# Aviation Investigation Final Report

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| **Location:** | LITTLETON, Colorado | **Accident Number:** | FTW98FA068 |
| **Date & Time:** | December 14, 1997, 22:00 Local | **Registration:** | N771AL |
| **Aircraft:** | Bell 407 | **Aircraft Damage:** | Destroyed |
| **Defining Event:** | | **Injuries:** | 4 Fatal |
| **Flight Conducted Under:** | Part 135: Air taxi & commuter - Non-scheduled - Air Medical (Unspecified) | | |

## Analysis

On takeoff from an automobile accident site, with the patient on board, the air ambulance flight made a climbing right turn and flew into power lines. Witness marks on the helicopter provided evidence the helicopter struck the transmission line from below and impacted the ground in an inverted attitude below and to the west of the lines. Light conditions were a dark night with emergency response, construction, and emergency response vehicle lights illuminating the landing site area. The existence of the power lines was unknown to the fire rescue on-scene commander and the light conditions prevented the pilot from seeing anything outside the lighted area. The unmarked power lines were 622 feet apart and oriented northeast/southwest. The southern tower was 106 feet high and the northern tower 83.5 feet high. The towers and lines did not meet obstruction-marking criteria and were not marked. In addition, they were not depicted on sectional or topographic maps. Company policy, promulgated through documents and training, provided landing zone departure procedures which instructed the pilot to climb straight ahead in a near vertical climb to a minimum of 300 feet agl before turning. The horizontal distance from the helicopter's takeoff position to the power line was approximately 630 feet based on global positioning system (GPS) measurement.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's inability to maintain adequate visual lookout due to the lighting conditions and his failure to follow company procedures for departure from a landing zone. Factors were dark night conditions, bright lights in the landing zone which prevented vision beyond the zone, and the power line existence was not available on charts to either the pilot or ground personnel.

## Findings

Occurrence #1: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. OBJECT - WIRE,STATIC
2. OBJECT - WIRE,TRANSMISSION
3. (F) LIGHT CONDITION - DARK NIGHT
4. (F) LIGHT CONDITION - OTHER
5. (F) VISUAL LOOKOUT - NOT POSSIBLE - GROUND PERSONNEL
6. (C) VISUAL LOOKOUT - NOT POSSIBLE - PILOT IN COMMAND
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Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
7. TERRAIN CONDITION - GRASS
8. (F) INFORMATION - NOT AVAILABLE - GROUND PERSONNEL
9. (F) INFORMATION - NOT AVAILABLE - PILOT IN COMMAND
10. (C) PROCEDURES/DIRECTIVES - NOT FOLLOWED - PILOT IN COMMAND

## Factual Information

HISTORY OF FLIGHT

On December 14, 1997, at 2200 mountain standard time, a Bell 407 helicopter, N771AL, operated by Air Methods Corporation as an air ambulance, impacted power lines then terrain during initial climb following takeoff from an accident scene in Littleton, Colorado. The helicopter was destroyed and the commercial pilot, two flight nurses, and the patient received fatal injuries. Visual meteorological conditions prevailed and a company flight plan was filed for this medical evacuation flight operating under Title 14 CFR Part 135. The flight departed a hospital in Aurora, Colorado, approximately 20 minutes prior to the accident.

According to witnesses, the flight arrived from the northeast and circled the site clockwise before landing heading south on U. S. Highway 85. After picking up the patient, who was one of the victims in a multiple injury/fatality automobile accident, the flight was on initial climb following takeoff, and in a right turn, when it struck power lines. The lines were to the west of the takeoff point across the South Platte River and located on a riverside golf course bounded on the west by condominiums.

Measurements, information from Public Service Company, and the witness marks on the helicopter provided evidence the helicopter struck the transmission line from below and impacted the ground in an inverted attitude below and to the west of the lines.

PERSONNEL INFORMATION

The pilot was a former U. S. Army helicopter pilot and reportedly had extensive rotary wing experience. He held commercial pilot certificate number 1987204, issued January 17, 1979, with a helicopter rating. He held an instrument rating in helicopters.

According to the company, he had 4,118 hours of flight experience, all of which was in helicopters, and had 122 hours of flight experience in the Bell 407. He had 583 hours of night flying experience and 333 hours of simulated instrument experience. He did not have any actual instrument flight time recorded.

Federal Aviation Administration (FAA) records provided information the pilot held a first class medical certificate issued June 3, 1997, with the restriction that he wear corrective lenses while exercising the privileges of the certificate.

According to company records, the pilot was hired on June 6, 1996, and completed initial flight training, including a 14 CFR Part 135 flight check on July 1, 1996. During initial training he received 11 hours of flight instruction in the Bell 206 L-3 which is certified for both VFR and IFR

operation.

He completed Bell Helicopter factory training on the Bell 407 on February 3, 1997. The training included 2.2 hours of flight training and was VFR only.

He completed recurrent ground training on February 18, 1997, and recurrent flight training in the Bell 407 on May 4, 1997. His flight check in the Bell 407 was completed on May 5, 1997. He then had another recurrent training session in the Bell 407 on December 5, 1997. The training was VFR only because the Bell 407 was certificated for VFR only operations.

Flight time duty time records for the pilot are attached for the months of October, November, and December, 1997. They provide information that the pilot was on duty from 0900 to 1900 the day prior to the accident and flew 1.1 hours during daylight on that day. He was off all company duty for 23 hours and reported for duty the day of the accident at 2100. The accident flight was his first flight after reporting for duty.

AIRCRAFT INFORMATION

The aircraft was a Bell 407 helicopter, serial number 53068, manufactured in 1996. At the time of the accident, it had accumulated 464 total hours and had flown 130 hours since the last inspection. It was certificated in the normal category for single pilot operation and was powered by an Allison 250-C47B turbo-shaft engine rated at 630 shaft horsepower. The engine serial number was CAE0847092. It was manufactured in 1996 and had accumulated 474 total hours.

The helicopter was equipped for emergency medical service and, in addition to the pilot, was equipped to be occupied by one patient and two flight nurses. The medical kit installation was done in accordance with Supplemental Type Certificate (STC) number SR00275DE, dated April 16, 1997. Copies of the technical data related to the STC are available from the Federal Aviation Administration, Denver Aircraft Certification Office.

It was equipped with a Pointer 3000 emergency locator transmitter, which was in the armed position, and activated during the impact sequence. It did not aid in locating the accident.

METEOROLOGICAL INFORMATION

The weather reporting facility nearest the accident site was Centennial Airport located approximately 10 miles to the east. The 2245 observation was clear skies, 30 miles visibility, temperature 39 degrees, wind 130 degrees at 7 knots, and an altimeter setting of 30.07 Hg.

According to the company, the pilot was given the following weather information prior to dispatch: Scattered clouds at 2,500 feet above ground level, 10 miles visibility, wind from 210 degrees at 18 knots and an altimeter of 30.01 Hg. No temperature information was given.

According to personal observations by the Investigator-In-Charge, and witness information, general conditions in the area of the accident was dark night conditions and clear skies. Localized visibility was limited to the area around the accident site/landing zone lighted by highway lights, construction lights, emergency service lights, and emergency response vehicle lights. Objects outside the lighted area, including the power line and support towers, were not visible from the takeoff area.

Attached is illumination information provided by the National Weather Service. The information indicates that sunset occurred at 1644 and the end of twilight was 1714. The altitude of the moon was 47.9 degrees above the horizon on a magnetic bearing of 95.4 degrees and the percent of moon illumination was 98%.

COMMUNICATIONS

Recorded communications between the fire department on-scene commander and the helicopter pilot are attached. They provide evidence the on-scene commander briefed the helicopter pilot on known obstructions and the helicopter pilot, in turn, briefed the on-scene commander on the planned approach. No mention was made of the power lines to the west of the river, and according to available information, their presence was unknown at the time.

WRECKAGE AND IMPACT INFORMATION

The helicopter came to rest on its left side on a northerly orientation. The fuselage was intact and deformed to the left and down from the top. The tail boom was severed just aft of the cabin area and just forward of the horizontal stabilizer. The tail rotor blades remained attached to the tail rotor drive shaft. Witness marks on the aft separation provided paint transfer marks which matched the paint on the main rotor blades. The forward separation point was ragged and the fracture area was crushed down and aft.

The pilot's seat remained attached and occupiable space was present. The cyclic and collective remained attached in normal fashion and the anti torque pedals were displaced aft. The left side of the cockpit area was crushed inward and contained a portion of the liter rack which remained attached at its mounting points. The medical equipment in the cabin area remained attached; however, the seats were displaced up and to the rear.

Cockpit documentation was as follows:

* Artificial horizon 30 degrees left wing down on horizon * Standby artificial horizon 45 degrees right wing down, 5 degrees nose down * Horizontal Situation Indicator (HSI) heading 210 degrees, heading bug 000 degrees course 090 degrees * Bearing Distance Heading Indicator (BDHI) course selector 005 degrees, "to" in window, needles centered * Radio Magnetic Indicator heading 235 degrees needle on 255 degrees * Nr/Nf 0 * Airspeed 0 Needle/ball - needle centered, ball 1/4 width left * Engine gauges unreadable* Altimeter (encoding) 5,420 feet Kolsman unreadable * Radio altimeter bug set at 500 feet. Needle at 500 feet * Vertical

speed indicator (VSI) 0 * Radio mixer panel - comm 2 and FM 3 selected

Overhead panel

* Rotor brake off * Battery off * Generator on GEN * Particle separator on

The wire cutter on the lower forward portion of the nose section was gouged on the cutting edge and had weld marks associated with the gouge areas.

The transmission was intact and turned by hand in a normal fashion.

The engine was examined on site and then removed and further examined at the facilities of the manufacturer. It exhibited crush damage externally; however, internal examination provided no evidence that the engine was not running at impact.

Observations made during the examination are as follows:

* The engine mounts were broken. * The throttle linkage to the hydro-mechanical unit was bent. * The left side compressor air discharge tube was crushed. * The outer combustion case (OCC) was crushed and dented. * The exhaust duct was crushed. * The NG rotor turned free and smooth when rotated by hand through the engine inlet. * The NP rotor turned free and smooth when rotated by hand at the fourth stage wheel. * There was fuel in the firewall to nozzle fuel supply line. * The upper and lower magnetic chip detector plugs were free of debris. * The accessory gearbox oil appeared clean with a normal oil smell. * The hydromechanical unit case casting was cracked at the fuel inlet. * There was oil in the number 6,7, and 8 bearings pressure oil supply lines. * The left fuel nozzle appeared normal with slight carbon build-up. The fuel nozzle had a five-washer stack-up. The nozzle boss on the OCC was deformed as a result of inward crushing. * The left side of the exhaust collector was crushed. * The MGT thermocouples were removed and examined. No damage was found. * The OCC and combustion liners were removed. The liners exhibited crushing which corresponded to the crushing on the OCC. * Aluminum splatter was noted evenly distributed around the 1st stage nozzle and the 1st stage wheel. * The turbine to compressor coupling exhibited rotational scoring in the middle and on the turbine wheel. * The NG and NP rotors rotated freely. * Rotational rub was found from both the 1st and 2nd stage wheels on the blade paths of the 2nd stage nozzle. * The 3rd stage nozzle exhibited aluminum splatter. The vanes were unremarkable. * The 3rd and 4th stage wheels were undamaged. * The 4th stage nozzle vanes were undamaged. Rotational scoring from the 3rd and 4th stage wheels contacting the blade paths of the 4th stage nozzle was present. * Numbers 6 and 7 bearings were free and lubricated. * Number 5 bearing was free and lubricated. * The oil slinger was not damaged. * The number 8 labyrinth seal was normal. * There was rotational scoring to the bore of the accessory gearbox where the compressor mounts. * The scroll assembly was dented. * Numbers 1 and 2 bearings were free and lubricated. * The impeller exhibited multiple areas of foreign object damage. * The impeller shroud exhibited rotational scoring which penetrated the base metal. * The accessory gearbox was oiled, all bearings were smooth and free, and all

gears appeared normal. * All shafting was intact and continuous. No distress to splines was observed. * The engine FADEC harness was torn from the connector to the speed sensor on the accessory gearbox. * The shaft of the FADEC speed sensor on the accessory gearbox was bent. * The exciter box had a hole punctured in the case. * The FADEC electronic control unit case was torn open with at least one circuit board broken.

The electronic control unit was sent to Chandler Evans Company for download of available engine performance data. The report is attached.

The main rotor blades remained attached at the hub and the main transmission and engine remained in the helicopter. All main rotor blades exhibited chordwise scarring and chaffing marks (see attached photographs). Main rotor blade number one was missing 2 feet of blade from the tip inboard and everything aft of the spar was missing on the outer 2/3rds of the blade. Blade number two was partially fractured at mid span and exhibited chordwise scarring on the upper surface of the blade. Blade number three had chordwise damage along the entire span on the upper surface. Blade number four was partially fractured approximately 4 feet from the blade grip and exhibited chordwise gouging on the rest of the blade. Several blades had electrical arc damage at the blade grip bolt on the upper surface.

Tail rotor blade number one was fractured at a point approximately 1/3 the distance from the blade root and exhibited chordwise deformation at the fracture point. Blade number two was undamaged.

The vertical fin was attached and approximately a foot of the top was missing. The fracture was smooth and exhibited knife cut type characteristics.

The left stabilizer was crushed inboard and the right was cut in half and exhibited a knife like cut at the fracture point.

Both fractures of the tail rotor drive shaft exhibited torsional twisting.

Fuselage crush and blade hub damage provided evidence that the helicopter was in a near inverted attitude on ground contact. All occupants remained within the confines of the cabin and were removed by emergency response personnel.

The skids and skid cross tubes separated from the helicopter during the impact sequence and were found within the confines of the impact area. The forward outboard portion of the right skid contained chafe marks and electrical burn marks.

TESTS AND RESEARCH

According to measurements and information from Public Service Company, the power line towers were 622 feet apart and oriented northeast/southwest. The southern tower was 106 feet high and the northern tower 83.5 feet high. The wire placement (from top to bottom)

consisted of two static lines at the 106/83-foot level with reported average sag of 3 feet over the span. There were six transmission lines placed at the 87/73-foot level, 71/63-foot level, and 55/53-foot level sequentially. Their average sag over the span was 7 feet. The western transmission cables were 230KV and the eastern 115KV. The horizontal distance from the helicopter's takeoff position to the power line was approximately 630 feet based on global positioning system (GPS) measurement.

The towers and lines did not meet obstruction-marking criteria and were not marked. In addition, they were not depicted on sectional or topographic maps.

Witness marks on the transmission lines provided evidence the helicopter's first contact with the power line was 186 feet south of the northern tower on the top east transmission line. The line was severed and damage extended from 186 feet to a point 259 feet from the northern tower.

The medical equipment kit was installed in accordance with the attached STC. Structural integrity of the items was maintained and no evidence was found that the equipment contributed to injuries sustained by the occupants.

Company policy, promulgated through documents and training, provided landing zone departure procedures which instructed the pilot to climb straight ahead in a near vertical climb to a minimum of 300 feet agl before turning. Following the accident, the company issued a revised Operations Memo 97-8, to all pilots further refining landing zone procedures.

ADDITIONAL INFORMATION

The aircraft was released to the owner on December 17, 1997. The engine and ECU were retained for further examination and returned directly to the owner's representative following the examination.

## Pilot Information

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| **Certificate:** | Commercial | **Age:** | 50,Male |
| **Airplane Rating(s):** | None | **Seat Occupied:** | Right |
| **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 1 Valid Medical--w/ waivers/lim | **Last FAA Medical Exam:** | June 3, 1997 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 4118 hours (Total, all aircraft), 122 hours (Total, this make and model), 3832 hours (Pilot In Command, all aircraft), 39 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

| | | | |
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| **Aircraft Make:** | Bell | **Registration:** | N771AL |
| **Model/Series:** | 407 407 | **Aircraft Category:** | Helicopter |
| **Year of Manufacture:** | | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 53068 |
| **Landing Gear Type:** | Skid | **Seats:** | 4 |
| **Date/Type of Last Inspection:** | December 6, 1997 AAIP | **Certified Max Gross Wt.:** | 5000 lbs |
| **Time Since Last Inspection:** | 130 Hrs | **Engines:** | 1 Turbo shaft |
| **Airframe Total Time:** | 464 Hrs | **Engine Manufacturer:** | Allison |
| **ELT:** | Installed, activated, did not aid in locating accident | **Engine Model/Series:** | 250-C47B |
| **Registered Owner:** | AIR METHODS CORPORATION | **Rated Power:** | 630 Horsepower |
| **Operator:** | | **Operating Certificate(s) Held:** | On-demand air taxi (135) |
| **Operator Does Business As:** | | **Operator Designator Code:** | QMLA |

## Meteorological Information and Flight Plan

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| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Night/dark |
| **Observation Facility, Elevation:** | APA ,5883 ft msl | **Distance from Accident Site:** | 10 Nautical Miles |
| **Observation Time:** | 22:45 Local | **Direction from Accident Site:** | 90° |
| **Lowest Cloud Condition:** | Clear | **Visibility** | 30 miles |
| **Lowest Ceiling:** | None | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 7 knots / | **Turbulence Type Forecast/Actual:** | / |
| **Wind Direction:** | 130° | **Turbulence Severity Forecast/Actual:** | / |
| **Altimeter Setting:** | 30 inches Hg | **Temperature/Dew Point:** | 4°C / 9°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | AURORA (N/A ) | **Type of Flight Plan Filed:** | Company VFR |
| **Destination:** | (N/A ) | **Type of Clearance:** | None |
| **Departure Time:** | 22:40 Local | **Type of Airspace:** | Class E |

## Airport Information

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| **Airport:** | | **Runway Surface Type:** | |
| **Airport Elevation:** | | **Runway Surface Condition:** | |
| **Runway Used:** | 0 | **IFR Approach:** | |
| **Runway Length/Width:** | | **VFR Approach/Landing:** | Full stop |

## Wreckage and Impact Information

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| **Crew Injuries:** | 3 Fatal | **Aircraft Damage:** | Destroyed |
| **Passenger Injuries:** | 1 Fatal | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 4 Fatal | **Latitude, Longitude:** | 39.590435,-105.009033(est) |

## Administrative Information

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| **Investigator In Charge (IIC):** | Wiemeyer, Norman |
| **Additional Participating Persons:** | JAMES FINN; DENVER , CO |
| **Original Publish Date:** | August 20, 1999 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=20392 |