Aviation Investigation Final Report

Location:	Coolbaugh Township, Pennsylvania	**Accident Number:**	ERA13FA014
Date & Time:	October 9, 2012, 20:00 Local	**Registration:**	N108MF
Aircraft:	Bell 407	**Aircraft Damage:**	Substantial
Defining Event:	VFR encounter with IMC	**Injuries:**	2 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Executive/Corporate		

Analysis

The surviving passenger reported that, after taking off, the weather "began to get worse," and the helicopter pilot advised the passengers that they would not be able to make it to their destination airport. The weather worsened, and the pilot decided to divert. When the surviving passenger looked out of the window, it was "misty and dusky." Shortly after, the helicopter struck trees and terrain. A witness reported observing the helicopter flying "very low" along the southbound lane of an interstate with all of its lights on just before the accident. He stated that the visibility was low, that the helicopter was under "low fog," and that it was like "pea soup" around the area.

Review of meteorological and GPS information indicated that dark night instrument meteorological conditions (IMC) existed in the accident area. Light rain was present, and low instrument flight rules conditions existed with vertical visibility of 200 feet and variable visibility of 1/2 mile. Before the accident, the helicopter was flying through this area of weather at a low altitude and an airspeed of about 30 knots. Although the pilot could have returned to the departure airport or landed in a suitable area along his route of flight, he chose to enter IMC despite the availability of safer options and was then forced to divert as the weather worsened. Also, once the helicopter had entered the weather, the sun had already set and minimal ground lighting was present in the heavily wooded area surrounding the interstate. Therefore, it is unlikely that a discernable horizon was present, which would have significantly increased the pilot's workload because it would have required him to reference the helicopter's flight instruments to maintain the helicopter's attitude, flightpath, energy state, and altitude.

Fuel was found onboard the helicopter, and no evidence of any preimpact failure or malfunction of the helicopter, drivetrain, or engine was found that would have precluded normal operation. Review of data recorded by the engine control unit revealed no hard faults or engine operational issues before the beginning of the accident sequence. Recorded data further indicated that the engine was running during the impact sequence and continued to operate for an additional 21 minutes following the accident while the helicopter was resting on its right side, which resulted in reduced oil flow and lubrication to the

engine and the eventual postimpact failure of the turbine main line bearings and rotatable parts.

Although the pilot held an airline transport pilot certificate that allowed him to fly under IMC in airplanes, he did not possess an instrument helicopter rating. Review of information provided by the helicopter manufacturer revealed no evidence that the pilot had received any inadvertent IMC or instrument flight rules helicopter training when he was at its training center. Examination of the pilot's flight- and duty-time records also revealed that he was scheduled to fly a round trip for the airline he worked for the day after the accident occurred, which likely resulted in self-imposed pressure to complete the trip he was flying on the day of the accident so that he could return home and make his report time for his assigned trip on the following day.

Probable Cause and Findings

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

The pilot's decision to continue visual flight rules flight into instrument meteorological conditions due to self-imposed pressure to complete the trip, which resulted in impact with trees and terrain.

Findings

Personnel issues	Decision making/judgment - Pilot
Environmental issues	Low ceiling - Decision related to condition
Environmental issues	Low visibility - Decision related to condition
Environmental issues	Drizzle/mist - Decision related to condition
Environmental issues	Fog - Decision related to condition
Environmental issues	Dark - Decision related to condition

Factual Information

History of Flight

Enroute-cruise	VFR encounter with IMC (Defining event)
Maneuvering-low-alt flying	Collision with terr/obj (non-CFIT)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On October 9, 2012, about 2003 eastern daylight time, a Bell 407, N108MF, operated by ACS Helicopters LLC., was substantially damaged when it impacted trees and terrain in Coolbaugh Township, Pennsylvania. The airline transport pilot and one passenger were fatally injured, and one passenger was seriously injured. The corporate flight was conducted under the provisions of 14 Code of Federal Regulations (CFR) Part 91. Dark night instrument meteorological conditions (IMC) prevailed and no flight plan was filed for the planned flight to Westchester County Airport (HPN), White Plains, New York. The flight last departed Elmira/Corning Regional Airport (ELM), Elmira, New York about 1845.

According to recovered cockpit documentation and passenger interviews, on the day of the accident, the helicopter departed Somerset Airport (SMQ), Somerville, New Jersey at 0730 for Morristown Municipal Airport (MMU), Morristown, New Jersey. After arriving at MMU at 0753, the pilot boarded four passengers, and then departed at 0830 for Camden County Airport (19N), Berlin, New Jersey, where it arrived at 0920. After having breakfast, the four passengers then played golf from approximately 1030 to 1500, and then socialized for approximately an hour before returning to the airport, where they once again boarded the helicopter. At 1630, the helicopter then departed for SMQ, landing there at 1710, and deplaned one passenger. At 1720 the helicopter departed once again, this time for ELM with three of the original four passengers onboard. After arriving at ELM at 1830 another passenger deplaned, and at 1845 the helicopter with the pilot and two of the original four passengers departed for HPN.

According to the surviving passenger, after taking off from ELM, the weather "began to get worse," and the pilot advised them that they would not make it to HPN. The weather became "even worse" and the pilot decided to divert to Pocono Mountains Municipal Airport (MPO), Mount Pocono, Pennsylvania. The surviving passenger then texted his wife and advised her that they were "3 miles/ 3 minutes" from MPO and that they were going to land there. When he looked out of the window it was "misty and dusky" and he thought it must have been around 1930 or later. He advised that the "crash" happened shortly thereafter.

According to a witness, at approximately 1945, she heard a helicopter that sounded "like it was going to land on my house" and that the helicopter was "extremely low" at a "really low altitude" in the area of Interstate 380 (I-380) and the Daleville exit.

A truck driver in the vicinity also reported that he saw the helicopter flying "very low" and observed it passing over a Pennsylvania Department of Transportation shed near exit 20 (the Daleville exit) heading southbound along the south bound lane of Interstate 380. All of its lights were on, and at first he thought it was a state trooper 'All lit up" chasing someone down the highway. He described the helicopter as being "at or below, 200 feet off the deck." The visibility was low, and the helicopter was under the "low fog." He also advised that it was like "pea soup" around the area of I-380 and the Daleville exit.

According to a limousine driver who was supposed to pick up one of the passengers at HPN, at 1938 he had received a text from the passenger stating that they were "running late". Then at 1953, he received another text instructing him to go back to MMU to pick up the passenger. After arriving at MMU, the driver waited but the helicopter never arrived.

A search by Federal, State, and Local authorities was initiated. On October 10, 2012 at approximately 0230 the helicopter was discovered in a heavily wooded area adjacent to the south bound lane of I-380 approximately 1.3 miles northwest of MPO.

PERSONNEL INFORMATION

According to Federal Aviation Administration (FAA), Bell Training Academy, and American Airlines records, the pilot in addition to flying for ACS Helicopters also flew for American Airlines as a First Officer. He held an airline transport pilot certificate with ratings for airplane multi-engine land, commercial privileges for airplane single-engine land, and rotorcraft-helicopter. He also held Type Ratings for the ATR-42, ATR-72, CE-500, DC-9, and HS-125, in addition to a flight engineer certificate for turbojet powered airplanes.

On November 3, 2009, he took his private pilot rotorcraft-helicopter examination in a Robinson R44. On that date, he reported that he had accrued 77 total hours of helicopter flight experience.

From November 16th to November 20th, 2009, he attended Bell 407 initial ground and flight training which included ground training, training in a flight training device, and flight training in the Bell 407.

On July 14, 2010, he took his commercial pilot rotorcraft-helicopter examination in a Robinson R44. On that date, he reported that he had accrued 202 total hours of helicopter flight experience.

On August 9th and 10th 2010, he attended bell 407 refresher training which included ground training, training in a flight training device, and flight training in the Bell 407.

On October 28, 2010, the pilot received one additional hour of flight training in the Bell 407.

On May 16th and 17th, 2011, he once again attended Bell 407 refresher training which included ground training, training in a flight training device, and flight training in the Bell 407.

On May 7th and 8th, 2012, approximately 5 months prior to the accident, he attended Bell 407 refresher training again which included ground training, training in a flight training device, and flight training in the Bell 407. At the time of his refresher training he reported to the Bell Training Academy that that he had approximately 400 total hours of helicopter flight experience, which included, approximately 350 hours in the Bell 407, and approximately 50 hours in the Robinson R44.

His most recent application for an FAA first-class medical certificate was dated June 1, 2012. On that date, he reported 19,000 hours of total flight time. Though he held an Airline Transport Pilot Certificate which allowed him to fly under IMC in airplanes, He did not possess an instrument-helicopter rating, and review of information provided by Bell Helicopter revealed no evidence of any inadvertent IMC or Instrument Flight Rules (IFR) helicopter training for the pilot during training at the Bell Training Academy.

Examination of the pilot's flight time and duty time provided by American Airlines revealed that on the day before the accident he had reported for duty at 0810 edt at Newark Liberty International Airport (EWR), Newark, New Jersey one hour prior to his scheduled departure to Dallas/Fort Worth International Airport (DFW), Dallas, Texas, then flew 7 hours and 10 minutes arriving back at EWR at 1741 edt. Further examination of his schedule also revealed that he was also scheduled to fly another EWR-DFW-EWR round trip the day after the accident occurred, and was scheduled to sign in at 1155 edt.

AIRCRAFT INFORMATION

The accident aircraft was a single-engine helicopter of conventional construction. It was equipped with a four-blade, soft-in-plane design, composite hub, main rotor system. A full monococque aluminum skinned tailboom, and conventional two blade tail rotor system. It was powered by a 650 shaft horsepower, Rolls-Royce/Allison 250-C47B turboshaft engine.

The original electro-mechanical instrumentation and spinning mass gyroscopes had been replaced with a SAGEM Integrated Cockpit Display System (ICDS) which consisted of electronic attitude & heading sensors and two 10-inch liquid crystal displays. One display functioned as a primary flight display and was vertically oriented on the right side of the instrument panel in front of the pilot, and the second display was horizontally-oriented and functioned as an engine instrument and multi-function display on the left side of the instrument panel. Standby analog instruments (clock, airspeed, attitude, and altimeter) were also provided.

The helicopter was certificated for land operation under day or night visual flight rules (VFR) in non-icing conditions. It was not certificated for IFR operations.

According to FAA and maintenance records the helicopter was manufactured in 2007. The helicopter's most recent annual inspection was completed on August 3, 2012. At the time of the accident, the helicopter had accrued 837.3 total hours of operation.

METEOROLOGICAL INFORMATION

Satellite Imagery and Weather Radar

Review of satellite imagery of the accident area revealed that cloudy conditions existed over eastern Pennsylvania. Weather radar returned reflectivity values which indicated that light rain was present. Surface temperatures were above freezing indicating that freezing rain and freezing fog were not present.

Automated Surface Observing System.

Recorded weather obtained from MPO's automated surface observing system located approximately 1.3 miles southeast of the accident site also revealed that low instrument flight rules weather existed around the time of the accident with vertical visibility of 200 feet and variable auto sensor visibility down to 1/2 mile, with a light east wind and light rain as indicated by METARs where:

- At 1953, the recorded weather included: wind 120 degrees at 6 knots, visibility 3/4 mile, light rain, mist, vertical visibility 200 feet, temperature 09 degrees C, dew point 09 degrees C, and an altimeter setting of 30.10 inches of mercury.

- At 2003, the recorded weather included: wind 100 degrees at 6 knots, visibility 1 1/4 miles, light rain, mist, overcast ceiling of 200 feet, temperature 09 degrees C, dew point 09 degrees C, and an altimeter setting of 30.10 inches of mercury.

- At 2017, the recorded weather included: wind 110 degrees at 5 knots, visibility 1/2 mile, light rain, fog, vertical visibility 200 feet, temperature 09 degrees C, dewpoint 09 degrees C, and an altimeter setting of 30.10 inches of mercury.

Sun and Moon Data

According to the United States Naval Observatory, on the day of the accident sunset occurred at 1829, and the end of civil twilight occurred at 1857. Moon rise did not occur until the following day at 0140.

AIRPORT INFORMATION

According to the Airport Facility Directory, MPO (the diversion airport), was a publicly owned, uncontrolled airport. It had two runways oriented in a 13/31and 05/23 configuration.

Runway 13 was the closest runway to Interstate 380 and was most closely aligned with the helicopters flight path. It was served by two instrument approaches a VOR approach and a GPS approach. The runway was asphalt, in excellent condition, and was equipped with non-precision runway marking in good condition. The total length of the runway was 5,001 feet, and its width was 75 feet. It was equipped with a 2-light precision approach path indicator located on the left side of the runway and runway end identifier lights. The threshold was displaced by 501 feet. An obstruction in the form of a 29 foot tree, located 348 feet from the runway, 235 feet left of centerline was present which took a 5:1 slope to clear.

FLIGHT RECORDERS

The helicopter was not equipped with a cockpit voice recorder or flight data recorder nor was it required to be equipped with them under the CFRs.

The helicopter however was equipped with a Garmin GNS 530 panel-mounted Global Positioning System (GPS) receiver, an Apollo SL40 dual Very High Frequency (VHF) communications transceiver, the ICDS, and the engine control unit (ECU). All of which had some capability of data retention.

Additionally, a Garmin Aera 560 portable GPS navigation device was also discovered at the accident site.

GNS 530

The Garmin Model GNS 530 GPS receiver featured a 5-inch color liquid crystal (LCD) display and offered navigation and communication data, along with precision and non-precision approach certification in the instrument flight rules (IFR) environment. The unit had a slot for a Jeppesen database (front-loading data card) containing all airports, VHF Omni Directional Radio Range (VOR) sites, Non Directional Beacons, NDBs, intersections, Approach, standard terminal arrival routes (STARs), standard instrument departures (SIDs), and special use airspace (SUA) information. A flight plan composed of multiple waypoints, including user-defined waypoints, could be programmed in to the unit. However, no provision had been made to record and store position information within the unit. Data related to last known frequency settings and last known GPS location was stored in volatile memory and could be read from the front panel display upon power-up. There were no provisions for downloading stored data. An internal button-battery was used to back-up power to the internal memory and real-time clock during those periods when main power was removed.

Examination of the unit revealed the unit had sustained minor damage. The unit was able to power on normally by applying external power, however only the active frequency of 120.1 MHz which was the Wilkes-Barre/Scranton International Airport (AVP) control tower frequency and the passive frequency of 121.5 MHz which was the international air distress frequency (emergency frequency) and the helicopter's last known GPS position was captured.

SL40

The Apollo SL40 dual VHF communication transceiver featured a 16 character, 5 x 7, LCD dot matrix LED display. The unit had a frequency range from 118-136.75 MHz and could store up to 8 user defined frequencies. The unit's frequency monitor function could listen to the standby frequency while monitoring the active frequency. The Apollo SL40 would also store the last known frequency settings in non-volatile memory.

Examination of the unit revealed that it had sustained minor damage. The unit was able to power on normally by applying external power. During power up, the active frequency of 125.47 MHz which was the Elmira / Corning regional Airport (ELM), automatic terminal information service frequency was displayed and the standby frequency of 122.95 MHz which was the AVP and ELM Unicom frequency was displayed.

ICDS

The ICDS had recording capability and was capable of storing data on two programing/data cards.

Examination of the ICDS revealed that the units had received minor damage and were functional. Each unit contained a slot for insertion of a programming/data card. However, examination of the cards contained in the slots revealed that they were dummy cards which were incapable of storing data.

Aera 560

The Garmin Aera 560 portable GPS navigation device employed a 4.3 inch touch-screen and color moving map display. The Aera was also capable of storing tracks logs that contained position location information for an unspecified number of points in non-volatile memory internally. Examination

revealed the unit had sustained major damage which required a chip level recovery of the data to be performed.

The data extracted during the chip level recovery included 103 tracks (24,504 total data points) which started on August 3, 2012. The accident flight was the last track recorded. It started on October 9, 2012 at 19:35:21 and ended at 20:03:24 and was composed of 2,084 total data points.

Examination of graphical overlays generated from the Garmin Aera 560 data using Google Earth revealed that a large difference existed between the previous altitudes and airspeeds that were stored during the previous 4 flight legs where for example, at 17:49:04 the helicopter was flying at a GPS altitude of 2,642 feet and a GPS groundspeed of 131 knots but, on the last flight leg the last data points indicated that helicopter was flying in the direction of MPO above and along Interstate 380 at low altitude and airspeed, and where examination of the last data point at 20:02:36 indicated that the helicopter was at GPS altitude of 2,162 feet and a GPS ground speed of 31 knots prior to turning slightly right towards the accident site.

WRECKAGE AND IMPACT INFORMATION

Examination of the accident site revealed that the helicopter had come to rest approximately 200 feet from the right shoulder of the southbound lane of I-380, near a group of approximately 40 foot high trees, in a heavily wooded area, at an elevation of approximately 1,930 feet above sea level, on a magnetic heading of 254 degrees. In close proximity to the wreckage, a large tree with its upper limbs broken off was present. The ground was saturated with fuel, and there was still fuel onboard the helicopter. Further examination of the accident site also revealed that the surrounding trees located adjacent to the accident site to the north and west of the accident site were approximately 50 to 70 feet in height.

No evidence of any preimpact failures, or malfunctions of the aircraft structure, drive train, flight controls, hydraulic system, main rotor system was discovered that would have precluded normal operation, and all observed fractures were consistent with overload forces during the impact sequence with the trees and ground.

Examination of the multi-segmented caution light panel also did not display evidence of filament stretching in any of the critical system's bulbs and the standby attitude indicator's gyro assembly showed evidence of rotational scoring internally.

Aircraft Structure

Examination of the helicopter's structure revealed that after striking trees, the helicopter struck the ground coming to rest on its right side.

All major components were found within approximately 100 feet of the main wreckage. One large section of main rotor blade material (blade skins and honeycomb) was observed suspended on tree branches near the main wreckage.

The fuselage exhibited crushing, fractures, and damage to the right bottom and right side surfaces. The tailboom was fractured aft of the horizontal stabilizer consistent with overload forces at impact however both sections of tailboom remained connected together through an unfractured tail rotor drive segment,

and the upper portion of the left horizontal stabilizer end plate had been severed consistent with a main rotor blade strike.

The landing gear exhibited bending of the cross tubes and fracturing consistent with overload on both the fore and aft right cross tubes. The right skid tube also exhibited an overload fracture at the forward saddle. The left side of the landing gear was intact.

Both the pilot and copilot seat belts had been cut by rescue personnel to facilitate recovery of the front seat occupants. Both the pilot and copilot seat pans and seat support structures exhibited downward deformation consistent with impact. The pilot seat structure also exhibited bending to the right consistent with a right side impact.

Drive Train

The main rotor hub assembly could be rotated in the direction of normal rotation (counter-clockwise) and free movement of the K-Flex main driveshaft was observed, indicating continuity within the main transmission. Examination of both main transmission chip detectors was performed and no chips were observed. The K-Flex main driveshaft had remained connected at both the transmission and engine ends. The four elastomeric corner mounts between the transmission and mount legs were intact, and all four transmission mount legs were also intact. The right side fore/aft pylon pitch restraint spring assembly exhibited a fractured housing at the forward end consistent with overload forces and the roof mounted right side pylon stop fitting also exhibited mechanical damage on its aft surface consistent with main rotor impact forces being applied through the protrusion on the transmission mounted pylon restraint fitting.

The steel tail rotor driveshaft (1st driveshaft in system) located under the engine exhibited a torsional overload fracture of the tube consistent with a sudden stoppage from the rear while being powered at impact. The oil cooler driveshaft rotated freely. All tail rotor hanger bearings rotated freely and were intact. Some splaying of the Thomas couplings flexure plates was observed, especially in the area surrounding the tailboom fracture. Approximately 1 foot aft of the tailboom fracture, the 2nd to the last driveshaft on the tailboom exhibited a fractured adaptor ear consistent with overload forces. The tail rotor gearbox could be rotated freely and no chips were observed on its chip detector.

Flight Controls and Hydraulics

The helicopter was equipped with dual flight controls. The pilot collective stick exhibited a fracture at its base consistent with overload forces. The throttle on the pilot collective stick was found to be in the Fly position. At areas of corresponding airframe damage, various main flight control fractures consistent with overload forces were observed in the vertical tunnel area, under the seats and between the seats. The collective control tube in the vertical tunnel was fractured at approximately the lower third section of the tube consistent with overload forces. The upper portion of the fractured collective tube was moved by hand and control motion was observed through the collective servo to the collective lever. The cracked left and right cyclic vertical control tubes were both moved by hand and corresponding cyclic control movement was observed through the left and right cyclic servos to the non-rotating swashplate. All four pitch change links exhibited fractures consistent with overload in the threads of the bottom rod ends that connect to the outer ring rotating swashplate.

The hydraulic reservoir was empty with visible signs of hydraulic fluid on roof surfaces near the reservoir, consistent with drainage after impact. Each of the three main rotor servo input connections at the wiredrive joints exhibited intact nuts that had not backed off between the servo wiredrives and the servo valve input levers. Locking tangs were bent over on each wiredrive attachment nut and torque stripe markings were observed to be in-line on each servo. The hydraulic filter buttons on both the Return and Pressure filters, which indicate an impending clogging condition when extended, were observed to be in.

The horizontal control tube attached to the pilot anti-torque control pedals exhibited a fracture at the center pedestal access hole consistent with overload forces at impact. At the accident site, the copilot pedals were manipulated by hand and control movement was observed at the fractured long tail rotor control tube at the area of tailboom fracture. The aft fractured section of the long tail rotor control tube was then moved and corresponding pitch control movement was observed at the tail rotor.

Main Rotor Hub and Blades

All four blades exhibited extensive damage consistent with striking trees during impact. Major portions of each main rotor blade were found near the main fuselage. Several large tree branches were observed cut and fallen to the ground in the vicinity of the accident site. Some afterbody (blade skins and honeycomb) blade sections were observed to be suspended on the branches of nearby trees.

The Red main rotor blade (Red triangle on blade) exhibited three composite spar fractures consistent with overload forces. The other three blades (Blue, Orange, and Green) exhibited spar damage and blade afterbody damage on the majority of the span of each spar.

All four main rotor hub composite flexure arms were fractured and separated from the hub. The hub flexures exhibited broom straw fracture features consistent with overload fractures from striking trees during the impact sequence. Extensive damage to outboard lead/lag feathering bearings was also observed on all blades, and the Orange and Red blade bearings exhibited complete separation between elastomer layers. The Blue pitch horn was fractured in the middle of the arm consistent with overload forces. The upstops and downstops for each blade on the main rotor hub were extensively damaged consistent with significant up and down blade movement during driven contact with the trees.

Tail Rotor Hub and Blades

Both tail rotor blades remained attached to the tail rotor hub assembly. The static stop yield indicator was bent in on both sides of the indicator and evidence of static stop to tail rotor yoke contact was observed on the yoke for each blade side. The Orange blade pitch change link was bent. The tail rotor hub was otherwise intact, with all cotter pins and nuts attached.

The Orange tail rotor blade exhibited evidence of a leading edge tip strike to the left side of the tailboom, and red paint transfer marks on the blade leading edge were observed. The left side of the aft tailboom was bent in, and marks on the tailboom consistent with a tail rotor strike were observed. The Green tail rotor blade exhibited a large dent in the leading edge approximately 8 inches from the blade tip.

TESTS AND RESEARCH

Examination and testing of the engine revealed no evidence of any preimpact failures or malfunctions which would have precluded normal operation.
On-Scene Examination of the Engine

On Scene examination of the engine revealed that he right forward engine mount was found to have fractured during the accident however the engine had remained securely attached to the airframe with no visible impact damage. The engine control unit (ECU) was found securely mounted in its normal position with no visible external damage. Both the J1 and J2 HiRel connector plugs were connected and both rings were seated.

During the visual examination, no visible impact damage was noted to the engine. Manual rotation of the N1 drive train at the starter generator revealed continuous rotation to the compressor. Manual rotation of the No.4 power turbine wheel resulted in continuous rotation to the power take off gear. No further examinations were conducted and the engine was shipped to Rolls-Royce Indianapolis for further examination and testing.

Examination and Testing at Rolls-Royce
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On November 28, 2012 further examination of the engine was conducted at Rolls-Royce, Indianapolis, Indiana under the auspices of the NTSB IIC. As the engine was being prepared for an engine run, examination revealed that both N1 and N2 drive trains exhibited continuity through their respective drive trains during manual rotation. Examination of the upper chip detector revealed however, the presence of a large amount of material. Examination of the lower chip detector revealed it to be void of any material. With the large volume of material present on the upper chip detector it was decided to disassemble the engine in lieu of an attempted engine run.

Compressor

Visual examination of the compressor found it properly positioned with no visible external damage. The left and right compressor air discharge tubes were in position and properly seated in both the scroll and outer combustion case. Separation of the compressor module from the engine revealed the spur adapter gear shaft to be in position. It was normal in appearance and oil wetted. The No. 2 bearing was also in its proper position, oil wetted and normal in appearance. Manual rotation of the compressor by the spur adapter gear shaft revealed smooth and continuous rotation of the compressor, and the compressor scroll was in position and externally, was also normal in appearance.

Accessory Gear Box

Both N1 and N2 gear trains were smooth and continuous through the gearbox during manual rotation. Visual examination into the gearbox revealed the inside of the gearbox to contain clean residual oil. The oil pump was in position and visually normal in appearance. The piccolo tube was in position and was also visually normal in appearance.

Turbine

Both the gas producer and power turbine support were in normal position with no visible external damage. The thermal couple harness was in position and displayed no visible damage and probe tips revealed no evidence of burning.

Examination of the No. 1 nozzle area revealed it to be normal in appearance. Removal of the stage one nozzle shield revealed outward denting of the No. 8 bearing sump cover nut. Further examination revealed the turbine tie bolt to have fractured approximately one inch aft of the forward end allowing aft movement of the stage one wheel stub shaft and subsequent contact of the tie bolt with the sump cover. The spanner nut was found backed off the stage one wheel stub shaft with no thread engagement. The stage one nozzle was in its normal position with the leading edge side normal in appearance. Examination of the trailing edge side revealed rub damage to the inner rim face and a small dent in the diaphragm from stage one wheel contact.

The stage one wheel exhibited blade tip and trailing edge damage from contact with the blade track of the stage two nozzle and the knife seals on the inner hub displayed evidence of rub from contact with the stage two nozzle inner bore. The curvic coupling exhibited smearing due to relative movement with the stage two wheel curvic. Evidence of circumferential rub was noted on the stub shaft from rotational contact with the No.8 bearing inner race. The stage two nozzle exhibited circumferential rub on the leading edge side around the inner rim area and extending into the vane root area with a beginning crack visible in the rim from stage one wheel contact. Rub evidence was also noted in the blade track of the stage one wheel. The trailing edge side of the stage two nozzle displayed rub in the blade track of the stage two wheel. The stage two wheel displayed several blade tips fractured off from contact with the stage two nozzle. The curvic couplings exhibited smearing from relative motion between the stage one wheel with rub damage noted to the inner knife seals from contact with the stage two nozzle bore. The trailing edge side of the stage two wheel exhibited circumferential rub around the inner hub face, and a section of approximately 30 degrees of the inner hub rim had fractured off.

The stage three nozzle leading edge side displayed rub evidence around the face of the inner rim and tang areas. The trailing edge side revealed nicks out of the trailing edges along with trailing edge cracks of several blades with an approximate 90 degree segment of the inner rim lip having fractured off. The stage three wheel leading edge side displayed circumferential rub damage around the outer rim face extending into the leading edges of the blades near the root from stage three nozzle contact. The forward section of the lab seal had fractured off and remained inside the stage three wheel bore. Stage three wheel outer rim knife seals displayed heavy rub damage from contact with the fourth stage nozzle blade track. The trailing edge side revealed circumferential rub around the outer rim face. The curvic coupling was normal in appearance.

Both The stage four nozzle leading edge and trailing edge side vanes were normal in appearance with heavy circumferential scoring noted in the both the stage three and stage four wheel blade tracks. The stage four wheel displayed one rub on the leading edge side outer rim face and on the outer rim knife seals from contact with the stage four nozzle.

Combustion System

The outer combustion case which displayed no visual damage was removed to reveal the combustor liner. Visual examination of the inside of the outer combustion case revealed no damage. The combustor liner was normal in appearance with no visible damage or unusual streaking.

Fuel System

The hydraulic metering unit (HMU) was undamaged with all line and fittings secure. The fuel line at the fuel nozzle revealed the presence of fuel. Fuel was also noted within the fuel nozzle at removal. The fuel nozzle was visually normal and no excessive carbon was present on the air shroud.

Lubrication System

All engine oil lines were found in position with no visible damage noted. During removal of the lines, all lines were found to be at least finger tight with no evidence of leakage. The engine oil pump was not removed but was visually inspected through gearbox openings and was in position with no visible damage. Manual rotation of the N1 drive train resulted in smooth rotation of the oil pump. The piccolo tube was in proper position and visually undamaged as was the No. 4 bearing oil nozzle. The inline screen at the No.6/7 bearing pressure line "T" fitting was clean and exhibited residual oil. The No. 6/7 bearing oil delivery tube exhibited heavy coking to external surfaces. Other than coking, the delivery tube was visually open. The No.8 bearing oil delivery tube displayed coking but was otherwise normal and open to air flow. The No.8 bearing oil nozzle was in position and visually open. The No.8 bearing sump area was dry.

Bearings

The No. 1 and No. 2 bearings remained in position within the compressor and were not removed. Manual rotation of the compressor by the spur adapter gear shaft resulted in smooth rotation of the compressor and both the No.1 and No.2 bearings. Viewed in position the No.2 bearing was oil coated and all balls had a normal appearance. The No.4 and No.2 ½ bearings remained in position were visually normal in appearance but dry. The No.5 bearing was in its normal position and dry. The balls were absent with the inner race exhibiting skidding and grooving.

The bearing bore of the power turbine support was found dry. The No.6 bearing balls were absent with the inner race exhibiting a mushroom appearance over the power turbine inner shaft. The No.7 bearing races were in position however the balls were absent from their position. The No. 8 bearing inner and outer races were in their normal position but the balls were absent.

Engine Shafting

The power turbine to pinion gear coupling was in position however both Teflon washers had melted from thermal exposure. Both forward and aft splines were visually normal. The power turbine outer shaft was normal in appearance. The power turbine inner shaft displayed some material flaking from thermal exposure, and the No.6 bearing inner race displayed an aft mushroomed appearance.

The spur adapter gear shaft was retained by the forward end within the compressor and was visually normal in appearance however the aft "O" ring was absent. The turbine to compressor coupling was also visually normally along its length. The turbine splined adapter was seized in the aft end of the turbine to compressor coupling with a torsional appearance of the splines.

Metallurgical Examination

The turbine tie bolt which was discovered fractured and the turbine to compressor coupling along with the turbine splined adapter underwent metallurgical examination. Laboratory results indicated that the tie bolt fracture that was discovered was consistent with torsional overload.

The turbine splined adapter and the aft end of the turbine to compressor coupling shaft which were fused together and deformed were also examined. Metallographic evaluation of these components revealed thermal distress.

Engine Control Unit

Examination of the engine control unit (ECU) which also recorded engine data revealed that the case exhibited no external damage and remained in its normal position during the accident with both J1 and J2 connectors remaining attached.

Review of the information recorded in the Incident Recorder data revealed the following faults from snapshot data records were recorded during the accident:

• At 746:21:41, a reduction in rotor speed (NR) and torque exceedance were recorded. The time stamp for the reduction in NR was later than the first full record of data in the incident data section and the line of data for the torque exceedance was incomplete indicating that the ECU lost power while writing this line of data.
• At 746:16:00, a power turbine (NP) exceedance, and Overspeed Solenoid Activation occurred, which was indicative of load being removed from the engine and the ECU sensing an overspeed condition. An NR exceedance was also recorded at this time.
• At 746:37:30, a measured gas temperature (MGT) exceedance was recorded (21 minutes after the NP exceedance).
• At 746:37:49, another NR reduction was recorded when a second electrical interruption occurred.
• At 746:37:37, another MGT exceedance was recorded followed almost simultaneously by another NP exceedance.
• At 746:37:38, the engine stopped running.

Further review of the recovered data revealed no preaccident hard faults or engine operational issues prior to the beginning of the accident sequence and that the engine had continued to operate for 21 minutes following the accident while the helicopter was resting on its right side.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot by Forensic Pathology Associates on behalf of the Monroe County Coroner. Cause of death was multiple blunt force injuries.

Toxicological testing of the pilot was conducted at the FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma. The specimens were negative for carbon monoxide, cyanide, basic, acidic, and neutral drugs with the exception of Ranitidine which was detected in Urine and is an over-the-counter histamine H2-receptor antagonist used to decrease gastric acid production, treat ulcers, and a number of other stomach complaints.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Examination of documents discovered onboard the helicopter revealed documentation indicating that the Standard Airworthiness Certificate had been issued to a "N108MG" (not N108MF) on September 18, 2007. The registration which was issued on July 28, 2009 listed the helicopter as being 108MF which matched the registration number on the helicopter, and that it was registered to ACS Helicopters LLC.

Multiple documents titled "TRIP SHEET" were also discovered that contained a space for entries titled: "Company (circle one) ACS / Aerocare Services." A space for entry of a "Customer" name was listed, as well as spaces to list passenger names, leg numbers for multiple flight segments, and duty time.

According to the State of New Jersey, ACS Helicopters LLC was incorporated in 2009, and Aero Care Services LLC was incorporated in New Jersey in 2002. The principal for both companies was the same individual.

According to FAA records, neither company held a 14 CFR Part 135 operating certificate.

Pilot Information

Certificate:	Airline transport; Commercial; Flight engineer; Flight instructor	**Age:**	52
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	June 1, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 24, 2012
Flight Time:	(Estimated) 19250 hours (Total, all aircraft), 350 hours (Total, this make and model), 9400 hours (Pilot In Command, all aircraft), 128 hours (Last 90 days, all aircraft), 52 hours (Last 30 days, all aircraft), 12 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N108MF
Model/Series:	407	**Aircraft Category:**	Helicopter
Year of Manufacture:	2007	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	53783
Landing Gear Type:	High skid	**Seats:**	7
Date/Type of Last Inspection:	August 3, 2012 Annual	**Certified Max Gross Wt.:**	5000 lbs
Time Since Last Inspection:	56 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	837 Hrs at time of accident	**Engine Manufacturer:**	Rolls-Royce
ELT:	Installed, not activated	**Engine Model/Series:**	250-C47B
Registered Owner:	ACS HELICOPTERS LLC	**Rated Power:**	650 Horsepower
Operator:	ACS HELICOPTERS LLC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	MPO,1915 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	20:03 Local	**Direction from Accident Site:**	303°
Lowest Cloud Condition:		**Visibility**	1 miles
Lowest Ceiling:	Overcast / 200 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	100°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.1 inches Hg	**Temperature/Dew Point:**	9°C / 9°C
Precipitation and Obscuration:	N/A - None - Fog		
Departure Point:	Elmira, NY (ELM)	**Type of Flight Plan Filed:**	None
Destination:	White Plains, NY (HPN)	**Type of Clearance:**	None
Departure Time:	18:45 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	Pocono Mountains Municipal MPO	**Runway Surface Type:**	Asphalt
Airport Elevation:	1915 ft msl	**Runway Surface Condition:**	Wet
Runway Used:	13	**IFR Approach:**	None
Runway Length/Width:	5001 ft / 75 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal, 1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal, 1 Serious	**Latitude, Longitude:**	41.150276,-75.410003

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Timothy Annis; FAA / FSDO; Allentown, PA Beverley Harvey; TSBC; Canada Mark Stutzner; Bell Helicopter; Fort Worth, TX David W Riser; Rolls-Royce Corporation; Indianapolis, IN
Original Publish Date:	July 9, 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=85290