Aviation Investigation Final Report

Location:	Erwinna, Pennsylvania	**Accident Number:**	ERA13FA026
Date & Time:	October 17, 2012, 06:36 Local	**Registration:**	C-FXGM
Aircraft:	Aerospatiale AS 355	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

According to the operator, the airline transport-rated pilot sent a text indicating that he was intending to depart on a scheduled repositioning flight from a helipad located behind the pilot's home to an airport located about 25 nautical miles southwest. Data recovered from a handheld GPS device showed that the helicopter lifted off from the helipad and began accelerating forward while turning right and maintaining a relatively constant altitude. During the 27 seconds of recorded flight that followed, the helicopter's right turn rate increased, shortly decreased slightly, and then significantly increased again as the helicopter began to descend. The helicopter subsequently impacted trees and terrain.

Although the weather reporting stations closest to the accident site and at the destination airport generally reported that visual meteorological conditions prevailed, the presence of calm wind, near-coincident temperatures and dew points, and the clear night sky favored the formation of patch radiation fog and/or dew on the surface. Visible satellite imagery captured about 1 hour after the accident depicted a band of low stratiform clouds or fog/mist over the accident site and along the adjacent river valley. Additionally, several witnesses near the helipad reported that the lighting and weather conditions about the time of the accident were "dark" and "foggy." Postaccident examination of the wreckage revealed no evidence of any preimpact mechanical malfunctions or failures of the airframe or engine that would have precluded normal operation.

The helicopter was not equipped to operate in instrument meteorological conditions (IMC). Although the airline transport-rated pilot possessed airplane and helicopter instrument ratings, his most recent instrument proficiency check was completed about 8 months before the accident in an airplane, not a helicopter, and no evidence was found indicating that he was current or proficient in operating a helicopter in IMC. Regardless, the fog should have been an indication to the pilot that IMC existed, and he should not have decided to operate the helicopter in such conditions. The flight profile and the presence of radiation fog during dark night conditions, which would have obscured visual references such as the trees, are consistent with the pilot having experienced spatial disorientation, specifically a vestibular illusion known as the "graveyard spiral."

Probable Cause and Findings

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

The pilot's decision to depart under visual flight rules in dark night instrument meteorological conditions, which resulted in subsequent spatial disorientation, uncontrolled descent, and impact with trees and terrain.

Findings

Personnel issues	Decision making/judgment - Pilot
Environmental issues	Fog - Decision related to condition
Environmental issues	Dark - Decision related to condition
Personnel issues	Spatial disorientation - Pilot
Aircraft	Altitude - Not attained/maintained

Factual Information

History of Flight

Initial climb	VFR encounter with IMC
Initial climb	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On October 17, 2012, at 0636 eastern daylight time, an Aerospatiale AS 355 F2, Canadian registration C-FXGM, operated by Catalyst Aviation LLC, was substantially damaged when it impacted trees and terrain shortly after takeoff from Brigham Heliport (4PN5), Erwinna, Pennsylvania. The airline transport pilot was fatally injured. Dark night instrument meteorological conditions prevailed, and no flight plan was filed. The positioning flight, destined for Wings Field (LOM), Philadelphia, Pennsylvania, was conducted under the provisions of 14 Code of Federal Regulations Part 91.

According to the operator, the pilot was scheduled to position the helicopter from 4PN5 to LOM, where after fueling; passengers would embark for a local pipeline patrol flight. The pilot reported to the operator his intent to depart from the heliport via a text message that was received at 0637. No further communications were received from the pilot.

Several witnesses reported hearing the helicopter as it overflew their rural neighborhood about the time of the accident. The witnesses reported that it was not unusual to observe the accident pilot operating helicopters from the heliport in his backyard, particularly during his prior years of service as a State Police pilot. The witnesses reported that on the morning of the accident flight, the helicopter they heard sounded "abnormal." The witnesses generally described that the helicopter was low, loud, and that it sounded different than previous times they had heard helicopters departing the heliport. One witness, who happened to be looking out a window at time of the accident, observed two lights that she presumed to be the accident helicopter as they descended into trees behind her home.

After hearing the sounds of impact, some of the witnesses responded to the accident scene and attempted to render assistance.

Several witnesses who lived in the vicinity of the accident site were interviewed separately shortly after the accident. Each was asked to describe the weather and lighting conditions that prevailed at the time. The witnesses consistently described the weather as "foggy," with some stating that it was "very" or "extremely" foggy. One witness described the fog as being very dense, like "pea soup," while another estimated the visibility to be about 1/8th-mile. The witnesses also consistently described the lighting conditions as "dark" or "very dark". Another witness who lived about 1 mile north of the accident site described the weather conditions about 1 hour after the accident as cloudy with no fog.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	52
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument airplane; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	July 23, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 8, 2010
Flight Time:	7106 hours (Total, all aircraft), 100 hours (Total, this make and model), 53 hours (Last 90 days, all aircraft), 12 hours (Last 30 days, all aircraft)		

The pilot, age 52, held an airline transport pilot certificate with a rating for rotorcraft-helicopter, as well as a commercial pilot certificate with ratings for airplane single and multi-engine land, and instrument airplane. He additionally held a flight instructor certificate with ratings for airplane single engine, rotorcraft-helicopter, and instrument helicopter. His most recent Federal Aviation Administration (FAA) second class medical certificate was issued on July 23, 2012 with the limitation, "must wear corrective lenses."

According to a résumé provided to the operator by the pilot, he was previously employed as a Trooper with the Pennsylvania State Police. Between 1993 and 1996, he was employed as a pilot operating airplanes, after which he operated helicopters through 2004. The pilot was employed as the helicopter unit supervisor between 2004 and 2011. During that period the pilot reported several other part time jobs with other helicopter operators. According to the pilot's personal flight log, his final flight as a State Police pilot was logged on January 5, 2011. When asked to describe the pilot, the operator stated that she was very confident in his abilities, judgment, and training; stating that he was a "go-to" person, and that he was the best representative of the company. She further described the pilot as very safety conscious, and related an anecdote about an instance where the pilot had refused to depart on a daytime mission until a burnt-out position light had been replaced.

The pilot's personal flight log was recovered at the accident site, and reflected flights logged between November 2002 and October 9, 2012. The pilot's flight hours between October 9 and October 14 were recovered from the accident helicopter's maintenance journey log. According to the logs, the pilot had accumulated 7,106 total hours of flight experience, 4,599 hours of which were in helicopters. The pilot recorded about 100 hours of flight experience in the accident helicopter make and model.

As of January 2011, the pilot had accumulated 593 total hours of flight experience at night, 228 hours of which were with the aid of night vision goggles. Between that time and the pilot's most recent flight log entry on October 9, 2012, he had logged an additional 4.1 hours of night flight experience, 2.9 hours of which were accumulated in the 90 days preceding the accident in the accident helicopter make and model.

According to the operator's records, the pilot's most recent FAR Part 135 recurrent check was completed

on April 27, 2012. While a remark on the evaluation form noted, "Inadvertent IMC tested & passed," the proficiency check did not cover instrument operations. According to the pilot's personal flight records, his most recent instrument proficiency check was completed in an airplane on February 25, 2012. The pilot's most recent logged instrument flight experience in a helicopter included 0.3 hours of simulated instrument experience logged in June 2010, and 1.0 hour of simulated instrument experience logged June 2008. No evidence of any more recent instrument flight experience in helicopters or an instrument proficiency check in a helicopter was contained within the pilot's personal flight log or other records provided by the operator.

Activities Preceding the Accident

The operator entered into a lease agreement with the accident helicopter's owner for use of the helicopter while another of the operator's helicopters underwent repairs. The accident pilot subsequently retrieved the accident helicopter from the owner on October 7, and flew it from Buffalo Niagara International Airport (BUF), Buffalo, New York, to one of his homes in Binghamton, New York. After performing four local flights in the vicinity of Binghamton between October 9 and 12, the pilot positioned the helicopter to his home at 4PN5 on October 14. The operator last contacted the pilot via telephone on October 16 at 2000. At that time the pilot was at the local fire department, receiving training as a volunteer fireman.

On the morning of the accident the pilot was scheduled to arrive at LOM about 0730 in preparation for the pipeline patrol flight that was to follow.

Aircraft and Owner/Operator Information

Aircraft Make:	Aerospatiale	**Registration:**	C-FXGM
Model/Series:	AS 355 F2	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	5474
Landing Gear Type:	Skid	**Seats:**	6
Date/Type of Last Inspection:	February 21, 2012 Annual	**Certified Max Gross Wt.:**	5600 lbs
Time Since Last Inspection:	22 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	7557 Hrs at time of accident	**Engine Manufacturer:**	Rolls Royce / Allison
ELT:	Not installed	**Engine Model/Series:**	250-C20F
Registered Owner:	Memento Mori Investments Limited	**Rated Power:**	420 Horsepower
Operator:	Catalyst Aviation LLC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	H4FA

According to the Canadian Civil Aircraft Register, the accident helicopter was manufactured in 1991, and imported to Canada in 2010. The helicopter was equipped with a three-blade main rotor system and

two Rolls Royce/Allison 250-C20F engines each rated at 420 horse power. According to the operator, the helicopter was not equipped for operation in instrument meteorological conditions.

The helicopter's most recent annual inspection was completed on February 21, 2012, and at that time the helicopter had accumulated 7,534 total flight hours. According to the maintenance journey log, which was recovered from the wreckage, the helicopter had accumulated 7,556 total flight hours prior to the accident flight. A log entry made by the accident pilot on the date of the accident noted compliance with Airworthiness Directives 2001-26-55 (tail rotor blade inspection) and 2011-22-05 (tail rotor control rod bearing play inspection) and that no discrepancies were found during either inspection.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	KDYL,394 ft msl	**Distance from Accident Site:**	12 Nautical Miles
Observation Time:	06:54 Local	**Direction from Accident Site:**	180°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	3°C / 2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Erwinna, PA (4PN5)	**Type of Flight Plan Filed:**	None
Destination:	Philadelphia, PA (LOM)	**Type of Clearance:**	None
Departure Time:	06:35 Local	**Type of Airspace:**	

The National Weather Service (NWS) Area Forecast applicable to the area surrounding the accident site, which was issued at 0445, predicted broken to scattered ceiling with visual meteorological conditions generally prevailing around the region. No AIRMETS or SIGMETS were current for the area of the accident flight at the time of the accident.

Geostationary Operational Environmental Satellite -14 infrared satellite image for 0645 depicted a band of mid-level stratiform-type clouds over the accident site with a radiative cloud top temperature that corresponded to cloud tops near 16,000 feet. The first available visible satellite image at 0732 showed a band of low stratiform clouds or fog/mist over the accident site, and along the Delaware River Valley.

The weather conditions at Doylestown Airport (DYL), Doylestown, Pennsylvania, located about 11 nautical miles south of the accident site, at 0654, included calm winds, clear skies below 12,000 feet, 10 statute miles visibility, a temperature and dew point of 1 degree C, and an altimeter setting of 29.99 inches of mercury.

The weather conditions at LOM, located about 25 nautical miles southwest of the accident site, at 0635, included calm winds, clear skies below 12,000 feet, 5 statute miles visibility, a temperature and dew point of 3 degrees C, and an altimeter setting of 29.97 inches of mercury.

According to the U.S. Naval Observatory, on October 9, 2012, the beginning of civil twilight occurred at 0648 and sunrise occurred at 0716. The moon set at 1902 on the preceding evening, and did not rise again until 0949 on the morning of the accident.

Several witnesses who lived in the vicinity of the accident site were interviewed separately shortly after the accident. Each was asked to describe the weather and lighting conditions that prevailed at the time. The witnesses consistently described the weather as "foggy," with some stating that it was "very" or "extremely" foggy. One witness described the fog as being very dense, like "pea soup," while another estimated the visibility to be about 1/8th-mile. The witnesses also consistently described the lighting conditions as "dark" or "very dark". Another witness who lived about 1 mile north of the accident site described the weather conditions about 1 hour after the accident as cloudy with no fog.

According to the NWS, "Radiation fog forms at night under clear skies with calm winds when heat absorbed by the earth's surface during the day is radiated into space. As the earth's surface continues to cool, provided a deep enough layer of moist air is present near the ground, the humidity will reach 100% and fog will form. Radiation fog varies in depth from 3 feet to about 1,000 feet and is always found at ground level and usually remains stationary. This type of fog can reduce visibility to near zero at times and make driving very hazardous." Radiation fog is most common under high pressure systems and ridges during the fall and winter months, where clear skies and light winds prevail.

Airport Information

Airport:	Brigham Heliport 4PN5	**Runway Surface Type:**	
Airport Elevation:	400 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

The departure heliport, 4PN5, was located about 1,000 feet southwest of the accident site. The heliport was comprised of a 65-foot square turf and gravel helipad, which was located in the backyard of the pilot's home at an estimated elevation of 400 feet. A rural neighborhood surrounded the heliport to the north, east, and south. The west bank of the Delaware River was located about 1/2-mile east of the heliport, at an elevation of 120 feet.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	40.528331,-75.074722

The accident site was located in a densely wooded area approximately 1,000 feet northeast of 4PN5. The IIP was identified by several damaged tree limbs about 75 feet above the ground, a height which was roughly the same as that of the departure heliport. A wreckage path approximately 300 feet long, oriented roughly 350 degrees magnetic, extended from the initial impact point to where the main wreckage came to rest against a tree. The main wreckage was oriented on a westerly heading, and was largely consumed by a post-impact fire. Each of the three main rotor blades was accounted for at the accident scene, and all came to rest within 30 feet of the main wreckage.

The wreckage was subsequently recovered from the accident scene and examined in detail at an aircraft recovery facility.

The tailboom had severed from the fuselage forward of the horizontal stabilizer, and was found along the wreckage path about 30 feet south of the main wreckage. The severed tail section consisted of the tailboom structure, left horizontal stabilizer, the inboard portion of the severed right horizontal stabilizer, the vertical stabilizer, and the tail rotor. The forward end of the tailboom was crumpled with a leftward directionality. The examined fracture surfaces of the tailboom structure all exhibited signatures consistent with overstress failure. The right horizontal stabilizer was severed from the tailboom via a fracture that began at the inboard forward end of the horizontal stabilizer with an aft and upward directionality. Examination of the fracture surfaces revealed signatures consistent with overstress failure and wooden splinters lodged between the top skin and doubler of the right horizontal stabilizer. The left horizontal stabilizer remained mostly intact and attached to the tailboom, albeit with a slight downward bend and with a small section of the outboard trailing edge that was severed. The vertical stabilizer suffered no major damage except for a large dent near the leading edge of the top portion of the vertical stabilizer.

The landing skids were recovered as an assembly. Both forward and aft crosstubes did not exhibit severe bending. The main fuselage attachment points remained on the crosstubes and did not exhibit significant movement or extreme rotation about the crosstubes.

All three main rotor blades exhibited significant impact-related damage to their respective leading edges, consistent with the damage observed to the trees at the accident site. Each of the main rotor blades (identified as red, blue, and yellow) exhibited the majority of the impact signatures at their tip, mid span, and root, respectively. The portions of the blades outboard of each impact was displaced aft, toward each of the blades trailing edge. The Starflex arms each exhibited signatures consistent with tensile failure on their advancing sides and compressive failure on their trailing sides. The composite main rotor blade sleeves for the yellow blade had fractured and exhibited severe splintering consistent with a high energy impact. The sleeves for the red blade exhibited less severe fractures, while the blue blade sleeves were consumed by the post-impact fire.

The tail rotor blades exhibited scuffing on the blade skin as well as damage to the blade tips. Several fractures that ruptured through the blade skin were observed on both blades, but the blades themselves remained whole. Both pitch links remained intact and attached to the blade and to the tail rotor gearbox. Continuity of the tail rotor drive and control systems were confirmed from the tail rotor to the tailboom-fuselage separation point; however continuity could not be confirmed forward of that point due to post-impact-related fire damage.

Both engines were recovered from the wreckage and forwarded to the engine manufacturer for disassembly and detailed examination.

The number 1 engine displayed impact-related damage and thermal damage consistent with exposure to a post-impact fire. Both left and right compressor air discharge tubes displayed denting and impact damage along their lengths but remained properly seated within both the scroll and outer combustion case. Removal of the air tubes revealed dirt within both tubes.

Separation of the compressor case halves revealed that the abradable material had melted and was generally consumed by post-impact fire. With the exception of the fire-exposure signatures, the compressor rotor blades and vanes were visually undamaged. Examination of the compressor impeller and shroud revealed that the shroud exhibited rotational scoring of an approximate two hundred degree arc from the knee area extending out to the exducer area with corresponding rub damage noted on the impeller blades.

The outer combustion case exhibited overall scratches with denting along the top of the dome area extending to the right shoulder area. Removal of the outer combustion case revealed dirt and vegetation debris in and around the basket area. The combustor liner was found in its normal position, visually normal in appearance with no unusual streaking; however, dirt adherence was noted on the inside of the liner.

Both the gas producer and power turbine supports remained in position and other than external thermal exposure signatures were normal in appearance. Separation of supports revealed both turbine rotors in proper position with dirt and light residual oil noted throughout the gas path with dirt adhesion noted across vane and blade surfaces. The #4 nozzle exhibited rub contact in the blade path of the #3 wheel between the 10 and 12 o'clock positions from rotational contact with the #3 wheel outer rim. The blade path of the #4 wheel exhibited scoring between the 4 and 5 o'clock position from rotational contact with the #4 wheel outer rim knife seals.

The number 2 engine displayed impact-related damage and thermal damage consistent with exposure to a post-impact fire. Both left and right compressor air discharge tubes were recovered. Both displayed denting along their lengths and were discolored from fire exposure.

Separation of the compressor case halves revealed the abradable material to have melted and to have been generally consumed by post-impact fire with hardened molten material also noted between vanes and between impeller blades. Other than fire exposure signatures and initiating corrosion the compressor rotor blades and vanes were visually undamaged. Examination of the compressor impeller and shroud revealed the shroud to exhibit light rub from the knee area extending out to the toe area with corresponding rub damage noted on the impeller blades.

The outer combustion case exhibited denting across the top forward of the dome area extending out and including the right arm area. The exterior bottom of the outer combustion case had area of molten material adhesion including the burner drain. The combustor liner was found in its normal position, visually normal in appearance with no unusual streaking.

Both the gas producer and power turbine supports remained in position and other than external thermal

exposure signatures were normal in appearance. Separation of the turbine supports revealed both turbine rotors in proper position with areas of dirt noted throughout the gas path. Dirt and external debris was noted positioned between the #1 nozzle rim and the gas producer support. The #1 nozzle exhibited debris ingestion-type impact damage to the trailing edge of three vanes .The #2 turbine nozzle was visibly normal in appearance and undamaged with dirt adhesion noted on vane surfaces. The #1 wheel displayed dirt adhesion to blade surfaces with the #2 wheel displaying an ashen coating. The #3 nozzle displayed no visible damage but did exhibit dirt adhesion to vane surfaces of an approximate 30% arc of the vane surfaces and a purple coating across surfaces similar to color noted on area vegetation at the accident site. The #4 nozzle displayed dirt adhesion to vane surfaces along with a purple coating. Rotational scoring was noted in the blade path of the #3 wheel between the 4 and 8 o'clock positions from rotational contact with the #3 wheel outer rim. The blade path of the #4 wheel revealed circumferential scoring resulting from rotational contact with the #4 wheel outer rim knife seals.

Flight recorders

The helicopter was not equipped with any flight data recording devices, nor was it required to be; however, a hand-held global positioning system (GPS) receiver was recovered from the wreckage, and found to contain data pertaining to the accident flight. The initial data point was recorded at 0634, at the 4PN5 helipad. The helicopter's position began tracking northeast at 0635:59, at a GPS altitude of 442 feet. Over the next 27 seconds, the helicopter began to accelerate to about 85 knots ground speed, while turning to the right and maintaining a relatively constant altitude, within about 50 feet of the helicopter's initial recorded altitude as it began to accelerate.

The helicopter maintained a consistent right-turning track for the entirety of the flight. Between 0636:09 and 0636:17, the calculated turn rate of the helicopter increased from about 3 degrees per second to about 18 degrees per second. Over the next 7 seconds, the turn rate decreased to about 14 degrees per second. The calculated turn rate between the final two recorded GPS positions increased again to about 31 degrees per second. Over the final 5 seconds recorded for the flight, the helicopter descended from a GPS altitude of 503 feet to 455 feet, which corresponded to an approximate 575-foot per minute average descent rate for that portion of the flight.

The initial impact point (IIP) was located about 300 feet northwest of the helicopter's final GPS recorded position.

Medical and Pathological Information

An autopsy was performed on the pilot by the Office of the Coroner, Bucks County, Pennsylvania. The listed cause of death was "multiple injuries."

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicological testing on the pilot. No cyanide, ethanol, or drugs were detected in the samples submitted

for testing. The samples submitted for carbon monoxide testing were deemed "unsuitable for analysis."

Additional Information

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 altitude. 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*."

Administrative Information

Investigator In Charge (IIC):	Diaz, Dennis
Additional Participating Persons:	Robert Ference; FAA/FSDO; Allentown, PA David Riser; Rolls-Royce; Indianapolis, IN Francois Hochart; Bureau d'Enquêtes et d'Analyses; Le Bourget Seth D Buttner; American Eurocopter; Grand Prairie, TX Peter Rowntree; Transportation Safety Board; Richmond Hill Gerard Palmer; Heli-Lynx; Stoney Creek
Original Publish Date:	April 23, 2014
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Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=85344