1980 and is headquartered at Centennial Airport in Englewood, Colorado. Air Methods received its Title 14 CFR Part 135 Air Carrier Certificate, number QMLA253U, on March 1, 1992. Air Methods has more than 321 bases and currently serves 48 states with a fleet of 419 aircraft (helicopters and airplanes).

Air Methods has acquired the following Helicopter Air Ambulance (HAA) operations since its inception: Mercy Air Service (1997), ARCH (2000), Rocky Mountain Holdings (2002), CJ Systems (2007), Omniflight (2011), and Tri-State Care Flight (2016).

Air Methods operates in accordance with its FAA-approved Operations Specifications (Ops Spec). The latest Ops Spec at the time of the accident was the revision dated April 15, 2015. Contained in the Ops Spec was authorization to conduct on-demand, single-engine, instrument flight rules, passenger-carrying operations. Air Methods provided an organizational chart which is contained in the NTSB Human Performance Specialist's Factual Report.

In 2009, Air Methods was the first helicopter air medical operator to enter the FAA Safety Management System (SMS) voluntary implementation program. The company reached the highest level of compliance in May 2013.

The company has invested more than $100 million in advancing and incorporating safety programs and technologies into its operations. Examples include use of advanced aviation training devices, including a Level D Full-Motion Simulator; a fully integrated Operational Control Center; implementation of a Line Operations Safety Audit (LOSA) program; ongoing development of a Flight Operational Quality Assurance (FOQA) program; formal fatigue studies; and technologies such as night vision goggles, Helicopter Terrain Avoidance Warning Systems (HTAWS), Global Positioning System (GPS) capabilities, Satellite Weather, and Satellite Tracking.

2.2. Mission

The purpose of the flight was a public relations mission at the Boy Scouts of America's Spirit of Adventure Ranch in Gypsum, Colorado.

2.3. Precursor Events

The accident helicopter was manufactured in March 2013 and had accumulated an aircraft total time (ATT) of about 487.4 flight hours at the time of the accident. The accident helicopter was based at the Flight for Life base in Frisco, Colorado and was used exclusively for HAA operations in conjunction with a hospital-based program. The pilots and flight nurses who were interviewed by the NTSB all spoke highly about the performance capabilities of the AS350 B3e helicopter.

The accident helicopter was maintained under an FAA approved aircraft inspection program (AAIP_ and there were no restrictions or open MELs on the aircraft at the time of the accident.

2.4. Accident Flight

On Friday, July 3, 2015, the accident helicopter was scheduled for a public relations flight departing at 1300 from the Summit Medical Center helipad in Frisco, Colorado en route to Gypsum, Colorado. This was the first flight of the day for the accident helicopter.

The accident pilot reported for duty at approximately 0735. At approximately 0734, the pilot contacted Air Methods' Operation Control Center (OCC) and noted that the weather was "Green. Low risk, whatever," and that conditions were visual flight rules (VFR). He also verified the flight release number at that time.

According to one of the flight nurses, the crew, which included the accident pilot and two flight nurses, conducted their routine briefing in the morning, during which time they would have discussed weather, crew readiness, maintenance checks, fuel load, NVG currency, and any other concerns they may have for the flight that day.

A preflight inspect of the accident helicopter was accomplished. The preflight activities were described by one crew member as "uneventful." The crew member further noted that, although he does not specifically recall that the accident pilot used the checklist prior to takeoff on the day of the accident, he is "confident" that the checklist was performed. This is consistent with the statements from other pilots and flight nurses who had flown with the accident pilot and noted that he always used the checklist.

For the accident flight, the pilot was seated in the pilot seat and the flight nurses were seated on the right and left most sides aft of the pilot seat. One of the crew members described the take-off as "rough," with "some unusual pitch" as the helicopter began to make a counterclockwise turn. He noted, however, that the counterclockwise turn was not unusual, as that was typical when departing from the helipad at Summit Medical Center. However, the helicopter paused momentarily before continuing to climb and turn. The crew member did not recall any caution lights, horns, alarms or abnormal smells after take off.

The helicopter made a 360-degree turn before briefly flying forward. The flight nurses both tightened their seatbelts. The helicopter started spinning violently in a counterclockwise direction. The crew member noted that he had never before experienced a spin that violent. The helicopter then impacted the ground.

Available surveillance video footage showed fuel flowing from the helicopter wreckage and the onset of a postcrash fire shortly thereafter. The postcrash fire spread and consumed or severely damaged the majority of the helicopter wreckage.

3. FACTUAL SUMMARY

3.1. Aircraft Configuration

The accident helicopter was an Airbus Helicopters AS350B3e (FAA Registration N390LG, S/N: 7595) designed and equipped for VFR and Night Vision Goggle flights. The helicopter was equipped with a high skid-type landing gear and a single Turbomeca Arriel 2D turboshaft engine. It was equipped with a three-bladed main rotor system and two-bladed tail rotor system. The helicopter flight controls are hydraulically assisted by a dual hydraulic system consisting of an "upper" and "lower" hydraulic circuit. Both upper and lower hydraulic system circuits provide hydraulic assistance to the main rotor flight controls, but only the lower hydraulic circuit provides assistance to the tail rotor flight controls. The interior of the helicopter was configured with a medical interior equipped for patient transport and care. As part of approved Helicopter Air Ambulance modifications, at the time of the accident the helicopter was equipped with flight controls on the right side only.

The accident helicopter was manufactured in March 2013 and had accumulated an aircraft total time of about 487.4 flight hours at the time of the accident.

3.2. Aircraft Examination

On July 4-5, 2015, representatives from the NTSB, FAA, AMC, Airbus Helicopters Incorporated, and Turbomeca convened at the accident site to document the wreckage. After the initial on-site investigation immediately following the accident, the helicopter's wreckage and components were subjected to further examination. The ACCU TEST switch and the yaw hydraulic isolation switch were tested by the NTSB Materials Laboratory using x-ray radiography. It was concluded that the switches were too damaged by the accident sequence to determine the position of either switch at the time of the accident.

3.3. Accident Site Description

The helicopter's wreckage was located in the upper west parking lot 360 feet southwest of the Summit Medical Center helipad (91CO). The helicopter came to rest on its right side oriented on a magnetic heading of about 60°. The majority of the main fuselage, canopy, and tailboom were consumed or severely damaged by the postcrash fire. All three main rotor blades were observed attached to the main rotor head. The main rotor blade spars, Starflex, and blade sleeves exhibited damage consistent with high rotational energy. Both tail rotor blades were recovered at the accident site. The cyclic and collective sticks were found in their installed positions. Both pedals were also found in their installed positions with the left pedal near its forward stop. The control block at the forward end of the collective stick was partially consumed by the post-crash fire. The yaw servo hydraulic isolation switch was observed to be in the forward position. The ACCU TEST push button was partially consumed by postcrash fire. The engine control twist grip, located on the collective, was heat distressed and observed to be in the "flight" position. The engine was still attached to the engine deck via the rear mounts and was found at the main wreckage site laying on its right side.

3.4. Weather

Visual Meteorological Conditions prevailed at the time of the accident. The closest official weather station to the accident site is Copper Mountain – Red Cliff Pass (KCCU) and is located seven miles south-southwest of the accident site. KCCU's AWOS reported winds out of 280 at 19 knots with gusts to 24 knots, 10 statute miles of visibility, scattered cloud layers at 6,000 and 7,000 feet and a broken ceiling at 12,000 feet at 1335 MDT (approximately five minutes prior to the accident). There was no reported precipitation or turbulence.

The vertical velocity data indicated that directly above the accident site were updrafts with a velocity between 200 and 600 feet per minute (*see* figures 36 and 41).[5]

There was also a corresponding downdraft just west of the accident site, as shown in figures 40 and 41, associated with an increase in relative humidity (*see* figures 42 and43) at the surface, as well as relative humidity increasing in height over the strong updraft and downdraft areas.

3.5. Aircraft History

3.5.1 Aircraft Maintenance

The accident helicopter was maintained under an FAA approved aircraft inspection program (AAIP). The last maintenance on the helicopter was performed on July 2, 2015 at ATT 483.5 flight hours and included a 15 hour/7 day inspection and a 25-hour inspection of the engine and VEMD, a 180-day inspection of various equipment, a 500-hour inspection and lubrication of the tail rotor drive shaft hanger bearings, and a 500-hour/12 month inspection of various installed equipment on the helicopter. Additionally, FAA AD No. 2007-12-2 was accomplished. Review of the maintenance records does not indicate any anomaly and confirmed the aircraft was in compliance with the manufacturer's instructions and pertinent FAA regulations and was deemed airworthy in accordance with Air Methods' AAIP.

3.5.2 Aircraft Weight & Balance

The aircraft's estimated weight at the time of takeoff on the accident flight was about 4,717 pounds. The maximum takeoff weight for the AS350B3e is 4,961 pounds.

3.6. Flight Crew Information

3.6.1 Pilot-in-Command

The pilot, age 64, held an Air Transport Pilot certificate with rotorcraft-helicopter and instrument – helicopter ratings. At the time of the accident he held a second-class medical certificate with the limitation that he must wear corrective lenses for near/intermediate vision. He was hired by Rocky Mountain Helicopters (acquired by Air Methods in 2002) on December 11, 1999 as a pilot. His position at the time of the accident was line pilot and aviation safety representative. The pilot completed his first 14 CFR Part 135 airman competency/proficiency check at Air Methods in January 2003 and received basic indoctrination and initial training in July 2003. He was qualified on the AS350B3 and received differences training on the AS350B3e (dual hydraulics) in August 2014. His most recent recurrent training was in March 2015. He had over 13,200 hours of total flight time, 5,231 hours of which in the AS350 (all variants) including 111 in the AS350B3e with dual hydraulics. He had been flying out of the base in Frisco since 2004.

Prior to joining Rocky Mountain/Air Methods, the pilot flew for Flight for Life starting in 1987. Previous to that, he received a bronze star and purple heart for his service as a pilot during the Vietnam War.

3.7. Human Factors

3.7.1 Pilot's Pre-Accident Schedule and Recency of Experience

The pilot was off duty from 0737 on June 26, 2015 until 0735 on July 3, 2015. According to Air Methods' duty time summary report, the pilot worked 12-hour night shifts on June 24, 25, and 26, during which he

[5] All figures referenced in Section 3.4 refer to the figures contained in the Meteorology Group Chairman's Factual Report.

flew a total of approximately 2 hours and 19 minutes in the accident helicopter, N390LG. The pilot worked 12-hour day shifts on June 21, 22, and 23 during which he flew a total of approximately 3 hours and 25 minutes in N390LG. From June 21 to June 26, the pilot had a total of 21 takeoffs and landings in N390LG. The accident flight was the pilot's first flight on July 3, 2015.

3.7.2 Sleep and Fatigue

According to the pilot's wife, on the evening of Thursday, July 2, 2015, the pilot was very happy that evening. The pilot and his wife spent time that evening at a friend's house and were in bed by 2200. No disruptions to his sleep were reported that evening. On Friday, July 3, the pilot awoke a little after 0600. She reported he was a morning person and was whistling, which was a sign that he was happy and felt good. His wife reported that she spoke with him later on July 3 and that he was "chipper" and told her it was a really nice day.

3.7.3 Use of Cellular Phone

No cellular phone activity was reported at or around the time of the accident in compliance with Air Methods' policies prohibiting such activity.

4. ANALYSIS (FINDINGS)

4.1. Pilot Awareness of Dual-Hydraulic System

Air Methods operates both single-hydraulic and dual-hydraulic AS350 helicopters in its fleet. On August 21, 2014, Airbus Helicopters released Safety Information Notice (SIN) No. 2776-S-29 warning pilots of dual-hydraulic AS350-series helicopters that during the preflight run up hydraulic checks, if the step to restore hydraulic pressure to the tail rotor hydraulic circuit was omitted, the pilot could encounter difficulty in moving the pedals, i.e., the perception of locked, jammed, or stuck pedals. According to other pilots at the Frisco base, this SIN was received by the pilots in that base before the accident and it was posted in their office.

The distinction between the operational checks in the single-hydraulic system and dual-hydraulic system on the AS350 were also covered in accordance with Air Methods' FAA Approved training program in both differences training and recurrent training provided to the accident pilot in August 2014 and March 2015, respectively.

An assistant nurse manager for the Flight for Life program who had flown with the accident pilot remarked that the lack of a tail rotor hydraulic warning light on the AS350B3e as differentiated from the a single-hydraulic helicopter was a "big deal" for the pilot and that he would tell everyone to pay attention to the position of the yaw isolation switch. According to this witness, the accident pilot commented that "this will kill you" after reviewing the video of the N395P accident in Albuquerque.

Based on a review of the pilot's training records and the witness statements and interviews, Air Methods believes that the accident pilot was adequately trained and properly informed as to the differences between the single-hydraulic and dual-hydraulic AS350 and was cognizant of the importance of returning the yaw servo hydraulic isolation switch to the forward/on position following the pre-flight run-up hydraulic check.

Proposed Finding: The accident pilot was aware of the danger posed by improper positioning of the yaw servo hydraulic isolation switch and the lack of warning light to indicate such improper positioning.

4.2. Switch Position Could Not Be Determined

The ACCU TEST and collective switches were tested via x-ray radiography following the accident in an effort to determine the position of the switches at the time of impact. Exemplar switches were also x-rayed for comparison. Those tests and their results are discussed in detail in NTSB Report No. 15-127. According to that report, both the ACCU TEST and yaw servo hydraulic isolation switch were "too damaged for determination of switch position."

Proposed Finding: There is insufficient evidence to conclude that the yaw servo hydraulic isolation switch was not in the forward/on position at the time of the crash.

4.3. Pilot Condition

The accident pilot was 64 years old and a highly experienced helicopter pilot with over 13,000 total hours and 111 hours in the AS350B3e. The date of the accident was the pilot's first day back on shift following an extended off-duty period after completing his shift on June 26, 2015. In the days prior to the break in his schedule, he flew several hours, including 21 takeoffs and landings, in the accident helicopter. The pilot began his shift at 0735 on July 3, 2015 and the accident flight was his first flight that day. The accident flight was a public relations mission and not a medical transport, thus eliminating the potential for any perceived sense of urgency or rush by the accident pilot.

The pilot's wife reported that he received adequate, undisturbed sleep the night prior to the accident and that the pilot was happy and chipper during the times she spoke with him on July 3.

Proposed Finding: Pilot fatigue or distraction was not a factor in this accident.

4.4. Dual-Hydraulic Warning Light Service Bulletin

On February 25, 2015, Airbus Helicopters released non-mandatory Service Bulletin No. AS350-67.00.66 which introduced MOD No. 07-4622 to modify the lights associated with the dual hydraulic system on the CWP. That SB modifies the CWP so that actuation of the yaw servo hydraulic switch to the "off" position would result in a flashing "HYD2" light on the CWP. The SB had not been incorporated into the accident helicopter. Air Methods had begun taking steps to implement this SB prior to the accident. Following a review of internal documentation, Air Methods has determined that kits from the manufacturer were unavailable to begin immediate implementation of the SB following its issuance. Even after kits became available, following the first kit installation after this accident, Air Methods discovered that the manufacturer failed to provide an FAA-approved Rotorcraft Flight Manual Supplement with the kit that resulted in grounding of that aircraft. Following the receipt of installation kits, Air Methods has since complied with this Service Bulletin on all affected helicopters in its fleet.

Proposed Finding: Air Methods could not have complied with Service Bulletin No. AS350-67.00.66 prior to the accident due to unavailability of parts and insufficient manufacturer documentation.

4.5. Pilot's Use of Checklist

The yaw servo hydraulic check would normally be performed in accordance with the Air Methods FAA accepted AS350B3e normal procedures checklist under the "starting engine" section. That check is more fully set forth, including all required steps, in the "Yaw Servo Hydraulic Check" section of the Air Methods FAA accepted AS350B3e series expanded checklist.

A pilot that flew with the accident pilot indicated the accident pilot always used the checklist when flying the aircraft. One of the accident pilot's flight instructors also observed the accident pilot using the checklist during training. A crew member on board the accident flight also indicated that while he did not see it, he was "confident" the pre-flight checklist was utilized on the accident flight.

Proposed Finding: It is likely that the accident pilot utilized the preflight checklist on the accident flight.

4.6. Survivability

At the time of the accident, N390LG was not equipped with a Crash Resistant Fuel System (CRFS). Prior to the accident, there were no retrofit options to equip an AS350B3e helicopter with a CRFS which met the criteria set forth in 14 CFR 27.952.

Once available, Air Methods has committed to retrofitting its entire fleet of AS350 and EC130 helicopters with a crash resistant fuel tank following Supplemental Type Certificate approval of the crash resistant tank.

Proposed Finding: No CRFS for the AS350B3e was available for retrofit installation at the time of this accident.

4.7. Post-Accident Testing

Post-accident calculations, simulations, and testing were performed with respect to the controllability of the accident helicopter with varying levels of hydraulic assist being provided to the tail rotor controls. The Federal Aviation Regulations pertaining to helicopter control system design specify that the limit for input forces for foot controls is 130 lbs[6]. According to post-accident calculations provided by the helicopter manufacturer based on helicopter weight, altitude, temperature, and wind conditions representative of the conditions at the time of the accident, calculated pedal loads to maintain steady heading while hovering in ground effect with no hydraulic boost and the accumulator depleted were 142 lbs in the "no wind" scenario and 162 lbs in the 15 knot wind scenario determined to be representative of accident conditions. Both figures exceed the FAA-specified force limit for foot controls.

Proposed Finding: The foot control forces on the AS350B3e do not comply with control force limitations set forth by the FAA when not hydraulically-assisted.

[6] See 14 CFR 27.395 and 14 CFR 27.397.

5. SAFETY CULTURE AND CONTINUOUS IMPROVEMENT

Air Methods is committed to the attainment of the highest level of safety in the accomplishment of its corporate mission. Its goal, as stated in the General Operations Manual (GOM), revision 8, chapter 7, is "to provide a safe and healthy working environment for all of [its] team members, and, in doing so, to support state and federal laws regarding safety." Air Methods' strong commitment to safety is intended to eliminate injuries to employees and accidental damage to equipment and/or property and provide a safe environment for patients and the communities it serves. To this end, Air Methods participates in a number of voluntary safety programs including: Line Operational Safety Audits (LOSA); Internal Evaluation Program (IEP); Aviation/Maintenance Safety Action Program (ASAP/MSAP); Voluntary Disclosure Reporting Program (VDRP); Flight Operations Quality Assurance (FOQA); Safety Management System (SMS); Accident, Incident, Damage, Malfunction and Operations Report (AIDMOR); AlertLine; Post-Accident Incident Report (PAIP); and Approved Aircraft Inspection Program (AAIP).

Air Methods' Safety Department is comprised of the following positions: a vice president of safety and risk management; a director of flight safety; six regional safety directors; a FOQA manager; an EtQ (excellence through quality) manager, and ASAP/MSAP manager; and 156 field safety representatives. In addition, Air Methods' Executive Leadership participates in monthly safety meetings in furtherance of SORT and SART initiatives.

5.1. Safety Management System (SMS)

In 2009, Air Methods was the first helicopter air medical operator to enter the FAA Safety Management System (SMS) voluntary implementation program. The company reached the highest level of compliance in May 2013.

The Air Methods' "SMS Policy Manual," Section 2: "Safety Policy and Objectives," subsection 2.2: "Management Commitment and Safety Accountabilities" provides as follows:

> Air Methods is responsible for promoting a culture that encourages accident prevention and continually strives to improve its performance. All levels of supervision are responsible for maintaining safe working conditions and for properly instructing their employees in the safe performance of assigned tasks to ensure the tools and equipment in their workplace are maintained and operated in a proper manner. All employees have a personal responsibility to understand, promote, and follow safe practices to ensure their actions will not cause injury to themselves or to others.

The proposed Air Methods' "SMS Policy & Procedures Manual, Section 1: "Introduction", subsection 1.1: "Purpose" provides as follows:

> The Safety and Risk Management Department is based at the corporate headquarters of Air Methods in Colorado. The role of this department is to promote programs that support operational excellence, prevent accidents and injuries, and manage corporate risk across the entire company. The primary tool used in support of this mission is the Safety Management System (SMS). The purposes of this document are to describe the basic components of an effective SMS, define the minimum requirements for each division's SMS program, and establish a framework for sharing operational risk information throughout the organization.
> At the heart of the Air Methods SMS strategy is a strong desire to establish a collaborative and data-driven approach to manage risk across the entire operation. This begins by establishing policies that

support the management of risk, promote safety programs, and continuously improve program quality. The ultimate goal is to ensure the proactive management of risk to an acceptable range, at every level of the organization.

Working together effectively requires knowledge and understanding of procedures, safe ways of working, and proper attitudes. Employees are also responsible to notify their supervisor of potential or existing hazards to health or safety. Willful or careless neglect resulting in occupational injury or property damage may be cause of disciplinary action. If working with a supervisor or manager does not resolve issues or concerns, employees are encouraged to report issues and concerns – without reprisal – using the AlertLine application. However, employees are encouraged to resolve issues at the lowest possible management level.

5.2. Internal Evaluation Program (IEP)

The IEP is based on the principle that Air Methods is responsible for ensuring that its operations are safe and in compliance with all regulatory requirements as well as its own policies and procedures. The IEP manual provides individuals and organizations with policies, procedures, and documentation regarding the Air Methods' IEP. The IEP function also requires auditing and evaluation of the safety management functions, policymaking, safety risk management, safety assurance, and safety promotion.

In pursuit of this objective, an ongoing process has been established which includes evaluations, Validation Audits and audits of company activities to aid in the assurance of safe and regulatory compliant operations. Findings encountered during this process are documented, reported to the appropriate individual or individuals for corrective action/protective action (CAPA), and to senior management. These findings and CAPAs are subject to follow-up to ensure that appropriate CAPAs are in progress.

The IEP is mandated by, and its participants answerable to, senior management. Those performing evaluations as part of the IEP operate on behalf of the Air Methods' Safety Department and are independent of the various disciplines within the company while performing this role. The IEP is an essential part of the Air Methods' Safety Management System (SMS). One of the goals of the program is to enhance Air Methods' reactive and proactive safety risk management processes. In addition to the requirements of SMS, the IEP is intended to be a value added function to the entity being evaluated, providing insight to potential regulatory and non-regulatory problems and or issues before they occur, focusing on Root Cause Analysis (RCA).

The IEP is designed to focus on Air Methods' 14 CFR part 135 and 145 operations. These areas include but are not limited to operations, maintenance, medical, ground support, material control, and communications. Any other area of Air Methods designated by the director of safety may be included as part of a larger evaluation or may be the subject of a standalone evaluation. This may include vendors, subsidiaries, and joint venture operations.

5.3. Anonymous Reporting

The Air Methods' AlertLine is a customized website hosted by an independent, third party organization. This tool allows all company employees, customers, and vendors to provide feedback, comments, suggests and alerts relative to any safety, financial, or human resources concern. The submitter may remain completely anonymous.

5.4. Aviation Safety Action Program (ASAP)/Maintenance Safety Action Program (MSAP)

Air Methods has a fully developed Aviation Safety Action Program (ASAP) and Maintenance Safety Action Program (MSAP). As defined by the FAA, the goal of ASAP/MSAP programs are to enhance aviation/maintenance safety through the prevention of accidents and incidents. Their focus is to encourage voluntary reporting on safety issues and events that come to the attention of employees of certain certificate holders including pilots, mechanics and repairmen.

To encourage an employee to voluntarily report safety issues even though they may involve an alleged violation of company policies or Title 14 of the Code of Federal Regulations, enforcement-related incentives have been designed into the programs. An ASAP/MSAP is based on a safety partnership that will include the FAA and the certificate holder, and may include any third party such as the employee's labor organization.

5.5. Line Operation Safety Audit (LOSA)

Line Operations Safety Assessment (LOSA) is a proactive and predictive approach to identify and address aviation safety utilizing Threat and Error management methodology. As a voluntary safety program, LOSA collects safety data during normal aviation operations. Air Methods has pioneered the use of LOSA in the HAA Industry by working with the LOSA Collaborative. It was originally designed for flight deck operations and has continued to evolve since its inception. The hazards that threaten the safety of flight deck operations are not unique to that environment. Similar human factors problems are present during maintenance and ramp operations. Air Methods has expanded the LOSA approach to view HAA operations more holistically to include clinical, communications and maintenance components.

Managing risks has become increasingly important in modern organizations. The initial identification and interpretation of hazards are some of the most challenging aspects of risk management, since many hazards remain hidden, unnoticed, or misunderstood for long periods of time before an accident. The risks associated with these hazards seem obvious after an accident; however, the early signs pointing to an emerging hazard and its consequent risk are often extremely weak and ambiguous.

Three sources of information may be indicative of emerging safety risks:

- Reactive sources highlight issues after an undesired event has taken place;
- Proactive sources look for precursors to undesired events; and
- Predictive sources capture system performance as it happens in real-time, normal operations.

Since the accident, Air Methods has conducted one LOSA observation.

5.6. Flight Operational Quality Assurance (FOQA) Program

FOQA is a voluntary safety program designed to improve aviation safety through the proactive use of flight recorded data. Air Methods' FOQA program was approved by the FAA in October of 2014. The core objective and intent of Air Methods' FOQA program is to facilitate the free flow of safety information. Although still in its initial stages, the FOQA program will:

- Collect operational flight data.
- Develop methods to analyze the collected flight data, such as triggered events and routine operational measurements.
- Establish procedures for comparing the collected data with established procedures and standards and the use of analyzed data in formal awareness and feedback programs to enhance safety in the areas of flight procedures; flight training procedures and qualification standards; crew performance in all phases of flight; air traffic control procedures; aircraft maintenance, engineering and reliability programs; and aircraft and airport design and maintenance.

- Perform trend analyses of FOQA data to identify potential problem areas, evaluate corrective actions and measure performance over time.

Air Methods' FOQA program will also interface and coordinate with Air Methods' other safety programs such as the Aviation Safety Action Program (ASAP), Anonymous reporting system, and Voluntary Disclosure Reporting System (VDRP).

Currently, 8.3% of Air Methods' fleet is equipped with flight data monitoring equipment.

6. CONCLUSIONS

6.1. Proposed Findings

6.1.1 The accident pilot was aware of the danger posed by improper positioning of the yaw servo hydraulic isolation switch and the lack of warning light to indicate such improper positioning.

6.1.2 There is insufficient evidence to conclude that the yaw servo hydraulic isolation switch was not in the forward/on position at the time of the crash.

6.1.3 Pilot fatigue or distraction was not a factor in this accident.

6.1.4 Air Methods could not have complied with Service Bulletin No. AS350-67.00.66 prior to the accident due to unavailability of parts and insufficient manufacturer documentation.

6.1.5 The accident pilot was properly and sufficiently trained on the differences between the single-hydraulic and dual-hydraulic AS350 helicopters.

6.1.6 There is no evidence to suggest maintenance of the accident helicopter was a factor in this accident.

6.1.7 It is likely that the accident pilot utilized the preflight checklist on the accident flight.

6.1.8 No CRFS for the AS350B3e was available for retrofit installation at the time of this accident.

6.1.9 Weather may have been a factor in this accident.

6.1.10 The foot control forces on the AS350B3e do not comply with control force limitations set forth by the FAA when not hydraulically-assisted.

6.2. Proposed Probable Cause

Air Methods proposes the following Probable Cause:

The probable cause of this accident was the loss of tail rotor control of the accident helicopter during takeoff. The cause of the loss of tail rotor control could not be determined based on available information and evidence.

6.3. Proposed Recommendations

Air Methods is in agreement with NTSB Safety Recommendations A-15-12 and A-16-8 through A-16-11.

7. POST ACCIDENT IMPROVEMENTS AND SAFETY INITIATIVES

7.1. Air Methods Operations Department

7.1.1

Though in process prior to the accident, Air Methods accelerated the timeline to complete installation of MOD No. 07-4622 as set forth in Airbus Helicopters SB AS350-67.00.66 on its dual-hydraulic AS350 helicopters. Air Methods' entire AS350 fleet, as applicable, now contains the modification.

7.1.2

Air Methods is working collaboratively on a crash resistant fuel tank solution and has committed to retrofit its entire AS350 and EC130 fleet with crash resistant fuel tanks following STC approval.

7.1.3

Non-mandatory service information notices and service bulletins are now reviewed by the Director of Operations and distributed for further review, analysis, and implementation. Previous to the accident, maintenance ensured distribution of non-mandatory Service Information Notices and Service Bulletins were distributed to maintenance management and engineering by Technical Publications.

7.1.4

Air Methods has increased emphasis on differences training for pilots flying both single- and dual-hydraulic AS350 helicopters.