Aviation Investigation Final Report

Location:	St Louis, Missouri	**Accident Number:**	CEN15FA164
Date & Time:	March 6, 2015, 23:10 Local	**Registration:**	N356AM
Aircraft:	Airbus Helicopters (Eurocopte EC-130-B4	**Aircraft Damage:**	Destroyed
Defining Event:	Settling with power/vortex ring state	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The emergency medical service (EMS) helicopter was landing on a privately owned elevated heliport to pick up two medical crewmembers. The medical crewmembers had been dropped off with a patient on a preceding flight. During the preceding flight, the nurse thought about telling the pilot to abort the landing on the heliport because there was a lot of rolling and yawing, and he was having a hard time landing the helicopter. After the landing, the nurse and another medical crewmember stated that the pilot did not want to depart the heliport, but the medical crewmembers told the pilot that there may be potential arrivals of other EMS helicopters. The pilot chose to depart the heliport and obtained fuel at the operator's base of operations. For the return flight to pick up the two medical crewmembers, the wind had increased, and the helicopter approached the heliport in high-wind conditions and with a right, quartering tailwind. Also, the wind along with the surrounding buildings likely created a turbulent airflow/windshear environment in which the helicopter was operating as it approached for landing. The helicopter's operation in a high-power, low-airspeed condition in high-wind conditions, including a right quartering tailwind, likely resulted in a loss of control due to settling with power.

A security video showed the helicopter on a northerly flightpath descending at about a 45-degree angle before impacting the ground and coming to rest on an approximate northerly heading. The pilot sustained fatal injuries due to the subsequent fuel tank fire/explosion, which otherwise would have been a survivable accident.

A postaccident safety evaluation of the heliport showed that the final approach and takeoff area/safety area were obstructed by permanent and semi-permanent objects that pose a serious hazard to helicopter operations. These obstructions limited the available approach paths to the heliport, which precludes, at times, approaches and landings with a headwind. The helipad is privately owned; therefore, it is not subject to Federal Aviation Administration (FAA) certification or regulation.

A review of the helicopter's flight manual revealed that there were no wind speed/azimuth limitations or suggested information available to pilots to base the performance capabilities of the make and model helicopter in their flight planning/decision-making process. Examination of the helicopter revealed no anomalies that would have precluded normal operation and showed engine power at the time of impact.

An accredited representative from the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) was assigned to this investigation as the state of manufacture of the helicopter. The BEA provided comments on this report, which can be found in the docket.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's decision to land during unfavorable wind conditions, which resulted in a loss of control due to settling with power. Contributing to the accident were the lack of an adequate approach path due to numerous obstructions and the lack of available guidance regarding the helicopter's performance capabilities in the right quartering tailwind condition.

Findings

Personnel issues	(general) - Pilot
Aircraft	Descent rate - Attain/maintain not possible
Environmental issues	(general) - Effect on operation
Aircraft	Descent/approach/glide path - Not specified
Environmental issues	Tailwind - Contributed to outcome
Environmental issues	High wind - Contributed to outcome
Aircraft	Fuel storage - Not installed/available

Factual Information

History of Flight

Approach	Other weather encounter
Approach-VFR pattern final	Loss of control in flight
Approach-VFR pattern final	Settling with power/vortex ring state (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

On March 6, 2015, at 2310 central standard time, an Airbus Helicopters (Eurocopter) EC-130-B4, N356AM, operated by Air Methods (doing business as ARCH), struck the edge of a hospital building and impacted its parking lot during a visual approach to the St Louis University Hospital elevated rooftop helipad (MO55), St Louis, Missouri. During the approach, the helicopter experienced a loss of directional control and entered an uncontrolled descent. The helicopter was destroyed by impact forces and a post-crash fire. The commercial pilot, who was the sole occupant, sustained fatal injuries. The helicopter was operated under Title 14 Code of Federal Regulations Part 91 as an air medical positioning flight that was operating on a company flight plan. Night visual meteorological conditions prevailed at the time of the accident. The flight was returning to MO55 after it had been refueled at the operator's base located at Arch Heliport (MU05), St. Louis, Missouri.

The flight's first approach and landing at MO55 was to drop off a medic, nurse, and a patient, who was not in critical condition. The flight release for the flight and the accident flight had a green weather status, whose criteria is solely based upon ceilings and visibility. The risk assessment, which was completed for the flight and not for the accident flight, was assessed as low.

The medic said that he had been employed as a medic for about a year and flew on previous flights that landed at MO55 "couple of times" and had flown with other Air Methods pilots. The nurse stated that she began employment at Air Methods in January 2015 and she had two years of experience with another aviation company.

The medic stated that during the first approach for landing to MO55 with the pilot, the pilot said that there was a 25 knot wind, but the medic did not know the source of the pilot's wind information. The medic said that the wind sock on the helipad was illuminated and pointing "straight out" towards the elevator shaft (the elevator shaft was located toward the northeast) next to the helipad. During the approach, the helicopter tail was "sideways a little bit." The pilot said it was going to be "a little rough" and that "it was a little windy." The medic said that the approach was "straight-in," and he felt a "little drop" when they came in. The helicopter did not slow down during the approach. The approach felt lower than usual and about 10-20 feet lower than that used by other pilots he had flown with and seemed closer to the elevator than the middle of the helipad while the helicopter was about a "football field" or "half of a football field" away from the helipad. The nose of the helicopter was directed away from elevator and the pilot would "straighten out" the helicopter when it was closer in.

The nurse said that there was "a lot of rolling" and "a lot of yawing" during the approach to MO55. Over the helipad, the pilot was having a "hard time" and "a couple of more seconds" she would had told him to abort the landing and to do another "recon."

The medic said that after landing, the pilot needed to shut down the helicopter at MO55 to remove a helicopter seat. After the helicopter shutdown, the pilot said that he wanted to stay on the helipad, but the medic told the pilot that the helicopter could not remain on the helipad because there were other helicopters coming in. The nurse stated that it was not a "typical thing to do" to have the helicopter remain on the helipad because other helicopter arrivals. The nurse stated that the pilot did not tell her why he wanted to remain on the helipad, but her "gut reaction was that it was a hard landing and he did not want to do that again." She said it was "difficult" to get the helicopter skids onto the helipad.

The flight then departed to obtain fuel at MU05 (located about 1.3 nautical miles from MO55). Upon refueling, the flight returned to MO55, to pick up the medic and nurse. Neither the medic nor the nurse saw the helicopter takeoff from MO55 for the flight to refuel at MU05.

The nurse stated that at 2258 she sent a text message to the pilot stating that they were ready to be picked up from MO55, and he responded in text that he was on his way. She said that at 2309, she looked at the time and thought it was "taking a while for his return."

The accident occurred during the flight's return, during approach for landing, at MO55.

A witness stated that he was sitting in his truck parked across from the St Louis University Hospital emergency room when he saw a light shine on his truck, "the light was coming closer and closer." After a while the light turned around and disappeared "quick." The light shined for about two minutes. His truck was facing west because it was parked on Vista, which is a one way street. The light shined on the truck for about two minutes. The light turned sideways, and it was a clear white light. The other lights he saw on the back of the helicopter "looked like red and green" from the tail. He said he could not hear the helicopter. The helicopter was "coming forward" and it took a "little tail spin" before it went out of sight. The helicopter went north and "went down." He saw the helicopter "side" and "back" and then it went down. He did not see any fire from the helicopter before the accident. He did not hear any noise after it went out of sight. He said that his truck was parked across from the hospital ambulance entrance. He said the helicopter made a "regular turn" and he could see its side, which was to his left before it went down. He saw it "spin only once and not more." He said the helicopter was pointing "straight down as it turned left." He said it was not "quite straight down" and the light was shining on the ground as it was going down on an angle. He said that he did not see the helicopter "wobble." He said a security guard came out and walked down Thistle. The witness said he got out of his truck, and the wind was "going pretty hard" going north. He said that helicopter was about 15 feet above the overhead tunnel between the hospital and hospital garage. He did not see the bottom of the helicopter because of the light. He said the wind was not shaking his truck when he was sitting inside of it.

Pilot Information

Certificate:	Commercial	**Age:**	52,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	December 19, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 17, 2014
Flight Time:	2614 hours (Total, all aircraft), 366 hours (Total, this make and model), 1449 hours (Pilot In Command, all aircraft), 29 hours (Last 90 days, all aircraft), 15 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

The pilot held a commercial pilot certificate with rotorcraft-helicopter and instrument-helicopter ratings issued on June 24, 1992. Air Methods reported on National Transportation Safety Board (NTSB) Accident Pilot/Operator Aircraft Accident/Incident (Form 6120) that the pilot accumulated a total time of 2,614 hours, all of which was in rotorcraft.

According to the FAA blue ribbon airman certification file for the pilot, he was issued a commercial pilot certificate based upon military competence obtained in the US Army and had flown at least 10 hours as pilot-in-command during the last 12 months in the following military aircraft: UH-1. Section III, Record of Flight Time was not completed upon the application for his commercial pilot certificate with rotorcraft-helicopter and instrument-helicopter ratings. A record of his military competence, Army DA Form 759, Individual Flight Record and Flight Certificate, was not in the airman certification file nor was it required to be submitted by the examiner that issued the pilot's commercial pilot certificate.

The pilot had applied for employment as a pilot at another EMS operator in the summer of 2013. According to the operator's regional director of flight operations during that time, he interviewed the pilot and went through the pilot's qualifications using the pilot's resume. The director of flight operations stated that he did not feel confident in the pilot's flight times. Another regional director for the EMS operator called someone at Ft. Campbell, Kentucky to verify if the pilot's PIC flight time in AH-64 helicopters and found out that the pilot had "very limited PIC time in the AH-64." The director of operation that had interviewed the pilot said that following the interview, the pilot contacted him 2 or 3 times but was told he was not being considered for employment. The pilot did not provide Army Form 759 for the EMS operator following the interview.

According to the pilot's resume that was on file with Air Methods, he had been previously employed as a EC-130 pilot by for air tour operations as of May 5, 2013 and listed his total flight time prior to his employment at Air Methods as 2,244.7 hours, "military helicopter" of 2,244.7 hours, and pilot-in-command (PIC) time of 1,155.7 hours. The "type ratings" listed on the resume were: Airbus Helicopters (Eurocopter) EC-130-B4, Bell UH-1, Bell AH-1, Boeing AH-64A and Bowing AH-64D helicopters.

The pilot's date of hire with Air Methods was October 21, 2013 and he reported, on his application for employment dated October 22, 2013, a total aircraft time all of which were in helicopters 2,503.4 hours,

1338.8 hours PIC, 168.7 hours at night unaided, and 674.8 hours with night vision goggles. He reported upon the application, that he had the following flight times by aircraft make and model: EC 130-B4 – 250 hours, UH-1 and AH-1 – 233 hours, and AH-64 – 2,015.4 hours. The pilot reported on his application that he had 0 years of experienced working as an air medical pilot under Part 135 and had 0 hours of air medical flight time.

On November 20, 2013, the pilot successfully completed his initial Part 135 293a, 293b, and 299 checkride provided by a company check airman for EC130 helicopters and his transition to EC130 NVG on the same date.

On December 1, 2013, he was assigned as an EC130/EC130NVG pilot based at R07.

Air Method's and the pilot's previous employer did not have a copy of the pilot's Army Form 759. A copy of the form was requested from the pilot's wife by the National Transportation Safety Board (NTSB) Investigator-In-Charge (IIC), but the form was not received during the accident investigation.

The pilot had no previous FAA record of incident, accidents, or enforcement actions.

Aircraft and Owner/Operator Information

Aircraft Make:	Airbus Helicopters (Eurocopte	**Registration:**	N356AM
Model/Series:	EC-130-B4	**Aircraft Category:**	Helicopter
Year of Manufacture:	2010	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	7006
Landing Gear Type:	Skid	**Seats:**	5
Date/Type of Last Inspection:	March 5, 2015 AAIP	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:	1378.4 Hrs as of last inspection	**Engine Manufacturer:**	Tubomecca
ELT:	Installed, not activated	**Engine Model/Series:**	Arriel 2B1
Registered Owner:	PNC Bank NA Trustee	**Rated Power:**	730 Horsepower
Operator:	Air Methods Corporation	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	ARCH	**Operator Designator Code:**	QMLA

N356AM was a 2010 Airbus Helicopters (Eurocopter) EC-130-B4, serial number 7006, which was configured for EMS operations under Part 135. The helicopter was powered by a Turbomeca Arriel 2B1 turboshaft engine, serial number 46489.

The helicopter underwent its last inspection on March 5, 2015 at an airframe and engine total time of 1,378.4 hours, which was also the engine total time since new.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	CPS,413 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	22:53 Local	**Direction from Accident Site:**	145°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.31 inches Hg	**Temperature/Dew Point:**	3°C / -6°C
Precipitation and Obscuration:			
Departure Point:	St Louis, MO (MU05)	**Type of Flight Plan Filed:**	Company VFR
Destination:	St Louis, MO (MO55)	**Type of Clearance:**	None
Departure Time:	23:08 Local	**Type of Airspace:**	

The 2100 sounding wind profile indicated there was a surface wind from 183 degrees at 7 knots and the wind speed increased to 25 knots by 1,300 feet msl and became southwesterly. The sustained wind speed reached up to 30 knots at 2,000 feet msl. At 0000, similar wind conditions persisted though the inversion height now reached up to 2,100 feet msl with the wind speed around 40 knots at 2,000 feet msl, just below the top of the inversion height. This inversion height is critical with the stable air below 2,000 feet msl, as any mixing of the wind speed and direction below 2,000 feet msl would have caused moderate or greater turbulence and low-level wind shear (LLWS). RAOB also indicated likely LLWS below 3,000 feet msl at both 2100 and 0000 CST along with clear air turbulence being likely from the surface through 6,500 feet msl. As soon as the accident flight took off it would have likely experienced LLWS, clear air turbulence, and wind speeds up to 40 knots between the surface and 2,000 feet msl. Given the upper air charts, these wind speeds above the surface would have been expected.

Airport Information

Airport:	St Louis University Hospital H MO55	**Runway Surface Type:**	
Airport Elevation:	713 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	H1	**IFR Approach:**	None
Runway Length/Width:	50 ft / 50 ft	**VFR Approach/Landing:**	Full stop

Destination Helipad

The MO55 helipad is privately owned and was not subject to meeting regulatory requirements for helideck design requirements by the FAA and adherence to those regulatory requirements were

voluntary.

A letter by an FAA Airports Airspace Data Specialist, dated August 19, 1986, stated that following an on-site inspection of MO55 on May 7, 1986 or the 210 foot by 150 foot landing/takeoff area and a 50 foot by 50 foot touchdown area. The letter stated that there is adequate ingress/egress greater than 8-1, in two directions, 180 degrees apart. The letter stated that the aeronautical study of the proposed heliport [MO55] would adversely affect that safe and efficient use of airspace by an aircraft unless the following conditions are maintained:

- Clear approach/departure paths to the landing area for a minimum 8:1 glide slope . Obstruction clearance planes (glide slope), aligned with the direction of the approach/departure paths, extend outward and upward from the landing/takeoff area to the en route altitude at an angle of 8 feet horizontally to 1 foot vertically (8:1).
- A clear transitional surface for a minimum 2:1 slope. The transitional surface extends outward and upward from the edges of the landing/takeoff area and approach/departure clearance planes at an angle of 2 feet horizontally to 1 foot vertically (2:1) to a distance of 250 feet from the center of the landing and takeoff area and 250 feet from the centerline of the approach/departure clearance surfaces.

The NTSB IIC requested that the FAA perform post-accident inspection of MO55, which was performed on April 16, 2015. The inspection results were documented in a Heliport Safety Evaluation Report, Case Number: 2015–ACE–1749–NRA. The report cited 10 obstructions within the final approach and takeoff area (FATO)/safety area of the heliport/helipad and 4 obstructions outside the FATO/safety area. The 10 obstructions outside the FATO/safety area had a ranged in azimuth from 005 – 236 degrees and there were no obstructions from 236 – 005 degrees, or west, northwest.

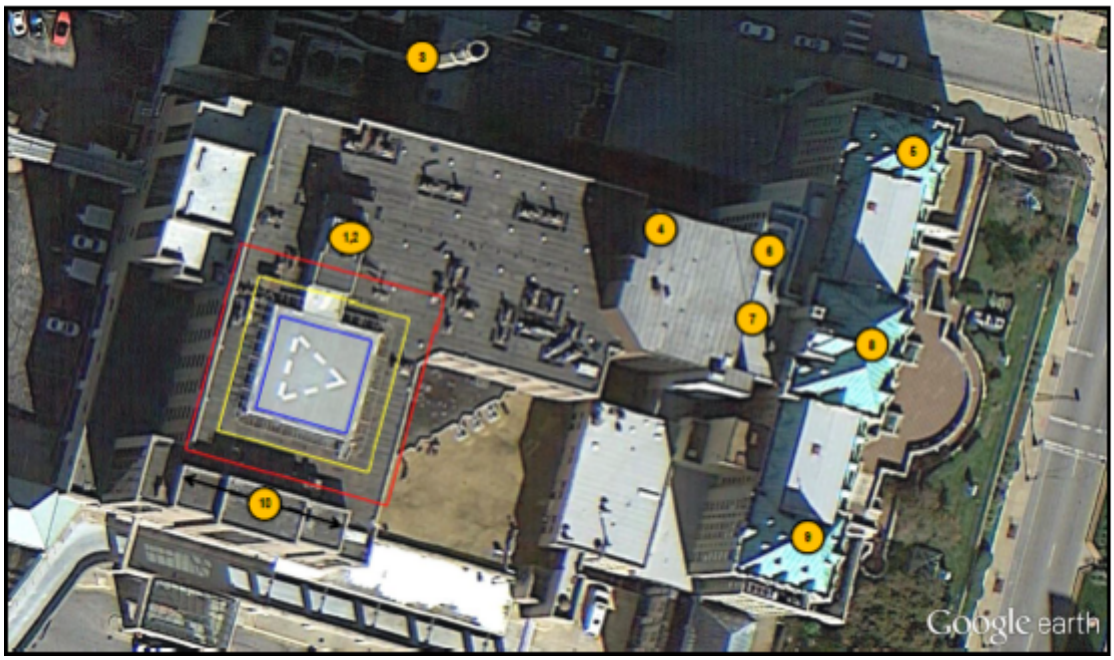

Figure 1: Obstructions Outside the FATO/Safety Area

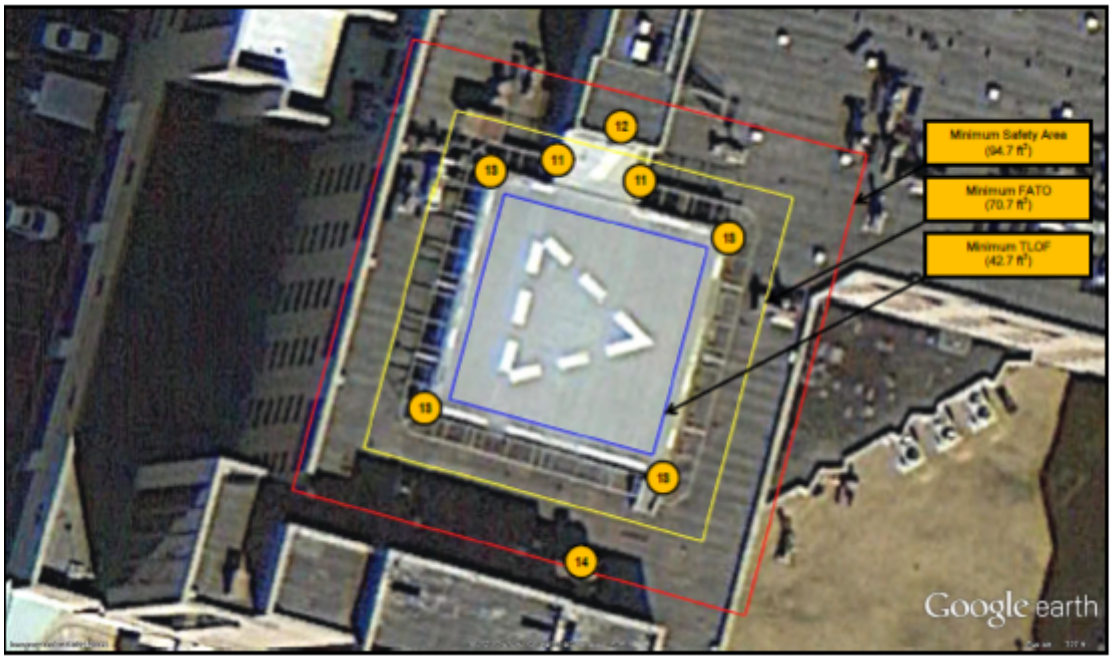

Figure 2: Obstructions Inside the FATO/Safety Area

The report's recommendations for ingress/egress stated:

"The heliport FATO/safety area is obstructed by permanent and semi-permanent objects that pose a

serious hazard to helicopter operations. The most serious obstructions cannot be easily lowered or removed. Flight Standards cannot recommend an approach/departure route into or out of a hazardous area that does not appear to have reasonable alternatives for mitigation. Therefore, no recommendation for ingress/egress is made in this case."

The medic said if there is a lot of wind, it is "always weird" coming in for approach to land at MO55. The nurse said that her knowing the area and the St Louis University Hospital helipad (MO55), she knew that it was going to be a "hard landing" on a good day."

A pilot that was not employed by Air Methods stated that he had flown in a Eurocopter "a handful of times. He said that flying into MO55 "is not the hardest pad but it's a difficult pad especially when the winds are at different angles and you have a lot of mechanical turbulence." The winds come around the building and can create a tailwind. Obstructions to the pad are the elevator shaft and buildings surround the pad. He takes new hire helicopter pilots and shows them the mechanical turbulence associated during flight training. He said that if "don't get set up at the right altitude and closure rate" for at MO55, you can "find yourself in a bad situation." He said the Baris hospital is "definitely more difficult to get into [than] MO55; you can have a headwind one minute and have a tailwind the next minute." He flies a Bell 206, which he said is not as strong as a Eurocopter 130 tailrotor. You can get into loss of tail rotor effectiveness approaching the wrong way during landing. His personal wind limitations are 25 knots with a gust spread of 10-12 knots. He feels "comfortable" with "steady winds of 25 knots." He said the Cardinal Glennon (MU52) hospital had a ground based helipad and using a ground pad required an arrangement to be made to transport a patient via an ambulance to the ground pad.

Nearest Ground Based Helipad

The nearest ground based helipad was MU52, which was located about 0.4 nautical miles west of MO55. The availability and its method of ground transportation from MO55 to MU52 prior to the accident was unknown to the investigation.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-ground
Total Injuries:	1 Fatal	**Latitude, Longitude:**	38.622222,-90.233612(est)

The main wreckage of the helicopter was located near the west parking lot entrance of the hospital. The wreckage and its debris were over an area estimated to be about 30 feet in diameter. The helicopter was oriented approximately toward the northeast as viewed from its tail to nose. There were blue colored witness marks alongside the top of the northern side of the west entrance for the building that were consistent with a strike by the helicopter tail.

Examination of the wreckage confirmed flight control continuity of the tail rotor drive system. Due to impact and fire damage, functional testing of the flight control system could not be performed.

Examination of the engine revealed that several of the axial blades exhibited foreign object damage. The gas generator and accessory gearbox could not be rotated by hand. The free turbine blades did not shed and could not be rotated by hand. The engine and helicopter were recovered to a salvage yard for further investigation.

All fuel, oil, and air connections were attached and their hoses sustained fire damage. The digital engine control unit was destroyed by fire.

The accessory gearbox magnetic plug was broken due to impact forces and could not be examined as well as the electronic chip detector. The reduction gearbox magnetic plug did not display metallic debris. The oil and fuel filters did not contain debris.

The reduction gearbox was removed and the input pinion alignment mark was in the over-torqued 4mm position, consistent with the engine providing power.

Upon removal of the gearbox, the free turbine could be rotated by hand but the powershaft still could not be rotated. The front support and liaison tube were removed and then the powershaft rotated freely and proper freewheel operation was confirmed.

Medical and Pathological Information

An autopsy of the pilot was conducted by the Office of the Medical Examiner City of St. Louis on March 7, 2015. The autopsy report stated the cause of death as "Thermal Burns and Smoke Inhalation."

The FAA Final Forensic Toxicology Fatal Accident Report of the pilot stated: no carbon monoxide detected in Blood (Femoral), cyanide- not performed, volatiles – no ethanol detected in vitreous, drugs – no listed drugs detected in urine.

Fire

A post-crash fire and explosion occurred upon impact when the helicopter impacted the parking lot adjacent to the building entrance which was captured by a security video. The following two frames

from a security camera show the explosion and fire that ensued after the helicopter's impact.

Figure 3: The top video frame at 11:17:14 PM shows the fire/explosion during the impact of N356AM and the bottom frame at 11:17:17 PM shows a fire ball separated from the initial fire and moved upwards and to the left of the screen in a direction consistent with approximate wind direction.

Survival Aspects

The autopsy determined the cause of death was thermal burns and smoke inhalation. It described severe thermal injuries to the entire body including multiple thermal fractures and soot deposition in the respiratory tract from the trachea to the bilateral bronchial tree. Traumatic injuries included a hairline fracture of the frontal bone, a sternal fracture, and a fracture of the fifth cervical vertebra without evidence of a spinal cord injury. Subarachnoid blood was attributed to extension of blood from the fracture in the cervical spine.

The autopsy identified coronary artery disease including 80 percent narrowing of the left anterior descending coronary artery. However, no focal lesions (evidence of an old or new heart attack) were identified in the heart muscle.

On March 23, 2016, the NTSB issued Safety Recommendations A-16-11 and A-16-8 through -10 pertaining to Airbus Helicopters EC-130-B4 and AS-350-B3e. Two 2015 accidents, one of which involved N356AM, had impact forces survivable for occupants but fatal and serious injuries occurred because of postcrash fires that resulted from an impact-related breach in the fuel tanks.

Tests and Research

Aircraft Performance Study

There was no sufficient radar data or nonvolatile memory aboard the helicopter to perform a performance study of the helicopter's accident flight.

Security Video

A review of the security video cited in the Fire section of this report, showed at about 11:16:52 PM, a light consistent in white color and shape of the helicopter landing light shining onto the hospital building facing the parking lot entrance where the helicopter later impacted. The light then moves toward the right edge of the building and about 11:17:03 PM, the light moves left, off the building. About 11:17:06 PM, a flash of white colored light appears in the camera. About 11:17:08 PM, the light moves from right to left across the hospital building face as a declination at an estimated approximate angle of 45 degrees. About 11:17:11 PM, the helicopter comes into view and descending at a similar declination angle and direction as was the light.

Settling With Power (Vortex Ring State)

According to the Helicopter Flying Handbook (FAA-H-8083-21A), Chapter 11, Helicopter Emergencies and Hazards:

"Vortex ring state describes an aerodynamic condition in which a helicopter may be in a vertical descent with 20 percent up to maximum power applied, and little or no climb performance. The term "settling

with power" comes from the fact that the helicopter keeps settling even though full engine power is applied. In a normal out-of-ground-effect (OGE) hover, the helicopter is able to remain stationary by propelling a large mass of air down through the main rotor. Some of the air is recirculated near the tips of the blades, curling up from the bottom of the rotor system and rejoining the air entering the rotor from the top. This phenomenon is common to all airfoils and is known as tip vortices. Tip vortices generate drag and degrade airfoil efficiency. As long as the tip vortices are small, their only effect is a small loss in rotor efficiency. However, when the helicopter begins to descend vertically, it settles into its own downwash, which greatly enlarges the tip vortices. In this vortex ring state, most of the power developed by the engine is wasted in circulating the air in a doughnut pattern around the rotor.

Critical Wind Azimuth or Maximum Safe Relative Wind Chart

According to the Helicopter Flying Handbook, Chapter 7, Helicopter Performance:

"The wind direction is also an important consideration. Headwinds are the most desirable as they contribute to the greatest increase in performance. Strong crosswinds and tailwind may require the use of more tail rotor thrust to maintain directional control. This increased tail rotor thrust absorbs power from the engine, which means there is less power available to the main rotor for the production of lift. Some helicopters even have a critical wind azimuth or maximum safe relative wind chart. Operating the helicopter beyond these limits could cause loss of tail rotor effectiveness."

Air Methods operates two other makes and models of single-engine helicopters, a Bell 407 GX and an AgustaWestland AW 119, both of whose flight manuals provide speed/azimuth wind charts. A review of the EC 130-B4 flight manual does not provide speed/azimuth envelope and the only guidance provided for the helicopter's stability and control relative to speed/azimuth was:

A review of the Eurocopter EC 130 B4 Flight Manual, Revision 9, revealed that the manual did not contain wind limits nor critical wind azimuth or maximum safe relative wind chart.

During the accident investigation, the NTSB Investigator-In-Charge requested that Airbus Helicopters perform a critical azimuth analysis and in response to that request, Airbus Helicopters provided the following charts showing pedal control and power required to maintain an out of ground effect hover relative to azimuth/wind speed.

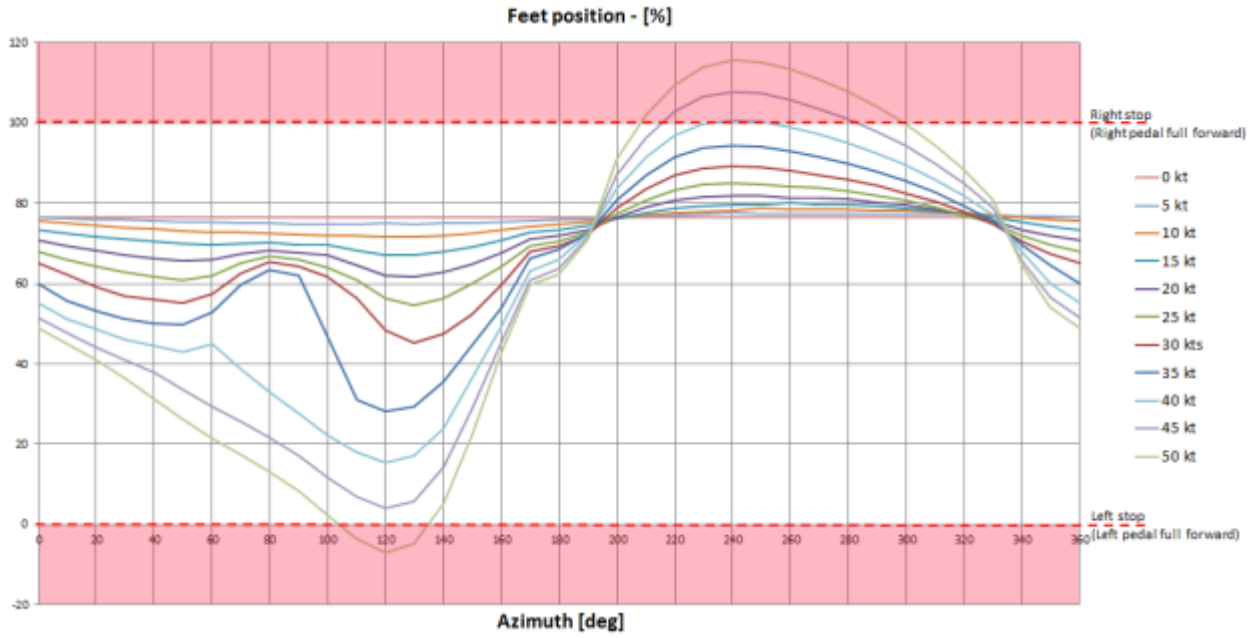

Figure 4: The plot shows percentage of foot position versus azimuth at wind speeds from 0-50 knots. The left stop limit occurs at azimuths of about 103 degrees to 138 degrees with a wind of 50 knots. The right pedal stop occurs at azimuths of about 230 degrees to 253 degrees at a wind speed of 40 knots; the azimuth range for the right pedal stop increases with increasing wind speeds of 45 knots and 50 knots.

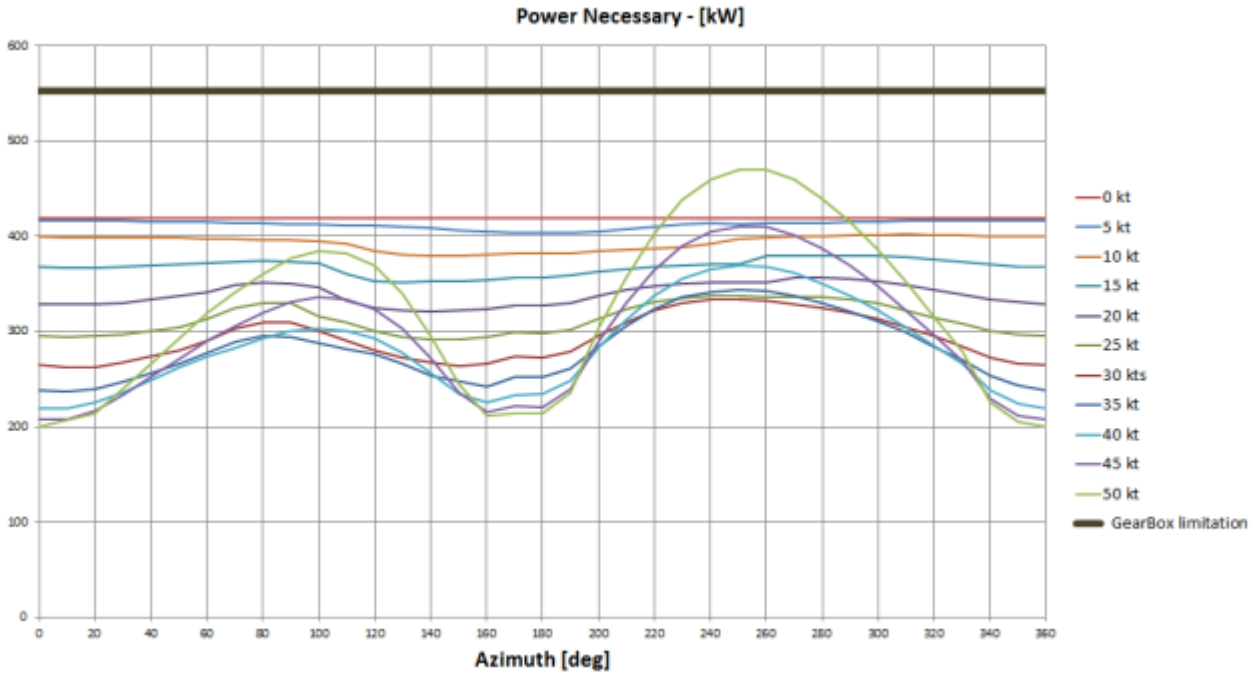

Figure 5: Plot of power necessary versus azimuth at wind speeds from 0-50 knots. The upper limit of power occurred at approximate azimuth of 223 degrees to 290 degrees with a wind speed of 50 knots.

Perspective of Handling Qualities of the EC-130-B4

A pilot flying emergency medical service helicopters since 2004. He said he had flown helicopters that included the BK136, EC130, Jet Ranger and "Hughey." He has a total flight time of about 17,000 hours, of which 9,700 hours are in helicopters. He said he had flown Chinook, Black Hawk, and OH58 helicopters.

He stated that flying into MO55 is "not that bad" for those pilots who are used to flying into confined areas. He said that the approach into MO55 is "almost a one way in and one way out." If there is a right or left crosswind, the approach into MO55 can be difficult but nothing that an experienced pilot can handle.

He said that the EC130 vertical fin is "extremely affected by a lot of wind," and he had to apply tail rotor pedal input to the pedal stops on certain occasions. The pedals are not boosted but are manual. He said that about every 100 hours or "a little over," the EC130 can have exhaust gases contaminate the blade roots of the Finestron. There is Teflon tape on the blade roots that allow for blade mobility. The exhaust contaminate may cause the blades to stick, which "can be felt in the rudder pedals." He said that in "only extreme cases the blades will stick."

When asked what his personal wind limits were, he said that if he is not "comfortable" with an approach/landing, he will fly to another landing zone.

Accident Flight Risk Assessment

The pilot completed a company risk assessment form dated March 6, 2015 with a time of 1751 for the flight to MO55 to drop off the medic, nurse and patient and a risk assessment total of low, which equated to 28; the flight request subtotal was 15 and the shift change subtotal was 13. Low risk was defined on the form to have a value of less than 30, and medium risk was defined with a value of 30-49. Item 3 of the form, pilot has less than 3,000 total rotor wing flight hours, which had a value of 4, was left blank.

An accredited representative from the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) was assigned to this investigation as the state of manufacture of the helicopter. The BEA provided comments on this report, which can be found in the docket.

Administrative Information

Investigator In Charge (IIC):	Gallo, Mitchell
Additional Participating Persons:	Randall Ottinger; Federal Aviation Administration; STL FSDO; St Louis, MO Don Lambert; Air Methods; West Mifflin, PA Brian Thomas; OPEIU Local 109; Fremont, NE
Original Publish Date:	June 22, 2016
Last Revision Date:	July 3, 2024
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=90830