Aviation Investigation Final Report

Location:	Newport Beach, California	**Accident Number:**	WPR22FA101
Date & Time:	February 19, 2022, 18:34 Local	**Registration:**	N521HB
Aircraft:	McDonnell Douglas 500N	**Aircraft Damage:**	Substantial
Defining Event:	Loss of tail rotor effectiveness	**Injuries:**	1 Fatal, 1 Minor
Flight Conducted Under:	Public aircraft		

Analysis

The pilot and tactical flight officer (TFO) onboard the law-enforcement helicopter were performing right turns around a ground altercation over an ocean peninsula at night when the helicopter began to spin rapidly to the right. The pilot applied corrective control inputs but was unable to arrest the rotation, and the helicopter descended into the water. The pilot sustained minor injuries and the TFO was fatally injured.

Examination of the airframe and engine did not reveal any anomalies that would have precluded normal operation.

Although the pilot reported that the helicopter was traveling at a speed of about 50 knots before the spins began, review of flight track data and onboard imaging revealed that, after factoring relative wind, the helicopter had essentially transitioned to a hover shortly before the event started and was flying almost perpendicular to the direction of travel for about 30 seconds before entering the rotation. This discrepancy was likely because the pilot was fixated on the scene below as it became obscured by buildings, and he was concerned about the safety of ground patrol officers who had just arrived.

The nature of law enforcement flights can result in pilots needing to perform tight- radius, uncoordinated turns in a high-power and low-airspeed regime. Such conditions create an environment where unanticipated right yaw may occur, with a greater susceptibility for a loss of tail rotor effectiveness (LTE) in right turns. Flight operations at low altitude and low airspeed in which the pilot loses situational awareness from the dynamic conditions affecting control of the helicopter are particularly susceptible to this phenomenon. Additionally, the helicopter was equipped with a ducted fan anti-torque system, rather than a conventional tail rotor, which was more susceptible to encountering unanticipated right yaw at higher speeds.

While the right yaw is usually correctable, the response must be appropriate and rapid, otherwise the condition may quickly increase to a point where recovery is not possible. Additionally, for the accident helicopter model, if aft cyclic was applied during the early recovery phase, the yaw rate can rapidly increase. An effective recovery is also dependent on the pilot's ability to use external visual references to coordinate corrective control inputs. Due to the night conditions and the helicopter’s proximity to open water, the pilot likely did not have a horizon or accurate external visual reference at the time the helicopter encountered the unanticipated right yaw.

Although the pilot stated that he immediately applied forward cyclic and full left foot pedal in accordance with the approved recovery technique, the helicopter’s imaging system camera pitched up rapidly at the onset of the spin, indicating that the helicopter likely was in an immediate nose-down attitude. Under these circumstances, with the ground immediately filling the windshield, it is possible that the pilot initially instinctively pulled aft on the cyclic, thereby exacerbating the early stages of the spin. Once the spin had progressed, recovery would have been difficult.

Both crew members had recently undergone water egress training, and the pilot was able to use it effectively to exit the helicopter after it sunk following the accident. Evidence suggests that the TFO survived the impact essentially uninjured and began the process of self-extracting. He was positioned on the lower right side of the helicopter, which was on the seabed, and would have needed to crawl through the cabin to climb out of another door or window. He had begun the process of extracting himself, but eventually drowned and was found partially out of the left door window.

The pilot had a significant amount of flight experience in the helicopter, much of it at night, and had recently received training in the tail rotor-equipped version about two weeks before the accident. That training included a section on LTE, but training records indicated that the last time he had received unanticipated right yaw training specific to the accident helicopter type was about seven years before the accident. The recovery techniques for the two situations are similar, however, and the phenomenon and its recovery are well understood, especially for a pilot with his experience.

The helicopter was equipped with a yaw stability augmentation system designed to reduce pilot workload by continuously adjusting the vertical control surface on the tailcone to correct out-of-trim flight. Postaccident examination revealed that the actuator for the control surface was at its full deflection, likely because of the system attempting to correct the extreme yaw encountered during the spinning descent. Detailed examination of the augmentation system did not reveal any anomalies, and although an electrical inductor within the actuator appeared to have burnt out, its damage signatures appeared to be fresh and were possibly a result of investigative testing after the unit had been damaged by corrosion following saltwater immersion. The augmentation system’s control authority was negligible at the speeds the helicopter was traveling before the spin began; therefore, an uncommanded control surface hard-over would not have contributed to the spin entry or inhibited the pilot’s ability to recover from it.

The pilot started the day earlier than usual at 0400, having spent the preceding few days on leave out of state. He reported for duty after taking a connecting commercial flight to get home, almost 12 hours after waking up. The accident then occurred about 3.5 hours later, with his duty day due to finish 23 hours after he woke up. Although he took a nap on the earlier flights, the short nature of the flights meant that his sleep would have been interrupted and insufficient to have overcome the accrued sleep debt. The police department did not have policies for crew rest requirements before reporting for duty, and it is likely that the pilot was beginning to show signs of fatigue during the flight.

Probable Cause and Findings

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

The helicopter’s encounter with unanticipated right yaw during a low-altitude, low-airspeed, tight-radius orbit. Contributing to the accident was the pilot’s distraction during the orbit, which resulted in the loss of control, his fatigue due to his early wake time and time since awakening, and the lack of external cues that hindered his ability to perform a recovery.

Findings

Personnel issues	Task monitoring/vigilance - Pilot
Aircraft	Directional control - Not attained/maintained
Personnel issues	Visual illusion/disorientation - Pilot
Personnel issues	Lack of sleep - Pilot
Personnel issues	Fatigue due to work schedule - Pilot

Factual Information

History of Flight

Maneuvering-low-alt flying	Loss of visual reference
Maneuvering-low-alt flying	Loss of tail rotor effectiveness (Defining event)
Maneuvering-low-alt flying	Loss of control in flight

On February 19, 2022, about 1834 Pacific standard time, a McDonnell Douglas Helicopter 500N (520N), N521HB, was substantially damaged when it was involved in an accident in Newport Beach, California. The pilot sustained minor injuries and the TFO was fatally injured. The helicopter was operated as a public aircraft flight by the Huntington Beach Police Department (HBPD).

The helicopter departed its home base, Huntington Beach Police Department Heliport (CL65), at 1800, and for the next 30 minutes flew a routine patrol along the coast of Huntington Beach, inland to Costa Mesa, and then south to Newport Beach.

The pilot reported that as they were about to depart the Newport Beach area, they received a transmission over the primary police radio channel that there was a fight taking place just south of their location. The pilot stated that he redirected the helicopter toward the area and began a right orbit between 500-600 ft above ground level (agl) while the TFO (who was seated in the right seat) turned on the infrared camera and began searching the ground. The TFO spotted a group fighting, and the pilot began to maneuver the helicopter in a tighter orbit while the TFO relayed his observations over the police radio channel.

Ground patrol officers arrived on the scene, and the pilot continued the orbits about 500 ft above ground level, while simultaneously viewing the activity through his monitor, and maneuvering the helicopter so the TFO could continue to observe the altercation. The pilot stated that he watched as ground patrol officers got out of their car and approached the group, who by this time had mostly dispersed. He was concerned that one person was about to start fighting with an officer, and he slowed the helicopter to about 50 knots (kts) indicated airspeed to keep the camera aimed at the scene longer, so that they would not lose sight of it behind a building.

The pilot stated that, suddenly, the helicopter yawed aggressively to the right, and he immediately applied full left foot pedal and forward cyclic to arrest the rotation, but there was no response. He then applied right pedal to see if the pedals had malfunctioned, and observing no change, he reverted to full left pedal. He continued to apply corrective control inputs, but the helicopter did not respond and began to progress into a spinning descent. (see Figure 1.) The

TFO transmitted over the police radio channel, “We’re having some mechanical issues right now”, followed by, “we’re going down, we’re going down”.

Figure 1 – Final flight path segment

The pilot stated that the rotation became more aggressive, and he began to modulate the throttle, collective, and cyclic controls to try to arrest the rotation rate. He stated that his efforts appeared to be partially effective, as the helicopter appeared to respond; however, because it was dark, he had no horizon or accurate external visual reference as the ground approached. The engine continued to operate, and he chose not to perform an autorotation because the area was heavily populated. He then had a sense that impact was imminent, so he pulled the collective control in an effort to bleed off airspeed.

The helicopter hit the water hard on the TFO’s side in a downward right rotation. The pilot recalled a sudden smash and saw water and glass coming toward him as the canopy shattered. He felt the rotor blades hitting the water, everything then stopped, and within a few seconds he was submerged.

The spinning sequence was captured by security cameras and multiple witness cell phone cameras. Review of the footage indicated that the sound of the helicopter’s engine and rotor system was present until water impact, and the helicopter was not emitting any smoke. As the helicopter descended, its pitch attitude violently oscillated between about 30° nose down and almost full nose down as the gyrations progressed.

None of the cameras captured the transition from the orbit maneuver to the spin, but one security camera captured the helicopter on its final orbit. The helicopter moved behind a building and out of view and was already spinning when it came back into view. The sound of the engine and rotor system could be heard throughout, with no sounds indicative of a mechanical failure.

Pilot Information

Certificate:	Commercial	**Age:**	50,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	January 24, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 2, 2022
Flight Time:	3746 hours (Total, all aircraft), 3632 hours (Total, this make and model), 3688 hours (Pilot In Command, all aircraft), 66 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Other flight crew Information

Certificate:	Commercial; Flight instructor	**Age:**	44,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	September 20, 2021
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 20, 2020
Flight Time:	1708 hours (Total, all aircraft), 1650 hours (Total, this make and model), 1657 hours (Pilot In Command, all aircraft), 72 hours (Last 90 days, all aircraft), 22 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

The pilot was hired by HBPD in 2005. His initial duties included that as a TFO, and over the next few years he began flight training, eventually attaining a commercial pilot certificate. At the time of the accident, he was the second most experienced pilot at HPBD, with about 3,700 flight hours of flight experience as pilot-in-command of the MD500N. He typically flew between 12 to 20 hours per month, with half of his flights performed at night.

The day of the accident was the pilot's first day of a three-day shift; he had spent the preceding days off in Spokane, Washington. He started his day by waking up at 0400, having gone to bed about 2100 the night before. He then flew down to Long Beach, California, via connecting commercial flights, arriving at 1230. He reported for work at 1500, and his duty was to end at 0330. He reported that he was able to get some sleep on the commercial flights.

HBPD did not have any policies in place for crew rest requirements prior to reporting for duty.

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas	**Registration:**	N521HB
Model/Series:	500N	**Aircraft Category:**	Helicopter
Year of Manufacture:	1998	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LN084
Landing Gear Type:	None; Skid	**Seats:**	4
Date/Type of Last Inspection:	February 15, 2022 Continuous airworthiness	**Certified Max Gross Wt.:**	3350 lbs
Time Since Last Inspection:	5 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	15028 Hrs at time of accident	**Engine Manufacturer:**	Rolls Royce
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	250-C20R/2
Registered Owner:	CITY OF HUNTINGTON BEACH	**Rated Power:**	450 Horsepower
Operator:	CITY OF HUNTINGTON BEACH	**Operating Certificate(s) Held:**	None

The helicopter was owned by the City of Huntington Beach and was providing law enforcement air support under a contract service agreement for the City of Newport Beach.

The helicopter was designated as a 500N, but marketed as the 520N. It was a no tail rotor (NOTAR) design, which utilized a variable thruster and ducted fan system for anti-torque control rather than a traditional tail rotor. It was configured with dual flight controls with the right (TFO side) foot pedals removed. It had been equipped for law enforcement and included an external "Nightsun" searchlight, and a "WESCAM MX-10" gimbled imaging system, processed by an AeroComputers digital mapping system.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KSNA,54 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	18:53 Local	**Direction from Accident Site:**	35°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Broken / 23000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	17°C / 8°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Huntington Beach, CA (CL65)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Huntington Beach, CA (CL65)	**Type of Clearance:**	None
Departure Time:	17:59 Local	**Type of Airspace:**	Class C

A High-Resolution Rapid Refresh (HRRR) model sounding was created for 1800 and 1900 for the accident location at varying altitudes. The 1800 data indicated that at an elevation of 313 ft msl, wind was from 281° at 14 kts, and at 1900 286° at 11 kts.

Sunset occurred at 1740, with dusk at 1805. The moon was below the horizon and rose at 2054.

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Minor	**Latitude, Longitude:**	33.610368,-117.92438

The helicopter came to rest on the seabed, submerged in saltwater about 45 ft from a beach within Newport Bay.

The fuselage was largely intact, with the landing skids and tailboom still attached. The stinger remained attached to the tail and had been displaced to the left. The cabin was intact, and the windscreen on both the pilot and copilot sides had broken out, leaving only the frame.

The main rotor drive assembly was still attached to the mast. Two rotor blades had separated from the rotor head and were recovered in the vicinity of the initial water impact, and the remaining three blades remained attached to the rotor head. The blades all exhibited varying degrees of aft bending, trailing edge buckling, and split skins at their trailing edges.

Examination of the flight control systems did not reveal any failures that would have precluded normal operation. The cyclic and collective controls were continuous from both the pilot and copilot's controls to the swash plate assembly.

The anti-torque blade drive system was still connected to the main transmission, and control continuity was confirmed from the pilot's anti-torque pedals through to the rotating cone and left vertical stabilizer bell crank. Pitch change of the anti-torque fan blades corresponded to movement of the foot pedals. The interior of the ducted tail boom was clear of debris and no damage was observed. The rotating diffuser cone sustained slight bending damage consistent with impact, but was intact. The stationary thruster was attached, and all thruster vanes were in place. The duct control assembly was intact and functional, and the anti-torque system appeared to have been correctly rigged.

The horizontal and vertical stabilizer assembly mounts had broken from the tail boom and the assembly remained connected by electrical cables and control linkages. First responders pulled the helicopter with a rope by the tail immediately following the accident to assist crew recovery.

Flight recorders

Both automatic dependent surveillance – broadcast (ADS-B) and GPS data recorded by the onboard imaging system were used by specialists from the NTSB Office of Research and Engineering to determine the helicopter’s heading and yaw rate towards the end of the flight. This data, along with winds aloft information was used to extrapolate the helicopter’s flight trajectory and heading for the last two minutes of flight.

The results indicated that, after performing two orbits, the helicopter slowed to a ground speed of between 15-23 kts as it moved east, which correlated to a calibrated speed of between 3-12 kts. During the next 5 seconds, the helicopter was pointing perpendicular to the direction of travel, on a heading of about 180°. The helicopter then held its position over the ground and started to move west while still pointing south, and two seconds later, it began to spin to the right as the imaging system's camera pitched up. The spin progressed at a rate of about 130° per second, and ground-based security video footage indicated that the rate remained about the same until the helicopter impacted the water. (See Figure 2.)

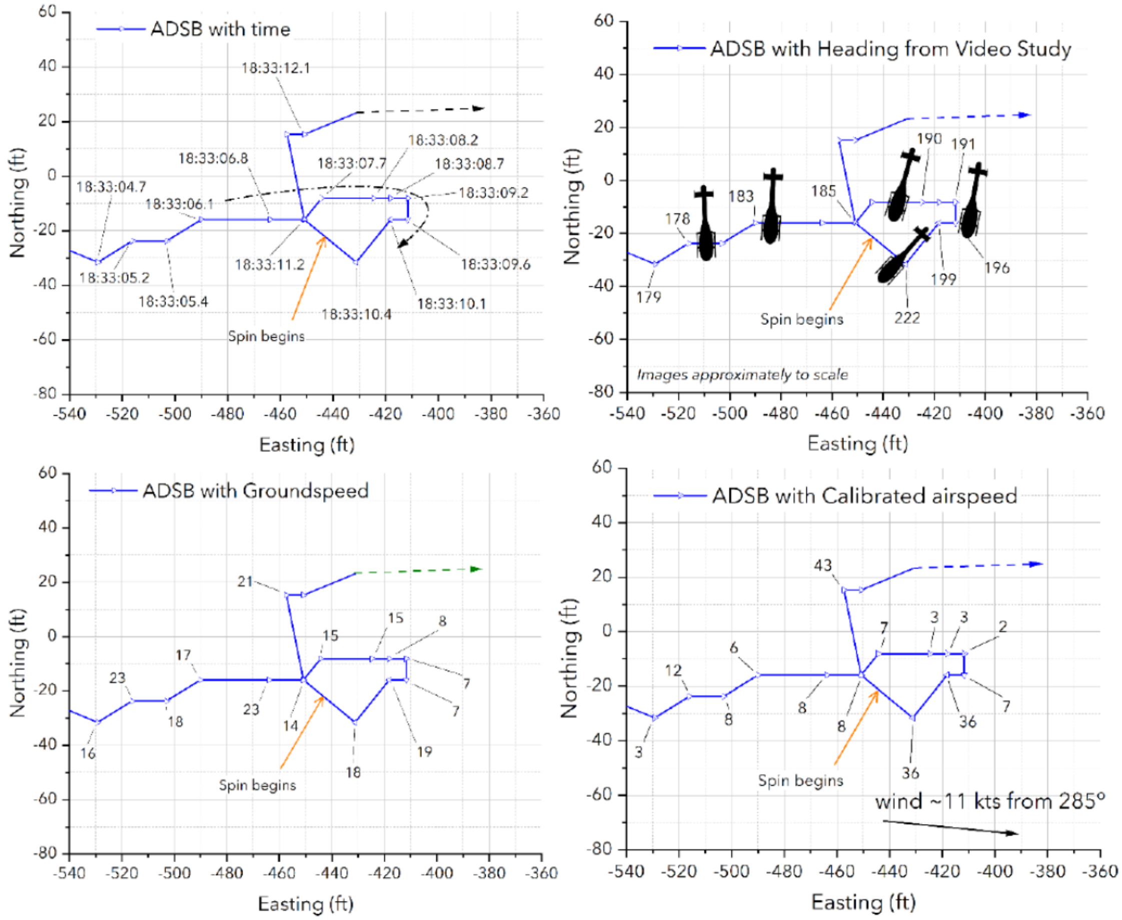

Figure 2 - ADS-B flight path in Northing and Easting with time (top left), heading (top right), groundspeed (bottom left) and calibrated airspeed (bottom right) for each point. The X and Y axes reflect the distance from the last ADS-B data point, which was in the water. Wind direction and magnitude is also noted on calibrated airspeed plot.

The data indicated that the helicopter approached the area for the first orbit at an altitude about 850 ft agl. It descended to 350 ft agl after completing the first orbit; its altitude varied between 450 ft and 300 ft for the final two orbits until the diversion. (see Figure 3.) The radius of the final two orbits was about 650 ft.

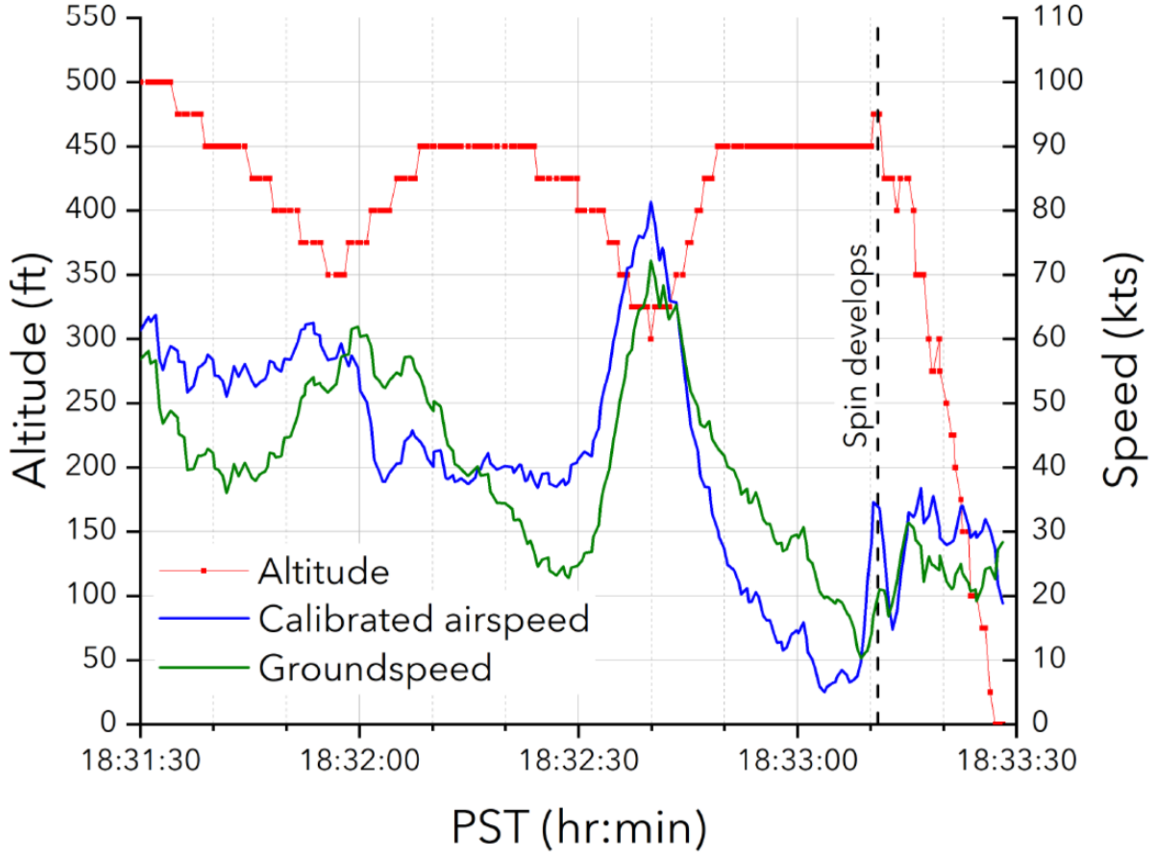

Figure 3 - Altitude (msl), calibrated airspeed, and groundspeed of the end of flight.

Medical and Pathological Information

An autopsy examination was conducted on the TFO by the Orange County Sheriff-Coroner. The cause of death was reported as drowning, and no significant injuries were noted. The autopsy indicated chest abrasions consistent with resuscitative efforts, along with rib and sternum fractures.

Toxicology testing did not identify the presence of any screened drug substances or ingested alcohol.

Survival Aspects

The pilot and TFO were wearing flight suits, a dual-visor helmet system, a combination inflatable life preserver/tactical vest, and an emergency breathing system that consisted of a supplemental rescue air bottle mounted to the vest. Both helmets were equipped with night vision goggles, which were not being used and were in the “up” position for the flight.

The pilot stated that, after impact, he continued to hold on to the collective as a reference point, then cleared the mouthpiece from the air bottle, and after clearing it, started to use it to breathe. He continued to hold the collective with one hand, and reached down and released his seat harness. His eyes were closed, and he was able to move by feel. He did not recall opening the door and was able to egress by pushing himself off the collective away from the helicopter.

He exited the helicopter and remained motionless while waiting to rise, but realized he was still attached to the helicopter by his helmet cord. He disconnected the cord, and slowly started to ascend. He reached the surface and could see the tail boom, and he started calling out for the TFO. He could see bubbles surfacing, but did not get a response. Witnesses began to arrive, and they pulled him away and toward a boat. He told them that he was ok, and that they should focus their efforts on finding the TFO.

A witness, who initially assisted the pilot, dived back in to search for the TFO. He used the pilot’s air bottle and reported that the water visibility was about 20 inches. He found a door handle and rotated it 90° and the door opened. When he entered, he felt initially what he thought was the TFO, but it was a tactical bag. He came back to the surface and the pilot called out that he was on the wrong side of the helicopter, so he dived again to the other side but was not able to find the door.

First responders began to arrive on the scene, and multiple members of the fire department and local law enforcement dived in to attempt to find the TFO. After a few minutes, the helicopter was pulled closer to the shore by a truck, revealing the cabin. A diver stated that the forward left door was closed, and its window was gone, and he could see that the TFO was halfway out of the window. He appeared uninjured, his seat harness was unbuckled, and his helmet cord was already disconnected. They attempted to pull him out, but it became apparent that his leg was stuck. They pushed him back in and tried again, and this time he came out easily.

The TFO was still wearing his helmet and vest. The inflatable section of the vest had not been deployed, and its trigger handle had not been pulled. The protective cover of his air bottle mouthpiece had been removed; the air valve was open, and the bottle was empty.

Examination revealed that both the pilot and TFO’s seat belt buckles were unlatched, and their belt harnesses remained attached to the respective airframe anchor points.

Both seat bases and seat pans were intact, attached to the airframe, and did not exhibit any evidence of crush damage or stroking. Additionally, the entire forward canopy and lower windows had shattered, leaving openings in the frame.

Egress Training

Both the pilot and TFO had completed “Dunker Training” using a shallow water egress trainer system (SWET) on January 27, 2020. The training used equipment in the shallow end of a swimming pool and taught basic underwater escape procedures dealing with seat belts, brace positions, reference points, and exits. The training included use of the emergency breathing device. The training was performed using a SWET roll cage system, rather than a simulation helicopter structure. According to the training syllabus, the course covered the content required for compliance with Army Regulation 95–1 (Flight Regulations).

Tests and Research

Flight Testing

A series of flight demonstrations were performed by members of the MD training department with the NTSB investigation group in a factory 520N helicopter, to demonstrate the handling characteristics as the helicopter approached and entered unanticipated right yaw. The tests were conducted at varying speeds and attitudes. It was found that once the yaw had begun, the rate could be arrested with prompt application of the left foot pedal followed by forward cyclic. If aft cyclic was applied, the yaw rate would rapidly increase. An effective recovery was dependent on the pilot's ability to use external visual references to coordinate corrective control inputs.

Y-SAS

The helicopter was equipped with a yaw stability augmentation system (Y-SAS), designed to provide the pilot with increased directional stability and thus reduce workload. It enhanced handling qualities by providing control inputs to an active vertical stabilizer. The system had control authority over the right vertical stabilizer, which had a total range of travel of approximately 15°. The left vertical stabilizer was also active but controlled by direct pilot input through the antitorque pedals, with a control surface range of about 29°. The system used information from a yaw rate gyro and a lateral accelerometer to position the right stabilizer. A Y-SAS control box/computer received signals from the rate gyro and accelerometer and used this information to send command signals to the Y-SAS actuator located in the right horizontal stabilizer, which then moved the right vertical fin.

According to MD, at slow airspeed when the helicopter is in a slipped condition with a large amount of right pedal, the dominant yaw control effect will not be from the vertical stabilizer, but rather as a result of the thruster being mostly open to the right.

During the helicopter examination, the Y-SAS actuator was found extended to almost the full right travel limit of the stabilizer.

In 1991, McDonnell Douglas performed a series of flight tests to ascertain the flying qualities of the NOTAR-equipped helicopter. Testing included determining the helicopter's controllability throughout the flight envelope during Y-SAS hard-over and oscillatory conditions. Testing revealed that, in hard-over conditions, pedal margins and controllability still allowed for full helicopter maneuverability, did not degrade the basic handling qualities, and overall, the handling qualities during the simulated failure events were considered "benign." It was found that hard-over failures at speeds less than 40 kts had little to no noticeable effect.

The primary components of the Y-SAS system were examined at the manufacturer's facility under the immediate oversight of the investigation team.

Both the yaw damper computer and rate gyro were externally undamaged, but disassembly revealed evidence of saltwater intrusion and corrosion, presumed to be because of the immersion following the accident. Acceptance test procedures were performed on both units, with sporadic failures observed.

The linear actuator appeared similarly undamaged, although corrosion deposits were present coming out of its case seals. The actuator began to vibrate ("chatter") when power was applied, and it would not respond to control inputs during a functional test. Disassembly revealed the motor and drive assembly, although corroded, appeared generally undamaged. The internal circuit board was coated in white- and rust-colored deposits, but all components appeared intact. Of note, an inductor through which electrical power was supplied to the unit's microprocessor had a longitudinal crack, which was emitting brown deposits. The deposits on the top of the inductor were clean and bright, and not coated in the white and rust deposits as found on the other circuit board components.

Additional Information

Flight Training

HBPD provided annual recurrency training to their flight crews at either their facility in Huntington Beach, or at the factory facilities of MD Helicopters. The recurrency training for the pilot was completed 17 days before the accident. However, because HBPD was in the process of transitioning its fleet to the conventional tailrotor 500 series, “difference training” was performed, in an MD530F at MD in Mesa, Arizona.

The “Normal Operations” segment of the MD syllabus included a section devoted to “Low Speed Maneuvering”. According to MD, this part of the syllabus includes “loss of tail rotor effectiveness (LTE)” training in tail rotor helicopters and “unanticipated right yaw” training in NOTAR helicopters. According to MD, the 500N series helicopter is more susceptible to encountering unanticipated right yaw at higher speeds than the 530F helicopter, but with appropriate control inputs, a prompt recovery can be achieved.

The pilot’s training records indicated that he last performed “Low Speed Maneuvering” during the “difference training” in the 530F in 2022, but the last time he performed this training in the 500N series was in 2015. According to MD training staff, guarding against unanticipated right yaw is intrinsic to the basic operation of the helicopter, and is addressed routinely throughout training.

The syllabus included night “Emergency/Malfunction” with unusual attitude recovery. Training records indicated that the pilot last completed this training in May 2018.

In addition to annual training with MD, HBPD provided monthly group training for all pilots. This included both ground and flight training performed by either the chief pilot or safety officer.

All checkrides were performed by members of the MD factory flight training department, either at the MD or HBPD facilities.

At the time of the accident, the “Low Speed Maneuvering” section of the MD600N (the other helicopter in the MD range that used the NOTAR system) Rotorcraft Flight Manual RFM gave specific guidance regarding unanticipated right yaw:

An unanticipated right yaw can occur when operating at low altitude (AGL) and low airspeed where a pilot, focusing his attention on surface objects, may be distracted from the aerodynamic conditions affecting the helicopter's attitude. If no directional or cyclic control inputs are made, a nose down pitch and a right roll may follow the right yaw.

Maneuvering at speeds less than 60 knots with left sideslips (flying out of trim with too much right pedal) or with winds from the left can cause a right yaw and an increase in left pedal force. Typical maneuvers where this can occur are uncoordinated turns to the right utilizing too much right pedal and right turns to a downwind condition.

If this condition is encountered, application of left pedal along with necessary cyclic inputs will stop the right yaw and return the helicopter to the desired attitude. The pedal force required to stop the right yaw will increase as the degree of left sideslip increases.

Although the MD500N RFM addressed emergency procedures during an anti-torque system failure, it did not make any specific reference to unanticipated right yaw as found in the 600N RFM.

Unanticipated Right Yaw

Federal Aviation Administration Advisory Circular 90-95 addressed the subject of unanticipated right yaw in helicopters.

The circular stated that any maneuver which requires the pilot to operate in a high-power, low-airspeed regime with a left crosswind or tailwind creates an environment where unanticipated right yaw may occur, with a greater susceptibility for a loss of tailrotor effectiveness in right turns. Flight operations at low altitude and low airspeed in which the pilot is distracted from the dynamic conditions affecting control of the helicopter are particularly susceptible to this phenomenon.

The right yaw is usually correctable, but if the response is incorrect or slow, the yaw rate may rapidly increase to a point where recovery is not possible.

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Benjamin Harris; Federal Aviation Administration FSDO; Long Beach, CA Joan Gregoire; MD Helicopters; Mesa, AZ Jeff Goodspeed; Huntington Beach Police Department; Huntington Beach, CA
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Last Revision Date:	
Investigation Class:	Class 3
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=104671