Aviation Investigation Final Report

Location:	Charlottesville, Virginia	**Accident Number:**	ERA17FA274
Date & Time:	August 12, 2017, 16:49 Local	**Registration:**	N31VA
Aircraft:	Bell 407	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal
Flight Conducted Under:	Public aircraft		

Analysis

The helicopter pilot and observer were conducting an aerial observation flight. The helicopter had been providing the Virginia State Police (VSP) with a continuous video downlink of the public demonstrations that were occurring in Charlottesville, Virginia, when the flight crew was tasked to provide overwatch for a motorcade. Radar data indicated that the helicopter was flying at an altitude of about 2,200 ft mean sea level (msl) in the area of the motorcade before it began to turn to the right and descend rapidly. Radar data also indicated that, about 30 seconds later, the helicopter was descending through 1,450 ft msl at a groundspeed of 30 knots. Shortly afterward, the helicopter descended below the area of radar coverage, and radar contact was lost. A witness aboard another helicopter observed the accident helicopter descending in an upright position into trees at a high rate of descent. The helicopter impacted the ground and a postcrash fire ensued.

Video from a security camera, which was located about 1.2 miles from the accident site captured the helicopter toward the end of the flight and showed that the helicopter was descending vertically at a constant acceleration and with increasing negative vertical speed until ground impact. Photographs of the accident helicopter that were taken by a ground witness revealed that, about the time that the helicopter began its vertical descent, the helicopter was yawing to the right at a rate between 87° and 97° per second.

The damage to the main wreckage was consistent with impact forces and the postcrash fire. Hard-body foreign object damage observed on the first-stage compressor blades was consistent with the ingestion of metallic helicopter debris after the helicopter impacted trees and the ground. Thus, the engine was operating at the time of impact.

The aft section of the tailboom was found about 100 to 150 feet from the main wreckage site, and pieces of the tail rotor control tube from the midsection of the tailboom were near the main wreckage and the aft section of the tailboom. Signatures of main rotor contact were observed at multiple locations along the aft section of the tailboom. Given the proximity of the aft section of the tailboom to the main wreckage site, the main rotor would likely have contacted the tailboom shortly before ground impact and not during the onset of the right yaw.

Although the pedal restrictor control system (PRCS) cam was found in the engaged position, examination of the PRCS found no anomalies consistent with a system malfunction. Therefore, the PRCS cam could have activated during the vertical descent and have limited left pedal forward travel, particularly if the helicopter's nose was lowered during the descent and the resulting airspeed was more than 55 knots (the airspeed at which left pedal travel would be restricted). Regardless, even if the PRCS were engaged, sufficient pedal travel would have been present to maintain heading in a hover out of ground effect.

The pilot's autopsy found moderate coronary artery disease without evidence of a previous scar or heart damage. Although the pilot could have been incapacitated by a number of medical conditions, such as a seizure, sudden loss of consciousness, or arrhythmia, that would have left no evidence at autopsy, he did not have a higher risk for such events even with his moderate coronary artery disease. Thus, the pilot's medical condition was not a factor in this accident.

Toward the end of the flight, the helicopter's low forward airspeed while descending was consistent with the helicopter entering vortex ring state. As a result, even though power was applied, the helicopter was unable to reduce the descent rate, and it continued descending with an estimated vertical acceleration between 10.5 and 13.5 ft/s^2. Anecdotal information indicated that the pilot had knowledge of vortex ring state, but review of the pilot's training records indicated that he had not received any formal recurrent vortex ring state recognition and recovery training during his 16 years with the VSP aviation unit. Also, the VSP aviation unit training manual did not include vortex ring state recognition and recovery in any of the sample lesson plans for initial or recurrent training, and the associated maneuvers were considered to be optional.

The helicopter was not equipped with, and was not required to be equipped with, crash-resistant flight recorders. The recovered engine control unit data revealed a sharp increase in torque, from 54% to 104% immediately before the helicopter's descent. Insufficient left pedal input with increasing torque can result in a right yaw that can develop into a spin. The lack of flight recorder data for this accident precluded an evaluation of the pilot's actions before the overtorque and the right yaw. Additionally, the lack of flight recorder data precluded a determination of the pilot's actions during the helicopter's entry into vortex ring state, including any attempt to recover. Last, the available data were insufficient to determine if the right yaw began immediately before or after the helicopter's encounter with the vortex ring state. This accident demonstrates the benefit of crash-resistant flight recorders aboard turbine-powered, nonexperimental, nonrestricted-category aircraft that are not currently required to be so equipped.

Probable Cause and Findings

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

The pilot's loss of helicopter control after entry into vortex ring state, leading to a high rate of descent to the ground with a right spin. Contributing to the accident was the pilot's lack of recent and recurrent training in vortex ring state recognition and recovery.

Findings

Personnel issues	Aircraft control - Pilot
Personnel issues	Recurrent instruct/training - Pilot

Factual Information

History of Flight

Maneuvering	Loss of control in flight (Defining event)
Uncontrolled descent	Part(s) separation from AC
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

On August 12, 2017, about 1649 eastern daylight time, a Bell 407 helicopter, N31VA, was destroyed when it was involved in an accident in Charlottesville, Virginia. The pilot and the observer were fatally injured. The helicopter was operated as a public aerial observation flight.

According to the Virginia State Police (VSP), the purpose of the flight was to provide the VSP command center with a continuous video downlink of the public demonstrations that were occurring in Charlottesville. The helicopter departed Charlottesville Albemarle Airport (CHO) about 1600. The helicopter arrived over the area of the demonstrations at 1604 and remained there until 1642 when the flight crew was tasked to provide overwatch for the Governor of Virginia's motorcade. At 1643, the flight crew advised the VSP command center that the helicopter was heading directly to the motorcade and was about 30 seconds away.

Radar data provided by the Federal Aviation Administration (FAA) indicated that, at 1648, the helicopter was flying at an altitude of about 2,200 ft mean sea level (msl) in the area of the motorcade. At that time, the helicopter was traveling north-northwest before it began to turn to the right and descend rapidly. Radar data indicated that, at 1648:30, the helicopter was descending at a rate of 6,800ft/min through 1,450 ft msl at a groundspeed of 30 knots. The helicopter then descended below the area of radar coverage, and radar contact was lost.

About 1649, a crewmember aboard a Fairfax County Police Department (FCPD) helicopter observed the accident helicopter descending upright into trees at a high rate of descent and then observed a "stirring" of debris. The crewmember advised the pilot, who immediately contacted the VSP command center to report that a helicopter had crashed. The pilot of the FCPD helicopter attempted to contact the accident helicopter but was unable to make contact with the flight crew. The FCPD helicopter pilot then landed near the accident site to render aid. The other two crewmembers exited the helicopter and proceeded to the accident site. Upon reaching the accident site, the crewmembers encountered heavy black smoke and fire.

The VSP interviewed 47 witnesses to the accident. Although their descriptions of the helicopter's altitude, direction of flight, and velocity varied, most witnesses reported that the helicopter, after initially hovering, entered a rolling oscillation, began to spin about its vertical axis, and descended in a 45° nose-down attitude while continuing to spin. Witnesses reported that they lost sight of the helicopter below the tops of the surrounding trees and then observed a plume of smoke rising from the area.

Video from a security camera located about 1.2 miles from the accident site captured images of the helicopter in a vertical descent with increasing vertical speed as the helicopter continued to descend toward the ground. Still photographs taken by a witness showed that the helicopter was spinning in a clockwise direction (when viewed from above the helicopter).

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	48,Male
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; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 19, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 15, 2016
Flight Time:	5831 hours (Total, all aircraft), 787 hours (Total, this make and model), 5727 hours (Pilot In Command, all aircraft), 19 hours (Last 90 days, all aircraft), 6 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Other flight crew Information

Certificate:	Private	**Age:**	40,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	May 12, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	December 21, 2016
Flight Time:	(Estimated) 97 hours (Total, all aircraft)		

The pilot had been employed with the VSP aviation unit since 1999 and became the unit commander in December 2012. The observer had been employed with the VSP aviation unit since July 2017.

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N31VA
Model/Series:	407	**Aircraft Category:**	Helicopter
Year of Manufacture:	2000	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	53465
Landing Gear Type:	N/A; High skid	**Seats:**	7
Date/Type of Last Inspection:	August 3, 2017 100 hour	**Certified Max Gross Wt.:**	5501 lbs
Time Since Last Inspection:	17 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	6000 Hrs at time of accident	**Engine Manufacturer:**	Rolls-Royce Corporation
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	250-C47B
Registered Owner:	COMMONWEALTH OF VIRGINIA	**Rated Power:**	650 Horsepower
Operator:	Virginia State Police	**Operating Certificate(s) Held:**	None

During this mission, the accident helicopter was configured with single main controls at the pilot's station and locked out pedals at the copilot (observer) station.

The accident helicopter's turbine engine had a full authority digital engine control (FADEC) system. The engine control unit (ECU) would continuously monitor the FADEC system for faults and would alert the pilot of any faults that could significantly impact engine performance.

The accident helicopter was also equipped with an airspeed-actuated pedal restrictor control system (PRCS), which reduces total left pedal travel at higher airspeeds by automatically adjusting the left pedal's forward stop. When the helicopter accelerates above 55 knots indicated airspeed (KIAS), the PRCS solenoid energizes, engaging a cam that limits forward travel of the left pedal by 25%, which reduces tail rotor blade angle from 25° to 17° When the helicopter decelerates below 50 KIAS, the PRCS solenoid de-energizes, which disengages the cam and enables full forward travel of the left pedal.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	CHO,644 ft msl	**Distance from Accident Site:**	7 Nautical Miles
Observation Time:	16:53 Local	**Direction from Accident Site:**	29°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	190°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	29.87 inches Hg	**Temperature/Dew Point:**	30°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	CHARLOTTESVILLE, VA (CHO)	**Type of Flight Plan Filed:**	None
Destination:	CHARLOTTESVILLE, VA (CHO)	**Type of Clearance:**	VFR
Departure Time:	16:00 Local	**Type of Airspace:**	Class E

A sounding (a high-resolution rapid refresh model) for the accident site and time depicted a light and variable wind of 3 knots with clear skies over the accident site. No significant turbulence or wind shear was detected.

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	38.034168,-78.529441

Accident Site

The main wreckage came to rest in an upright position along a magnetic heading of 333° in heavily wooded terrain that was adjacent to a residence. The main wreckage comprised the main fuselage (cockpit and cabin), aft fuselage, forward section of the tailboom, midsection of the tailboom (including the horizontal stabilizer), main rotor system, and engine. The main wreckage showed damage consistent with impact with trees and the ground. The main fuselage, aft fuselage, main rotor system, and engine were thermally damaged from the postcrash fire. The landing gear exhibited multiple fractures and a flattened appearance.

The aft section of the tailboom, containing the tail rotor gearbox, tail rotor, and vertical stabilizer, was found about 40 ft above the ground in a tree and about 100 to 150 ft south-southwest of the main wreckage. Debris from the fragmented tailboom was found in a debris field that spanned about 300 ft in length west of the main wreckage. Examination of the fragmented tailboom sections revealed multiple angled cuts consistent with main rotor blade contact.

Main Rotor System

The main rotor hub remained attached to the main rotor mast, and the four main rotor blades remained attached to their respective hub locations. For one of the main rotor blades, the pitch horn lug (for the pitch control link upper rod end) was fractured from its pitch horn. The pitch horn lug fracture surface exhibited signatures consistent with overload and thermal damage. Neither the fractured pitch horn lug nor the pitch control link upper rod end were found. The remainder of the major components of the main rotor system were found within or near the main wreckage site and exhibited fragmentation from impact and thermal damage.

The main rotor gearbox remained attached to the airframe. Drive continuity was established within the main rotor gearbox. The engine-to-transmission driveshaft was present, but its aft coupling was fractured.

Tail Rotor and Tail Rotor Drive System

Sections of the tail rotor drive system, from the steel tail rotor drive shaft at the forward end to the tail rotor gearbox input at the aft end, were recovered from the main wreckage, the debris field, and the aft tailboom section. Reconstruction of the tail rotor drive system revealed that most of the components were present except for the No. 3 tail rotor drive shaft, the forward portion of the No. 4 tail rotor drive shaft, and the hanger bearing between the Nos. 3 and 4 tail rotor drive shafts, which were not found. Fractures observed on the Nos. 1, 2, and 4 tail rotor drive shaft tubes were consistent with main rotor blade contact and were co-located with the angled cuts observed on the tailboom.

The tail rotor gearbox remained installed on the tailboom, and drive continuity within the gearbox was established. Residual oil was present within the gearbox, and the magnetic chip detector revealed no evidence of debris. The tail rotor remained installed on the tail rotor gearbox output shaft. Both tail rotor blades remained installed and were intact. One tail rotor blade displayed damage to its tip end, consistent with contacting the left side of the tailboom. The tail rotor blade leading edge also displayed a damaged area about 3 inches wide and about 15.5 inches inboard from the tip. The other tail rotor blade exhibited no anomalous damage.

Engine

The engine was found in the main wreckage lying on its right side near its installed location. All engine mounts had fractured in overload. The engine exhibited impact damage and was bent at an angle of about 30° at the junction of the turbine and gearbox modules. All major components for the engine were found at the main wreckage site.

The oil and pneumatic lines were manually checked and none showed evidence of looseness. The leading edges of the compressor impeller blades exhibited evidence of hard-body foreign object debris ingestion.

The ECU was found in the main wreckage near its installed location with one of its electrical connectors still attached. The ECU exhibited thermal damage due to the postcrash fire.

Flight Controls Systems

The three main rotor actuators were found in the main wreckage near their installed locations and exhibited impact and thermal damage. The main rotor controls, from the cyclic and collective to the swashplate, and the tail rotor controls, from the pedals to the forward section of the tailboom, sustained multiple fractures due to impact forces, and portions were consumed by the postcrash fire. Pieces of the tail rotor control tube from the midsection of the tailboom were recovered in the debris field. The tail rotor control system remained intact within the aft section of the tailboom (which was found in a tree, as previously discussed) except for slight bending of the tail rotor pitch control rods near the rod ends. The recovered main rotor and tail rotor controls showed no evidence of disconnection.

The PRCS remained installed, but its solenoid exhibited impact damage. The PRCS cam was found in the engaged position. The PRCS emergency release cable (which enables manual disengagement of the PRCS pedal stop) was found in the cockpit and was thermally damaged, and the copper wire for the emergency release cable (which prevents the inadvertent disengagement of the PRCS pedal stop and provides an indication for when the emergency release has been pulled) was found unbroken. The plastic pull knob for the emergency release cable was not recovered, and the adjacent cable housing exhibited thermal damage.

A pitot-static test bench was used to functionally test the pedal restrictor control unit (a PRCS component). The unit responded normally in activating and extinguishing the PRCS engagement and solenoid activation lights when pitot-static pressure (to simulate airspeed) was increased and decreased, respectively. The solenoid functioned normally when power was applied to it. Functionality of the emergency release cable was confirmed.

Avian Material Examination

During the investigation, no evidence was observed to suggest that the accident was the result of a mid-air collision involving another aircraft, or object, and examination of samples taken from the main rotor, nose, windscreen, and cockpit areas were examined for microscopic avian material. No bird remains were found in any of the samples.

Medical and Pathological Information

The Virginia Department of Health, Office of the Chief Medical Examiner, Richmond, Virginia, performed autopsies of the pilot and the observer. The pilot's cause of death was blunt force injury to the head, torso and extremities, and the observer's cause of death was blunt force injuries to the head and torso. The autopsy also identified the pilot's moderate coronary artery disease with a 60% stenosis of the left anterior descending coronary artery. The remainder of the heart examination was unremarkable.

Toxicology testing at the FAA Forensic Sciences Laboratory were negative for the pilot for carbon monoxide, ethanol, and all drugs tested. The testing for the observer detected naproxen in his urine samples. Naproxen is a non-narcotic analgesic and anti-inflammatory agent that is available over the counter and as a prescription. Carbon monoxide and ethanol were not detected in the observer's specimens.

Tests and Research

Performance Study

The performance study for the accident flight was conducted using three data sources: 1) data recovered from the ECU; 2) radar data from airport surveillance radar (ASR)-9, which was located about 3 nautical miles north of CHO; and 3) automatic dependent surveillance – broadcast (ADS-B) system data.

ASR-9 radar data showed that the helicopter left the downtown Charlottesville area about 1644:00 and flew to the southwest and then to the north. The terrain below the helicopter had an elevation from 300 to 600 ft. The helicopter's maximum groundspeed was above 100 knots early in the flight and then varied from 5 to 80 knots during the rest of the flight.

ADS-B data toward the end of the flight indicated that the helicopter was climbing and that its calculated forward airspeed was slowing until 1646:00, when the helicopter leveled off at 1,950 ft for about 1 minute. The helicopter then began climbing again, reaching an altitude of 2,250 ft, and its forward airspeed slowed from 30 to about 20 knots. At 1648:06, the helicopter's forward airspeed increased to 30 knots. Four seconds later, the helicopter climbed from 2,225 to 2,275 ft, and its forward airspeed slowed to about 10 knots. The helicopter's descent began at 1648:18.

The nonvolatile memory from the ECU was successfully downloaded. About 20 seconds of parametric data, which included rotor speed, torque, collective position, gas generator speed, and absolute ambient pressure, were recorded at the end of flight. The ECU data revealed an increase in torque, from 54% to 104%, immediately before the helicopter's descent. The ECU data also indicated that, between 1648:18 and 1648:20, the collective position decreased from 40% to 14% and that, during the next second, the collective position increased to about 30%. Even as the collective continued to increase to a peak of 68% by 1648:31, the helicopter's altitude decreased, indicating that the helicopter did not respond to the increase in collective.

A video study determined the motion of the helicopter based on the security camera video, which captured about 10 seconds of the helicopter's descent but not the beginning of the descent, and a sequence of four still photographs, which were taken during a 2-second period. The video study indicated that, according to the security camera video, the helicopter was descending with an estimated vertical acceleration of 12 ± 1.5 ft/s^2. The photographs indicated that the estimated yaw rate of the helicopter about 20 seconds before impact was at least 92° ± 5° per second in the clockwise direction. The helicopter had already started descending at the time that this estimated yaw rate occurred. The helicopter tail structure appeared undamaged in the photographs.

After 1648:16, the helicopter's low forward speed while descending put it in or near a region conducive to a vortex ring state, which is an aerodynamic condition that occurs when the helicopter descends at the downward speed of its own vortex wake. The vortex system accumulates, building in strength and producing increased downwash through the main rotor. The rotor, operating in a high downwash field, is unable to arrest the helicopter's descent rate, even with increased collective. Even though the collective was raised after 1648:20, the helicopter's altitude did not increase. The security camera video and the photographs of the descent, which were determined to be after 1648:22, showed that the helicopter rolled to the left, between 30-57 degrees, as it was spinning to the right.

Pedal Restrictor Control System Calculations

To determine the effect on tail rotor authority if the PRCS were to remain engaged below 50 KIAS, the National Transportation Safety Board (NTSB) requested that Bell perform calculations to determine the left pedal control margin that would be available for different airspeed conditions with the PRCS cam engaged. The calculations used conditions similar to those on the day of the accident: a gross helicopter weight of 4,633 pounds, an ambient temperature of 86°F (30°C), and a pressure altitude of 2,200 ft.

Bell determined that the left pedal margin would increase with increasing airspeeds and that a hover out of ground effect (OGE) would be the most critical condition for restricted left pedal authority. The calculated tail rotor blade collective pitch angle that would be needed to maintain heading while hovering OGE was between 10° and 11°. If the PRCS were to remain engaged during a hover, a tail rotor blade collective pitch angle of 17° could be achieved with full left pedal travel restricted by the PRCS. Without the PRCS engaged, a tail rotor blade collective pitch angle of about 25° +/- 0.5 could be achieved with the left pedal at its unrestricted full forward position.

Additional Information

Vortex Ring State

According to the FAA's *Helicopter Flying Handbook* (FAA-H-8083-21B), a vortex ring state "describes an aerodynamic condition in which a helicopter may be in a vertical descent with 20 percent up to maximum power applied, and little or no climb performance." The handbook also states the following:

A fully developed vortex ring state is characterized by an unstable condition in which a helicopter experiences uncommanded pitch and roll oscillations, has little or no collective authority, and achieves a descent rate that may approach 6,000 feet per minute (fpm) if allowed to develop….

Situations that are conducive to a vortex ring state condition are attempting to hover OGE without maintaining precise altitude control, and approaches, especially steep approaches, with a tailwind component.

When recovering from a vortex ring state condition, the pilot tends first to try to stop the descent by increasing collective pitch. The traditional recovery is accomplished by increasing airspeed, and/or partially lowering collective to exit the vortex. In most helicopters, lateral cyclic thrust combined with an increase in power and lateral antitorque thrust will produce the quickest exit from the hazard.

Vortex Ring State Training

According to the FAA's *Helicopter Instructor's Handbook* (FAA-H-8083-4), vortex ring state (also known as settling with power) can safely be introduced and practiced at altitudes allowing distance to recover. The handbook also states the following:

Ensure the student understands that settling with power can occur as a result of attempting to descend at an excessively low airspeed in a downwind condition, or by attempting to hover OGE at a weight and density altitude greater than the helicopter's performance allows….

Recovery is accomplished by…if altitude allows, reducing collective and lowering the nose to increase forward speed. This moves a helicopter out of its downwash and into translational lift. When the helicopter is clear of the disturbed air, or downwash, confirm a forward speed indication and initiate a climb to regain the lost altitude.

Virginia State Police Aviation Unit Training Manual

The VSP aviation unit training manual required that its unit instructors refer to the current *Federal Aviation Regulations* and the FAA's practical test standards for standardization. Review of the practical test standards for rotorcraft revealed a required task for settling with power (vortex ring state) for which pilots were to (1) exhibit knowledge of the elements related to settling with power, (2) promptly recognize the onset of settling with power, and (3) use the appropriate recovery procedure.

Review of the VSP aviation unit training manual revealed that vortex ring state was not listed in any of the sample lesson plans for initial or recurrent training and that the associated maneuvers were considered to be optional. Anecdotal information indicated that the pilot had knowledge of vortex ring state, but review of the accident pilot's training records from 2001 to the accident found no record of him receiving settling with power or vortex ring state recognition and recovery training on the accident helicopter make and model.

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Patrick Hempen; FAA / AVP-100; Washington, DC Nora Valee; TSBC; Ottawa Mark Stuntzner; Bell Helicopter; Fort Worth, TX Jack Johnson; Rolls Royce Corporation; Indianapolis, IN Jeffrey Bush; Virginia State Police; Richmond, VA Steve Dudka; Transport Canada; Ottawa Don Hubbard; Genesys Aerosystems ; Mineral Wells, TX
Original Publish Date:	July 13, 2020
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95805