Aviation Investigation Final Report

Location:	Manchester, Kentucky	**Accident Number:**	ERA13FA273
Date & Time:	June 6, 2013, 23:15 Local	**Registration:**	N114AE
Aircraft:	BELL HELICOPTER TEXTRON 206L-1	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The air ambulance repositioning flight was en route to base following a patient transfer. Weather information forecast about 3 hours before the accident indicated a moist environment; however, visual conditions were anticipated around the time of the accident. An updated forecast was published about 10 minutes before the accident, and it indicated that fog or low stratus cloud development was possible and that visibility could decrease to near or below airport weather minimums in the early morning hours. Witness statements and the reported weather conditions indicated that patchy fog had developed near the helipad at the time of the accident and that visibility at the accident site was 1/4 mile; however, the specific visibility conditions encountered by the helicopter during its approach could not be determined. A witness reported seeing the helicopter "flying lower than normal" and then spinning before impact. Another witness reported seeing the helicopter in a nose-down attitude and then impact the ground.

The wreckage was located in a school parking lot, which was about 750 feet from the landing pad and at an elevation of about 900 feet mean sea level (msl). The wreckage distribution was consistent with an in-flight separation of the main rotor and tailboom. An examination of the helicopter airframe, engine, and related systems revealed no preimpact anomalies that would have precluded normal operation. Both the main rotor assembly and tailboom separated in overload.

Review of GPS data showed the accident helicopter descending in three right circuits near the landing pad just before the accident. The final recorded data were in the immediate vicinity of the accident location and indicated an altitude of 1,437 feet msl. The maneuvering flightpath of the helicopter before the accident was consistent with an attempt to avoid fog followed by a loss of control. Although the pilot was instrument rated, he had not logged recent instrument time. Further, although the pilot had recent training in night vision goggle usage and had night vision goggles available during the flight, it could not be determined if he was using them at the time of the accident. Given the reports of fog in the area and the accident circumstances, it is likely that the pilot entered instrument meteorological conditions during the approach to the helipad, which resulted in spatial disorientation and loss of control.

Probable Cause and Findings

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

The pilot's loss of helicopter control due to spatial disorientation when he inadvertently encountered night, instrument meteorological conditions, which resulted in the in-flight separation of the main rotor and tailboom.

Findings

Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Identification/recognition - Pilot
Aircraft	(general) - Capability exceeded
Aircraft	(general) - Capability exceeded
Environmental issues	Fog - Effect on personnel

Factual Information

History of Flight

Approach-VFR pattern final	VFR encounter with IMC
Approach-VFR pattern final	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Explosion (post-impact)

HISTORY OF FLIGHT

On June 6, 2013, about 2315 eastern daylight time, a Bell 206 L-1, N114AE, was destroyed when it impacted the ground in an elementary school parking lot while on approach to the company's helicopter landing zone near Manchester, Kentucky. Night visual meteorological conditions prevailed; however, reports of patchy fog were reported by numerous eyewitnesses and a company visual flight rules flight plan was filed. The airline transport pilot and two medical personnel were fatally injured. The helicopter was owned and operated by Air Evac EMS Inc. and was operated under the provisions of Title 14 Code of Federal Regulations Part 91 as a repositioning flight to the company-owned helipad. The flight originated from the St. Joseph-London Heliport (5KY9), London, Kentucky about 2259.

Numerous eye and auditory witness statements were recorded by the Kentucky State Police and reported to the NTSB for reference. Several eyewitnesses reported to the State Police that the helicopter was observed "flying lower than normal" and "spinning" prior to impact. Some of the eyewitnesses reported that there was no fog in the area and the sky was clear at the time of the accident. Other eyewitnesses reported that while driving down the road that ran in front of, and parallel to, the elementary school, and located between the accident site and the intended landing location, they observed the helicopter in a nose down attitude, impact the ground, and subsequently engulfed in a fireball; however, they also stated the visibility at the time was around 1/4 mile. The eye and auditory witnesses that reported the clear skies were at their residence about 1/2 mile from the accident site on the opposite side of the creek that ran along the back side of the school. One of the eyewitnesses observed the helicopter in a tail low attitude, then in a more level attitude prior to the engine noise ceasing, which took place prior to the accident.

PERSONNEL INFORMATION

According to Federal Aviation Administration (FAA) and company records, the pilot held an airline transport pilot certificate with a rating for airplane multiengine land and a held a type rating in CE-500 airplanes, a commercial pilot certificate with ratings for airplane single-engine land, helicopter, and instrument helicopter, and a control tower operator certificate with limitations for Simmons Army Airfield, NC GCA only. He also had a flight instructor certificate for airplane single-engine, multiengine, and instrument airplane. He held a second-class medical certificate, which was issued on January 4, 2013, and had one restriction of "must have available glasses for near vision."

According to company records, the pilot was hired on February 16, 2013. At that time the pilot reported that he had 4,877 total hours of flight experience and 1,902 flight hours in helicopters, of which, 1,600 total flight hours were in Bell 206/OH 58 Helicopters. Since the start of his employment, the company had recorded 54.4 total flight hours for the pilot, not including the flights on the day of the accident. The pilot had completed ground training on February 16, 2013, and flight training on March 3, 2013, in the handling and use of the ITT Model F4949 night vision goggles. The operator reported that the pilot had no previous recorded night vision goggle flight time, and that since employment, he had logged 13.2 total hours of night vision goggle experience.

According to records provided by the operator, in the 3 days preceding that accident, the pilot had worked 3 shifts with a total of 36.6 hours of duty and 2.5 hours of total flight time. According to the company records, during that period of time the pilot had 53.2 total hours of "Hours Off" time.

AIRCRAFT INFORMATION

According to FAA and company records, the helicopter was issued an airworthiness certificate on September 26, 1980 and was registered to Air Evac EMS, Inc on October 31, 2002. It was equipped with an Allison 250-C30P engine, with 650 shaft horsepower. The helicopter was modified with enhanced power and increased payload, which gave it a further designation of an "L-1 Plus." The helicopter was on an Approved Airworthiness Inspection Program (AAIP) and its most recent event 1 inspection was completed on June 6, 2013. The helicopter was equipped with a SkyTrac system, which recorded data in 5 second intervals and some of the data was transmitted to the operator's enhanced operation control center (OCC) once every minute.

COMMUNICATIONS

Communication recordings obtained from the operator, indicated that at 2312:24, the pilot announced that "one oh nine roger show us arriving at the base" followed by the Operators Central Communication (CENCOM) responding at 2312:30, with "air evac one oh nine got you on final for base." At 2315:02, a recording of a male voice was captured and stated "no." No other recordings were captured for the accident flight.

METEOROLOGICAL INFORMATION

The 2339 recorded weather observation at London-Corbin Airport-Magee Field (LOZ), London, Kentucky, included calm wind, 2 1/2 miles visibility due to mist, scattered clouds at 8,000 feet above ground level (agl), temperature 19 degrees C, dew point 19 degrees C, and a barometric altimeter of 29.80 inches of mercury

The 2253 record weather at LOZ included calm wind, 6 miles visibility due to mist, scattered clouds at 5,500 feet agl, temperature 20 degrees C, dew point 19 degrees C and a barometric altimeter of 29.81 inches of mercury.

The NWS Surface Analysis Chart for 2300 EDT depicted a low-pressure center very near the accident location, with a cold front extending southwest, and a warm front extending east from the low-pressure center. A separate cold front was advancing from the north through the northern portion of Kentucky. Surface temperatures in eastern Kentucky and eastern Tennessee were generally in the high 60's° F.

Dew point temperatures were in the mid- to high 60's°F. Station models depicted the wind as calm or light, with one station near the accident site reporting mist.

A NWS Weather Depiction Chart for 0000 EDT on June 7, 2013, depicted fronts in a similar fashion to the Surface Analysis Chart. In addition, the Weather Depiction Chart, which provides contours for areas of IFR and MVFR conditions, indicated the accident location was in an area of VFR conditions with ceilings greater than 3,000 feet agl and a visibility greater than 5 miles.

An Area Forecast Discussion (AFD) was issued at 2053 EDT by the NWS Weather Forecast Office in Jackson, Kentucky (KJKL). The aviation portion of the AFD, which was originally issued at 2005 EDT in a previous AFD, was:

FXUS63 KJKL 070253 AAB AFDJKL
AREA FORECAST DISCUSSION...UPDATED NATIONAL WEATHER SERVICE JACKSON KY
1053 PM EDT THU JUN 6 2013

.AVIATION...(FOR THE 00Z TAFS THROUGH 00Z FRIDAY EVENING) ISSUED AT 805 PM EDT THU JUN 6 2013
ISOLATED CONVECTION IS POSSIBLE UNTIL AN HOUR OR TWO PAST
SUNSET AT THE TAF SITES AND WELL INTO THE NIGHT OVER THE FAR SOUTHEAST.
FOG OR LOW STRATUS DEVELOPMENT CANNOT BE RULED
OUT AT THE TAF SITES...BUT THERE MAY BE ENOUGH CLOUDS THROUGH THE NIGHT TO KEEP CONDITIONS FALLING AS LOW AS MUCH OF THE GUIDANCE SUGGESTS. LAMP AND OTHER GUIDANCE SUGGESTS CONDITIONS FALLING TO NEAR...IF NOT BELOW AIRPORT MINIMUMS OVERNIGHT. CONFIDENCE IN THIS WAS NOT ALL THAT HIGH DUE TO UNCERTAINTY IN CLOUD COVER OVERNIGHT...BUT OPTED TO TREND IN A PERIOD OF IFR AT THE TAF SITES BETWEEN ABOUT 7Z AND 14Z.
WINDS SHOULD BE LIGHT AND VARIABLE THROUGH THE PERIOD.

One Airmen's Meteorological Information (AIRMET) advisory was active at low altitudes for the accident location at the accident time. This AIRMET for IFR conditions was issued at 2245 EDT:

WAUS43 KKCI 070245
WA3S
_CHIS WA 070245
AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 070900
.
AIRMET IFR...IN KY TN
FROM 20S FWA TO CVG TO HNN TO HMV TO GQO TO 40W IIU TO 20SSW IND TO 20S FWA
CIG BLW 010/VIS BLW 3SM BR. CONDS DVLPG 03-06Z. CONDS CONTG
BYD 09Z THRU 15Z.

AIRPORT INFORMATION

The intended helipad was privately owned, by the operator, and at the time of the accident did not have an operating control tower. The helipad was 40 feet by 40 feet and was located approximately 750 feet northwest of the accident site. The helipad was 895 feet above mean sea level.

WRECKAGE AND IMPACT INFORMATION

The helicopter impacted an elementary school parking lot on its right side and in a partially inverted attitude. According to surveillance video, the helicopter exploded on impact and a fireball ensued. The accident flight path was oriented on a 268 degree heading. The debris path began approximately 300 feet prior to the main wreckage and terminated approximately 90 feet past. The main rotor blades and upper deck of the helicopter came to rest approximately 300 feet prior and to the east of the impact site. The tailboom aft of the aft bulkhead and tailrotor with the gear box still attached came to rest about 300 feet to the northeast of the impact location. Both items came to rest in a tree line that ran perpendicular to the flight path and the main rotor and upper deck assembly came to rest immediately below a 3 phase power line. According to local authorities, the power line was not severed; however, a cross member located on a pole near the accident site had given way resulting in a power outage in the area. A tree, approximately 80 feet in height, located near the main rotor blade, exhibited limb damage towards the top, which was consistent with damage produced by rotor blades although due to the height it could not be confirmed. A fluid splatter, similar in appearance as an oil splatter, was located from about 100 feet prior to the wreckage up to the wreckage and was about 30 feet in width. The left side patient/crew door was located along the debris path and to the north of the path. The inside of the door exhibited hydraulic oil splatter through the entire interior.

Cockpit/Cabin Section

The cockpit/cabin section was thermally damaged and according to local authorities came to rest inverted. The engine was co-located with the cabin section. The left side instrument panel remained intact and exhibited thermal damage. The pilot's instrument panel and overhead panel were thermally damaged and did not yield any pertinent information. Examination of the pilot seat revealed extensive thermal damage; however, the seat belt mechanism was located, and was latched with the shoulder harness also secured to the latching mechanism. The anti-torque pedals were impact separated and one pedal exhibited overstress factures. Due to the extensive thermal and impact damage neither the cyclic nor collective remained attached. However, control continuity was confirmed from the aft bulkhead to the tail rotor through the tailboom fracture points. Examination of the remaining seatbelts indicated that two sets of shoulder harness latches associated with the flight nurse and paramedic seats were unsecured, The patient transport stretcher was located in the vicinity of the cockpit; however, exhibited extensive thermal damage. The seat belt latches associated with the stretcher appeared to be latched.

The landing skid assembly was located about 35 feet forward and to the left of the main wreckage as viewed from the debris path and was separated from the fuselage of the helicopter. The rear attach area exhibited some thermal damage but no other thermal damage was noted on the landing skid assembly. The right side of the skid gear, as viewed from the tail of the helicopter, had crush damage on the aft portion of the gear and was impact separated at the aft cross tube. The forward portion of the skid exhibited crush damage on the side wall of the skid tube, as well as numerous scraping and gouge marks along the tube. The right hand step was also impact separated at the forward attach point. The left hand tube and step exhibited slight inward bowing about midspan of the tube; it remained attached to the gear assembly.

Airframe

The tailboom fractured just aft of the intercostal support and forward of the horizontal stabilizer. The forward portion of the tailboom skin exhibited fracture marks consistent with compressive forces. The right side of the fuselage exhibited impact and crush damage consistent with a right side low at impact. The main and tail rotor flight controls exhibited impact and thermal damage. The fractures and position of the wreckage were consistent with an inflight breakup prior to ground impact.

Engine

The engine was co-located with the main wreckage and was found inverted. The engine remained attached through one engine mount and several steel braided hoses, the other engine mounts exhibited impact and thermal damage and were impact fractured. The compressor impeller blades rotated by hand with some resistance noted; however, several blades exhibited extensive damage to the blade tips. The upper and lower chip detectors were removed, examined, and did not display any debris. The engine was removed from the helicopter and shipped to the engine manufacturer for further examination.

Main Rotor Assembly and Transmission

The main rotor assembly and transmission (upperdeck) was located to the south side of the debris path about 300 feet prior to the main wreckage. The upperdeck came to rest at the edge of a ditch immediately below 3-phase power lines. The power lines exhibited marks similar to impact marks created by a falling object from above. The blades exhibited a braided pattern along the bottom side similar to the braided wire pattern of the 3-phase wires. Approximately 3 feet of the tip of one blade was impact separated. The fracture marks exhibited overstress signatures consistent with an overstress fracture. The mast exhibited a slight S-bend along the length. The transmission was rotated utilizing the connecting rod and continuity was confirmed through the main rotor system. The K-Flex main drive shaft was located in the parking lot approximately 75 feet from the main wreckage and exhibited rotation scoring on the engine end outer diameter consistent with contact during rotation with the forward engine firewall. No evidence was located along the leading edge of the blades that would be consistent with striking a stationary object; however, 65 inches from the center of the mast and 11.5 inches in length was faint paint transfer marks consistent with the paint color of the helicopter. Examination of the right side engine cowling exhibited a main rotor blade impact mark. Both chip detectors were removed, examined, and noted as unremarkable.

Tail Section

The tail rotor assembly remained attached to the tailboom. The tail rotor blades exhibited minimal leading edge damage and the vertical tail assembly had been impact separated from the tail boom; however, the vertical tail assembly was located in a tree in the immediate vicinity of the tail boom. Continuity was confirmed from the fracture point to the rotor blades as well as to the horizontal stabilizer. The tail rotor drive assembly shroud was removed and the assembly was examined. The drive assembly hangers aft of the fracture point exhibited aft movement and rotational scoring on the hanger assembly. The assembly hangers forward of the fracture point exhibited forward movement and rotational scoring on the hanger assembly. The tail rotor driveshaft remained connected to the end of the freewheeling unit and the splined shaft coupling was disconnected from the oil cooler. The driveshaft exhibited a fracture adjacent to the tailboom fracture. The chip detector was removed and examined and was unremarkable.

The report for the postaccident airframe examination is included in the public docket for this accident investigation.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

The FAA issued Air Evac EMS, Inc., an operating certificate in February of 1986 to conduct on demand emergency medical service transports. At the time of the accident, Air Evac conducted air ambulance operations in 15 states with 114 bases. The accident crew was based at Manchester, Kentucky. The corporate headquarters, including training, the Director of Operations, Chief Pilot, and Director of Safety were located in O'Fallon, Missouri. The FAA Flight Standards District Office in St. Louis, Missouri managed the operating certificate.

The company operated 2 different make and models of helicopters, and employed about 450 pilots. Prior to employment, each pilot was required to have a minimum of 2,000 hours total time; 500 hours turbine time, 100 hours of night flying, and an instrument rating.

TEST AND RESARCH

Engine Examination

The engine was disassembled and examined at the Rolls-Royce facility at Indianapolis, Indiana on July 9, 2013. During the engine examination nothing was discovered that would prevent normal engine operation. Rotation scoring signatures were noted throughout the different blade sections and were consistent with engine operation at impact.

The engine examination report is included in the public docket for this accident investigation.

Examination of Bird Remains

Several samples of potential bird matter were taken from an area around the pitch change links, located on the main rotor assembly and sent to the Smithsonian Institution's Feather Identification Laboratory in Washington, D.C. The samples were microscopically examined by personnel at the laboratory for evidence of feather remains, no remains were found. DNA testing was conducted and two of samples contained DNA. One sample contained a 94 percent match to the order of birds that includes perching birds. The other sample contained a 99.6 percent match to an Empidonax minimus also known as a Least Flycatcher. For the Laboratory to consider the sample test reliable a 98 percent or better is required.

ADDITIONAL INFORMATION

Pre Flight Risk Assessment

Air Evac pilots were required to use a Risk Assessment Worksheet prior to all air medical and air medical reposition flights. There were two versions of the worksheet, the short form, and the long form.

The short form had 17 areas of review. Each area was assigned a numerical point, or points, by the pilot. The area's point(s) were added into a final tally of points, which was considered the flight's risk assessment. The short form areas included pilot experience with the company, pilot experience in the

make and model of the helicopter, and weather and terrain for the flight. The 10 areas under weather and terrain were further broken down into a point assignment for day operations and a higher point assignment for night operations. If the total point value of the short form was less than 35 points, pilots were advised that the flight is at their "discretion." If the total of the short form was 35 points or greater, the pilot was required to complete the long form and consult with the operational control center.

The long form had 31 areas to be reviewed and scored the same way as the short form. A score of 35 points or less was low risk with the conduct of the flight being pilot's choice. A score of 35 points to 60 points was low to moderate risk, advising the pilot to exercise caution. A score of 61 points to 99 points was moderate to high risk, advising the pilot to exercise extreme caution. A score of 100 points and above was high risk, and the flight was not permitted. Use of the long form and consultation with the operational control center was required for all risk levels above 34 points.

The risk score for the accident flight was 30 points, as reported by the pilot prior to the flight, which did not require the use of the long form, and did not require a consultation with the operational control center.

Operations Specifications

According to the operator's weather minimums, criteria for flying at night in mountainous conditions varied depending on if the helicopter was equipped with Night Vision Imaging System (NVIA) or Terrain Awareness Warning System (TAWS). Furthermore, weather minimum criteria were based on if the flight was a "local" or "cross country" flight. The General Operations Manual Section 5.20, defined the "local flying area" during daylight hours as 25 nautical miles (NM) from the base and the "night local area" was 5 NM from the base, all other flights were considered "cross country." Since the accident helicopter was equipped with the proper equipment, as specified in the General Operations Manual, and the flight was considered "cross country," the weather minimums for the accident flight were 1000 foot ceilings and the visibility minimum was 5 statute miles.

Air Evac Pilot Training

At the time of the accident, Air Evac conducted ground and simulator-based training with their pilots. The pilots received ground training on an annual basis, which included situational awareness, human factors, patient interaction and awareness, critical incident task saturation, workload management, risk assessment, loss of tail rotor effectiveness, weather, and weather preparedness for the day to enhance launch decision making. Additional training included all required aspects of Parts 91 and 135 as well as night operations, the FAA approved night vision goggle (NVG) curriculum, and recovery from inadvertent instrument meteorological conditions (IIMC) conditions. The pilots received simulator training every six months. The simulator training included unusual attitudes and recovery from IIMC, a PAR/ASR approach, a GPS approach, simulated white out and brown out conditions, and several emergency procedures. The emergency procedures included engine failures, hydraulic failures, and component failures.

The pilots also received NVG flight and ground training. Flight training was conducted at night flying various maneuvers, experienced different emergency procedures, system failures, and flight into various lighting conditions. In addition, IMC conditions were simulated.

Operational Control Center

Air Evac operated one main Operational Control Center (OCC) located in O'Fallon, Missouri. The OCC was manned by multiple dispatchers performing the functions of call taking and flight following. These dispatchers were not FAA certificated aircraft dispatchers; however, they were trained in emergency response. Each dispatcher worked a 12-hour shift and EMS operations at Air Evac were conducted 24 hours a day, 7 days a week. In addition to flight followers, the OCC was staffed 24/7 with "Operational Controllers." Air Evac Operations Specifications - A008 OPERATIONAL CONTROL lists Tier 1 Operational Control: "The Operational Control Center (OCC), through the authority of the Director of Operations, and through the Chief Pilot, exercises Operational Control of company aircraft. The OCC has the authority to decline a flight request, or terminate a flight, in the interest of safety."

The Operational Controllers did not perform the duties of Flight Followers, rather their purpose was to serve as a resource, available by radio, to assist the pilot with weather, publications, and emergency information, if requested.

Each dispatch and operation controller station was equipped with a computer, several monitors, a telephone, and a radio. Each computer was equipped with software to provide updated weather information, satellite tracking of all active operations, flight details, and flight timers. Each conversation was recorded.

All calls for dispatch were made to the OCC. The dispatcher would determine which aircraft was best positioned for the mission, track base status, and would notify the crew by either a page, radio call, or telephone call. Base status was determined at crew change and as the shift progressed, with changes in weather/crews.

SkyTrac

SkyTrac provided satellite-tracking capabilities and could provide GPS coordinates, ground speed, a pictorial depiction of aircraft location, and text communications between the aircraft and dispatch. Immediately after the aircraft's power was applied the system tracking became active. SkyTrac recorded the aircraft latitude and longitude position every 5 seconds and every 60 seconds it would send the OCC a position update. Once the flight had landed uneventfully, the dispatcher closed out the flight record. Review of global positioning system data depicted the accident helicopter descending in three right circuits in the vicinity of the landing pad, just prior to the accident. The final recorded data was at 2314:44 and indicated an altitude of 1437 feet above mean sea level on a heading of 315 degrees and an groundspeed of 6 knots in the immediate vicinity of the accident location.

Night Vision Goggles

According to the operations specifications, the helicopter was equipped with two ITT model F4949 NVGs. One goggle was designated for the pilot and the other was for either the flight medic or flight nurse to be worn, when the pilot was landing utilizing NVG's. These goggles are equipped with a rear-mounted, low-profile battery pack, which utilizes four AA alkaline batteries. The power was provided by a cable extending from the battery pack, over the helmet, and into a connector in the mount. The NVG consisted of two components, the mount assembly and the binocular assembly. The mount assembly was designed to be secured to the helmet and hold the binocular assembly in position. The

binocular assembly consisted of a pair of monocular assemblies which incorporate the optical elements as well as numerous adjustment controls. The goggles included flip-up/flip-down capability.

United States Army Field Manual (FM) 3-04.203, Fundamental of Flight, May 2007

The United States Army has incorporated NVGs into their flying programs, several decades prior to the accident. While not required reading for civilian pilots, FM 3-04.203 was developed to educate pilots on the principles surrounding aviation and to better prepare the pilot to react to unexpected conditions. In Chapter 4, "Rotary-Wing Night Flight," several passages describe the hazards and risks of night flight with night vision systems. Section 4-89 "Weather" states in part "When using NVGs, aviators may fail to detect entry into or presence of IMC. NVGs enable crewmembers to see through obscurations, such as fog, rain, haze, dust and smoke, depending on density. As density increases, aircrews can detect a gradual reduction in visual acuity as less light is available. Certain visual cues are evident when restriction to visibility occurs. The apparent increase in size and density of halos during bad weather is an illusion. The halos are due to the electron spread for bright light sources, size remains the same. Any reduction in visibility decreases light intensity and reduces density of the halo. While contrast decreases, video noise may increase. There may be a loss of celestial lights, while the moon and stars may fade or disappear due to overcast conditions. When these conditions are present severity of the condition is evaluated and appropriate action taken. Actions include reducing airspeed, increasing altitude, reversing course, aborting the mission, or landing. If visual flight cannot be maintained the crew must execute appropriate IMC recovery procedures."

Spatial Disorientation

According to the FAA Airplane Flying Handbook (FAA-H-8083-3), "Night flying is very different from day flying and demands more attention of the pilot. The most noticeable difference is the limited availability of outside visual references. Therefore, flight instruments should be used to a greater degree.… Generally, at night it is difficult to see clouds and restrictions to visibility, particularly on dark nights or under overcast. The pilot flying under VFR must exercise caution to avoid flying into clouds or a layer of fog." The handbook described some hazards associated with flying in airplanes under VFR when visual references, such as the ground or horizon, are obscured. "The vestibular sense (motion sensing by the inner ear) in particular tends to confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in the attitude of the airplane, nor can they accurately sense attitude changes that occur at a uniform rate over a period of time. On the other hand, false sensations are often generated; leading the pilot to believe the attitude of the airplane has changed when in fact, it has not. These false sensations result in the pilot experiencing spatial disorientation."

According to the FAA Instrument Flying Handbook (FAA-H-8083-15), a rapid acceleration "...stimulates the otolith organs in the same way as tilting the head backwards. This action creates the somatogravic illusion of being in a nose-up attitude, especially in situations without good visual references. The disoriented pilot may push the aircraft into a nose-low or dive attitude."

The FAA publication Medical Facts for Pilots (AM-400-03/1), described several vestibular illusions associated with the operation of aircraft in low visibility conditions. Somatogyral illusions, those involving the semicircular canals of the vestibular system, were generally placed into one of four categories, one of which was the "graveyard spiral." According to the text, the graveyard spiral, "…is

associated with a return to level flight following an intentional or unintentional prolonged bank turn. For example, a pilot who enters a banking turn to the left will initially have a sensation of a turn in the same direction. If the left turn continues (~20 seconds or more), the pilot will experience the sensation that the airplane is no longer turning to the left. At this point, if the pilot attempts to level the wings this action will produce a sensation that the airplane is turning and banking in the opposite direction (to the right). If the pilot believes the illusion of a right turn (which can be very compelling), he/she will reenter the original left turn in an attempt to counteract the sensation of a right turn. Unfortunately, while this is happening, the airplane is still turning to the left and losing latitude.

Pulling the control yoke/stick and applying power while turning would not be a good idea–because it would only make the left turn tighter. If the pilot fails to recognize the illusion and does not level the wings, the airplane will continue turning left and losing altitude until it impacts the ground."

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	61
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	January 4, 2013
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 24, 2013
Flight Time:	(Estimated) 4937 hours (Total, all aircraft), 1660 hours (Total, this make and model), 4710 hours (Pilot In Command, all aircraft), 49 hours (Last 90 days, all aircraft), 17 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	BELL HELICOPTER TEXTRON	**Registration:**	N114AE
Model/Series:	206L-1	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	45507
Landing Gear Type:	High skid	**Seats:**	3
Date/Type of Last Inspection:	June 6, 2013 Continuous airworthiness	**Certified Max Gross Wt.:**	4450 lbs
Time Since Last Inspection:	1 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	19772 Hrs as of last inspection	**Engine Manufacturer:**	Allison
ELT:	C126 installed, not activated	**Engine Model/Series:**	250-C30P
Registered Owner:	AIR EVAC EMS INC	**Rated Power:**	650 Horsepower
Operator:	AIR EVAC EMS INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	Evac 109	**Operator Designator Code:**	EVCA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	LOZ,1212 ft msl	**Distance from Accident Site:**	16 Nautical Miles
Observation Time:	22:53 Local	**Direction from Accident Site:**	260°
Lowest Cloud Condition:	Few / 5500 ft AGL	**Visibility**	6 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.8 inches Hg	**Temperature/Dew Point:**	21°C / 19°C
Precipitation and Obscuration:	N/A - None - Mist		
Departure Point:	London, KY (5KY9)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Manchester, KY	**Type of Clearance:**	VFR
Departure Time:	22:59 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	3 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-ground
Total Injuries:	3 Fatal	**Latitude, Longitude:**	37.132778,-83.756385

Administrative Information

Investigator In Charge (IIC):	Etcher, Shawn
Additional Participating Persons:	Randall D Sizemore; Federal Aviation Administration; Louisville, KY Charles B Holsclaw; Federal Aviation Administration; Louisville, KY Mark C Stuntzner; Bell Helicopter; Ft. Worth, TX Casey Lehman; Rolls-Royce; Indianapolis, IN Tony Bonham; Air Evac EMS, Inc; O'Fallon, MO Dave Hardin; Air Evac EMS, Inc; O'Fallon, MO John R Britten; Transportation Safety Board of Canada; Gatineau
Original Publish Date:	September 24, 2014
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=87119