Aviation Investigation Final Report

Location:	New Castle, Delaware	**Accident Number:**	ERA17FA190
Date & Time:	May 25, 2017, 11:53 Local	**Registration:**	N62UP
Aircraft:	EUROCOPTER DEUTSCHLAND GMBH EC 135	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The purpose of the flight was for the airline transport pilot of the helicopter to practice solo instrument approaches in instrument meteorological conditions (IMC). The pilot received adequate preflight weather briefings using company-approved weather sources, including one 35 minutes before departure. The terminal area forecast published earlier that morning and valid for the pilot's anticipated time of arrival at the destination indicated that the visibility would be 6 statute miles with an overcast ceiling at 1,200 ft agl; though the most recent surface observation report contradicted the forecast, indicating that the visibility was 4 statute miles in rain and the overcast ceiling was at 500 ft. The pilot subsequently submitted a flight request form to his company, which documented the weather products he reviewed before the flight and indicated that he was aware of the reported and the forecast weather conditions for the route before departure. The company's operation control center approved and released the helicopter for the flight. A review of weather radar and surface weather observation reports current at the time of the departure revealed that the helicopter entered and remained in IMC as it continued to the destination airport.

A review of radar data and air traffic control (ATC) communications revealed that controllers provided radar vectors to the pilot for an instrument landing system (ILS) approach. The helicopter intercepted the localizer course about 1 nautical mile (nm) outside the approach gate. The controller then cleared the pilot for the approach with a restriction to maintain an altitude at or above 2,000 ft mean sea level (msl), which was both the assigned altitude and the intermediate altitude for the approach, until established on the approach and to contact the control tower at the destination airport. The pilot acknowledged the clearance and contacted the tower controller shortly thereafter. After checking in with the tower controller; the helicopter maintained 2,000 ft msl as it continued through the glideslope and crossed over the locator outer marker, which had a published crossing altitude of 1,842 ft msl.

As the helicopter reached a point about 3 nm inside the outer marker, while flying at an altitude about 2,000 ft msl, the pilot declared a missed approach, telling the controller that he had received "some bad vectors at the very end" and that he wanted to "just line up and come back around again." The controller advised the pilot to fly the published missed approach procedure (a straight-ahead climb to 900 ft msl and then a left climbing turn toward the next navigational fix, at an altitude 2,000 ft msl). The helicopter then climbed straight ahead to an altitude of 2,525 ft msl in 9 seconds, before it turned right and started descending rapidly. The helicopter's calculated rate of climb before it began to descend was about 3,000 ft/min, while it's calculated groundspeed was about 120 knots. This climb rate and speed were not consistent with the pilot using the helicopter's automatic flight control system go-around mode because they were well above the climb rate and groundspeed that the "go around" mode would have maintained. Radar contact was lost as the helicopter descended through 1,625 ft msl, and the calculated descent rate between the helicopter's final two radar-recorded positions was more than 7,000 ft/min. No further communications were received from the pilot. One witness reported seeing the helicopter "spinning down…out of the clouds in an upside-down nose dive." Another witness reported that the helicopter descended "like a rocket" and that he did not observe any smoke or fire before the helicopter impacted the ground.

The helicopter came to rest in a ditch, fragmented and mostly consumed by postimpact fire, about 3,200 ft before the runway threshold. All the helicopter's major components were located in the wreckage area. Examination of the helicopter revealed no evidence of any preimpact mechanical malfunctions or failures that would have precluded normal operation.

The weather conditions recorded at the destination airport showed that IMC existed with easterly surface winds, visibility 2 1/2 statute miles in mist, an overcast ceiling at 500 ft agl, and temperature and dew point of 16°C. An AIRMET was current for low-level wind shear and turbulence for the region at the time of the accident, and high resolution rapid refresh model sounding data from around the time of the accident indicated that there was a possibility of turbulence. However, there was no verification of any significant wind shear or turbulence in any PIREPs, and the pilot did not report turbulence to air traffic control. Therefore, it could not be determined if turbulence contributed to the accident.

Although the radar vectors provided by the controller during the approach were contrary to the FAA's guidance to air traffic controllers, which required aircraft to be vectored to intercept an ILS localizer course 2 nm outside the approach gate given the weather conditions that prevailed at that time, radar data confirmed that the helicopter successfully tracked inbound toward the airport on the localizer course. Although the radar vectors did not directly contribute to the accident, they likely increased the pilot's task load during the accident sequence.

Several factors indicated that the pilot was task-saturated when the accident sequence occurred: he was performing an instrument approach that he had not previously performed; he was provided radar vectors close to the approach gate, which accelerated the timeline of the approach procedure; and he was likely already planning the return flight to the departure airport, which he previously indicated to the controller that he would conduct following the approach. That the pilot did not descend the helicopter after intercepting the glideslope or passing the final approach fix and did not fly the published missed approach procedure are indicative that he had likely become task-saturated during the final moments of the flight.

Nontime-correlated but sequentially recorded data recovered from the helicopter's warning unit revealed that, at some time during the accident flight, the greater-than-106% rotor rpm warning indicator illuminated multiple times, then the greater-than-112% rotor rpm warning illuminated. The rotor rpm warnings cycled between greater than 106% and 112% and less than 95% multiple times. Given that no discrepancies wiht the helicopter's engines or rotor system were discovered during the postaccident examination, it is likely that these rapid, dramatic changes in rotor rpm annunciated and recorded by the warning unit were the result of the pilot's control inputs as he became task-saturated and began to experience the effects of spatial disorientation. The helicopter's subsequent rapid climb, right turn contrary to the published missed approach instructions, and its near-vertical descent are consistent with the pilot's loss of helicopter control due to spatial disorientation.

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 during a missed approach in instrument meteorological conditions due to spatial disorientation and the cumulative effects of task saturation.

Findings

Personnel issues	Aircraft control - Pilot
Personnel issues	Spatial disorientation - Pilot
Personnel issues	Cognitive overload - Pilot
Aircraft	(general) - Not attained/maintained

Factual Information

History of Flight

Approach-IFR missed approach	Loss of control in flight (Defining event)
Approach-IFR missed approach	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On May 25, 2017, at 1153 eastern daylight time, a Eurocopter Deutschland GMBH EC 135 P2 helicopter, N62UP, was destroyed when it impacted terrain near New Castle, Delaware. The airline transport pilot was fatally injured. The helicopter was registered to the University of Pennsylvania and was being operated by Metro Aviation, Inc., as a Title 14 Code of Federal Regulations Part 91 personal flight. Instrument meteorological conditions (IMC) prevailed at the accident site about the time of the accident, and an instrument flight rules (IFR) flight plan had been filed for the flight. The local flight originated from Atlantic City International Airport (ACY), Atlantic City, New Jersey, at 1117.

According to a representative of Metro Aviation, a helicopter air ambulance operator, the purpose of the flight was for the pilot to practice instrument approaches at New Castle Airport (ILG), Wilmington, Delaware, pick up a clearance in flight, and then return to ACY. The pilot obtained weather briefings via the Foreflight application at 1026 and 1042. The briefings included weather observations, forecasts, and NOTAMs for the departure, destination, and selected en route stations; PIREPs (pilot reports); and in-flight weather advisories for the planned flight. At 1043, the pilot submitted a flight request form to the company, which documented the weather products he reviewed before the flight and indicated that he was aware of the reported and forecast weather conditions for the route before departure. After reviewing the request, weather, and risk assessment, the company's operation control center approved and released the helicopter for the flight five minutes after the request was submitted. In addition, the pilot performed and signed off the preflight inspection of the helicopter the morning of the accident.

A review of radar data and air traffic control (ATC) communications provided by the Federal Aviation Administration (FAA) revealed that after departing from ACY, the flight proceeded uneventfully and at 1150, an ILG tower controller cleared the pilot for the ILS RWY 1 approach (see figure 1, which shows an overhead view of the helicopter's radar ground track overlaid on the ILS RWY 1 instrument approach procedure plan view). The radar track showed that the helicopter was established on the final approach course about 2,000 ft mean sea level (msl), which was both the assigned altitude and the intermediate altitude for the approach. The helicopter maintained 2,000 ft msl as it continued through the glideslope and crossed over the locator outer marker (HADIN). The published crossing altitude for HADIN while established on the glideslope was 1,842 ft.

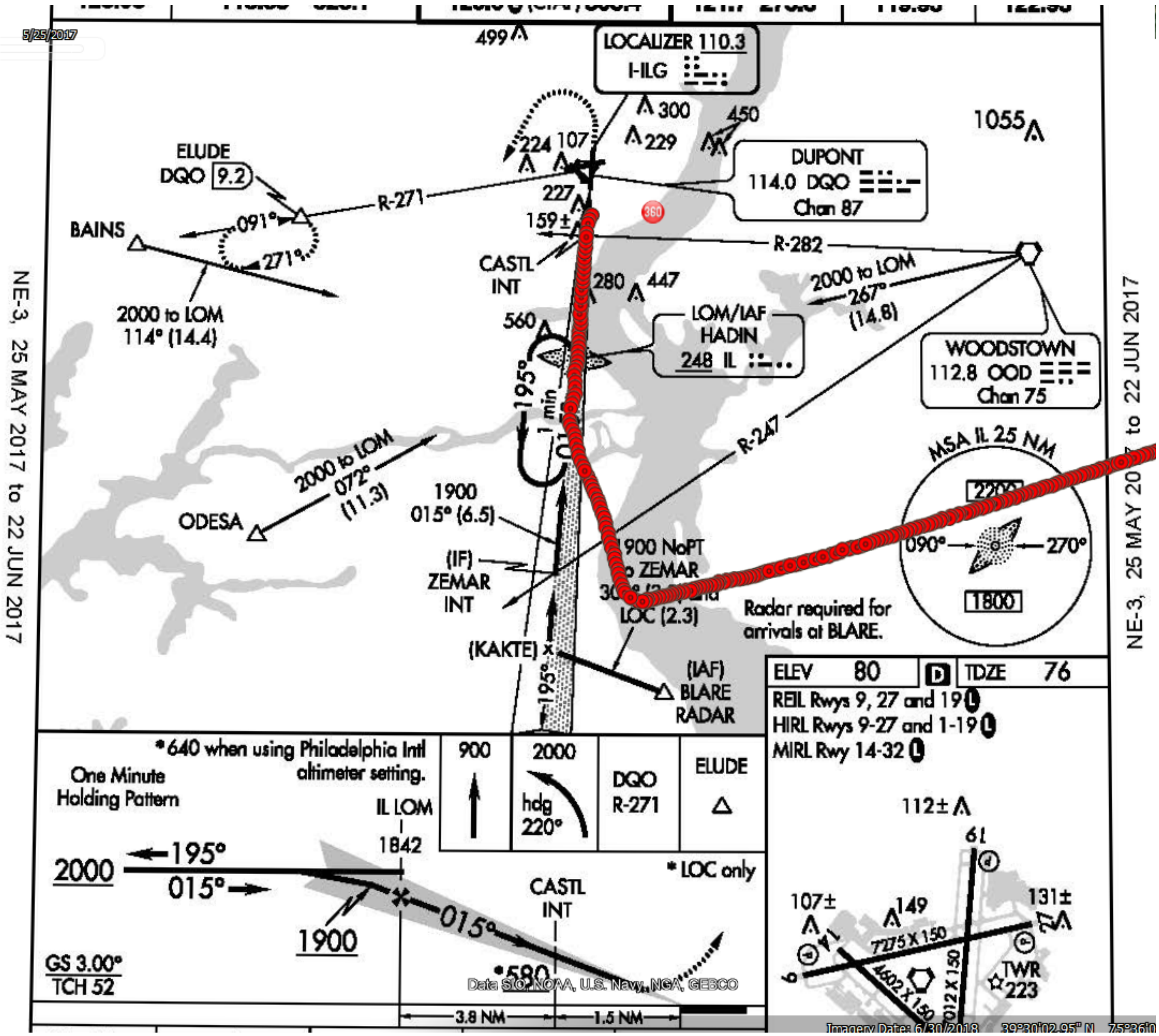

Figure 1. Overhead view of helicopter's radar ground track (red) overlaid onto the ILS Rwy 1 instrument approach procedure plan view.

The helicopter continued on course toward the runway; when it was about 3 miles, and about 2 minutes and 15 seconds beyond HADIN and still at an altitude of 2,000 ft msl, the pilot declared a missed approach. The controller advised the pilot to fly the published missed approach procedure. (The published procedure was a straight ahead climb to 900 ft, then left climbing turn to 2,000 ft to a heading of 220° to the ELUDE fix). Following the instruction, the helicopter climbed on course to 2,525 ft msl before it turned right and started a descent to 2,225 ft msl 4 seconds later. Subsequently, radar contact was lost when the helicopter was at 1,625 ft msl, and no additional communications were received from the pilot.

One witness reported seeing the helicopter for about two seconds "spinning down…out of the clouds in an upside-down nose dive." Another witness reported that the helicopter descended "like a rocket" and that he did not observe any smoke or fire before the helicopter impacted the ground.

PERSONNEL INFORMATION

The pilot held an airline transport pilot certificate with a rotorcraft-helicopter rating. Additionally, he held a flight instructor certificate with helicopter and instrument helicopter ratings and a private pilot certificate with airplane single-engine land and instrument airplane ratings. The pilot's most recent FAA second-class medical certificate was issued on October 20, 2016. At that time, he reported 4,200 hours of total flight experience, 100 hours of which were in the previous 6 months.

According to Metro Aviation's duty log for the pilot, he had accumulated 827.0 hours of flight experience with the company since he was hired in June 2013, 21.9 hours of which were in IMC and 33.2 hours of which were simulated instrument time. Since January 1, 2016, he had completed 18 precision instrument approaches and 21 non-precision instrument approaches. The duty log indicated that, from January 2016 through the accident date, the pilot had only flown to ILG for the company once, on March 12, 2017, on a day, visual flight rules flight.

The pilot's most recent instrument proficiency program check flight was on April 9, 2017. During that flight, the pilot practiced several types of instrument approaches, including an ILS approach and a missed approach.

AIRCRAFT INFORMATION

The light helicopter was manufactured in 2006 and was configured with the pilot's seat on the right side. It was equipped with two Pratt & Whitney Canada PW206B2 engines.

The helicopter was equipped with a four-blade, rigid hingeless, bearingless main rotor system. In addition, it had a fenestron-type antitorque system, which is comprised of a ten-blade fan housed in the vertical fin. The helicopter was also equipped with an Automatic Flight Control System (AFCS), three-axis autopilot.

According to the helicopter flight manual, the AFCS had the ability to perform several different types of instrument approaches such as localizer approaches and ILS approaches (which used localizer mode with the glide slope mode), in addition it had a "Go around (GA) mode," which could be used in the event of a missed approach. When using the autopilot during an ILS approach, the AFCS would capture and fly the localizer first, and then capture the glideslope and command the helicopter to track the glideslope beam. The glideslope mode captured when the glideslope deviation was inside the -0.2/+0.5 dot range. In order to use the autopilot for an ILS approach the approach and the glide slope modes needed to be engaged separately. In the GA mode, the helicopter would acquire and hold a vertical speed of 1000 ft/min or 75 knots indicated airspeed.

According to the helicopter's maintenance logbook, the most recent approved aircraft inspection program 100-hour inspection was conducted on April 25, 2017, at an airframe total time of 5,152.1 hours. Before the accident flight, the helicopter's airframe total time was 5,163.1 hours and the left and right engines total operating times were 5,168.9, and 5,155.7 hours, respectively.

METEOROLOGICAL INFORMATION

The 1036 weather observation from ILG, which was the prevailing conditions when the pilot was performing his preflight weather planning, reported wind from 070° at 13 knots, visibility 4 miles in light rain and mist, overcast clouds at 500 ft above ground level, temperature 14° C, dew point 14° C, and an altimeter setting of 29.52 inches of mercury.

The 1151 weather observation from ILG reported wind from 050° at 7 knots, visibility 2 1/2 miles in mist, overcast clouds at 500 ft above ground level, temperature 16° C, dew point 16°C, and an altimeter setting of 29.53 inches of mercury.

Helicopter Emergency Medical Services (HEMS) Weather Tool images depicting the route between ACY and ILG, at 1000, 1030, 1100, 1130, and 1200, all indicated that IMC to "low" IMC prevailed in the area.

Terminal Forecast

The 0800 forecast for ILG predicted wind from 080° at 12 knots, gusting to 20 knots, visibility 4 miles in light rain showers and mist, ceiling overcast at 800 ft. The forecasted weather at 1000 was with wind from 090° at 10 knots, visibility greater than 6 miles, and ceiling overcast at 1,200 ft. Then, visual flight rules (VFR) conditions at 1400, with visibility greater than 6 miles and a cloud ceiling broken at 3,500 ft. Low-level wind shear was not mentioned in the forecast.

The forecast for ACY predicted wind from 070° at 12 knots, visibility 5 miles in light rain showers and mist, and ceiling overcast at 600 ft. At 1000, forecast conditions included wind from 090° at 10 knots, visibility greater than 6 miles in light rain, and ceiling overcast at 1,200 ft. After 1500, VFR conditions were expected with visibility unrestricted and ceiling broken at 4,500 ft.

Area Forecast

The forecast for southern New Jersey issued at 0445 and valid through 1700 predicted general overcast clouds at 1,000 ft with tops to 25,000 ft and visibility 3 to 5 miles in light rain and mist through 1500, then lifting to broken at 3,500 ft with widely scattered light rain showers and thunderstorms with tops to 35,000 ft. The forecast for Delaware and northern Maryland also expected general overcast clouds at 1,000 ft with tops to 25,000 ft, with visibility 3 to 5 miles in light rain and mist. After 1400, scattered clouds at 1,500 ft, and broken clouds at 4,000 ft were expected with scattered light rain showers. The forecast was amended by AIRMET Sierra, which was current at the time of the accident.

Inflight Weather Advisories

The primary advisories current at the time of the accident included a series of AIRMETs, which were issued at 1045, and warned of a wide area of IFR conditions, moderate turbulence, and low-level wind shear (LLWS). The conditions were expected to continue through 1700.

High Resolution Rapid Refresh (HRRR) Numerical Model Sounding

A National Oceanic and Atmospheric Administration HRRR model sounding for the approximate location of the accident at 1200 predicted a wind profile indicated easterly winds below the frontal inversion with winds veering to the south and southwest abruptly above the inversion with increasing wind speeds. The data indicated that, during the descent from 3,000 ft to 1,000 ft, a 90° shift in wind direction and speed would have occurred and that this had the potential of producing moderate or greater turbulence. The data also indicated that there was a greater than 90% probability of turbulence and/or wind shear at 1,600 ft, when the last ATC radar contact with the helicopter occurred.

Aircraft Meteorological Data and Relay Observations

Three aircraft provided Aircraft Meteorological Data and Relay or in situ reports, which contained real-time observations of the atmospheric conditions and observed winds immediately surrounding the time of the accident, The reports came from special instrumented aircraft departing from or arriving at the Philadelphia International Airport, Philadelphia, Pennsylvania, located about 20 miles northeast of the accident site.

These reports confirmed the presence of frontal inversions and change in wind direction and speed with height. One of the airplanes, which was equipped with a moisture sensor, provided a descent sounding at 1046, which reported a saturated environment from 4,000 ft to the surface with a relative humidity greater than 97%. All three aircraft reported that the low-level wind maximums near 3,000 ft were from the south from 31 to 39 knots and that winds below 1,000 were from the east. One report showed a sharp increase in the temperature profile about 1,620 ft where the temperature fluctuated and a strong vertical shear was noted, suggesting turbulence might have existed.

PIREPs (Pilot Reports)

Four PIREPs were made within 100 miles of the accident location around the time of the time of the accident. Each reported cloud bases near as low as 400 ft, and cloud tops at 2,000 ft. One of the reports described the air as "smooth" and none reported the presence of turbulence or windshear.

AIRPORT INFORMATION

ILG was located 4 miles south of Wilmington, Delaware, at an elevation of 80 ft msl. The airport had an operating control tower that was open from 0730 to 0000 daily. Runway 1 was equipped with a medium intensity approach lighting system and runway alignment indicator lights.
Review of radar data, and interviews with two pilots operating on the ground at ILG just before the accident, revealed that the ILS critical area was free of aircraft or vehicular obstructions.

WRECKAGE AND IMPACT INFORMATION

Accident Site Examination

The helicopter came to rest in a ditch about 3,200 ft before the runway threshold and right of the runway centerline. The helicopter was fragmented and partially consumed by postimpact fire. All of the helicopter's major components were located in the main wreckage area. The odor of Jet A fuel was noted at the accident site. The top post of a fence located about 15 ft from and parallel to the main wreckage location was cut at a 45° angle. In addition, about 5 ft directly beneath the cut post, the fence was damaged, and part of a rotor blade was embedded in it. Further, a section of wood from the fence was located that exhibited 45° angle cuts on either end.

Airframe and Rotor System Examination

The cockpit and forward section of the fuselage were partially consumed by fire. Control continuity of the cyclic and collective was confirmed to the rotor head from the cockpit through several breaks and fractures. The cyclic, collective, and antitorque pedals were separated and found in the main wreckage. Not all sections of the control system were located because they were destroyed by impact forces and fire damage; however, no preimpact anomalies were noted with the sections of the control system that were found.

The standby attitude indicator was removed from the cockpit and disassembled. Rotational scoring was noted on the gyro housing.

The rotor head and transmission remained attached to each other but were separated from the airframe due to impact forces. The control actuator assembly was examined, and all tie rods remained intact. All four blades of the main rotor remained attached to the rotor head. One blade exhibited impact damage and was not thermally damaged. the three other blades were consumed by fire. All of the pitch-change links remained attached to the rotor head. The transmission mounts were separated from the helicopter. The tailboom was impact-separated and consumed by fire. The fenestron was impact-separated. Several fenestron vanes were bent in the opposite direction of rotation and exhibited rotational scoring. In addition, a few of the vanes were impact separated.

Engine Examinations

The left engine was impact-separated from the engine mounts. The reduction gearbox and the turbomachine were impact-separated. The compressor turbine disc and compressor could be rotated by hand. The left engine power turbine was removed, and the drive shaft exhibited torsional deformation and fractures. The power turbine wheel exhibited rotational scoring.

The right engine was impact-separated from the engine mounts. The right engine power turbine was removed, and the drive shaft exhibited torsional deformation and fractures. The power turbine wheel exhibited rotational scoring.

Engine Control System Unit and WU Examinations

The helicopter was equipped with an engine control system unit that included electronic engine control units and data collection units for each engine. Thermal and impact damage precluded the download of any data from the units.

The helicopter was also equipped with a warning unit (WU) that provided visual and audio indications when warning conditions were triggered. The WU accommodated several warnings that were chronologically recorded but not timestamped. The warnings appeared red when illuminated and were unlit when inactive. Each warning simultaneously initiated an audible 'gong'. The audio for some of the warnings could be silenced using the audio reset button on the top of the cyclic control stick, but a visual warning could not be cleared while the warning condition remained. All warning gongs were audible to the pilot and observers through their headsets.

The WU was removed from the wreckage, disassembled, and a non-volatile memory chip was removed for data download. Examination of the data revealed that the engine start-up was consistent with the expected and normal engine startup warnings, as well as an expected autopilot warning. Subsequently, the rotor rpm warning illuminated multiple times as the rotor rpm cycled between normal range (95% to 106%) and greater-than-106% rotor rpm multiple times and then the greater-than- 112% rotor rpm warning illuminated while a gong sounded. After that, the autopilot warning illuminated, and the rotor rpm warnings cycled between greater than 106% and 112% and less than 95% multiple times. While the WU preserved the sequence of the annunciated warnings, it did not record timestamps, so it could not be determined when the rpm warnings occurred beyond what order they occurred in.

According to the helicopter flight manual, the autopilot warning light would illuminate when the autopilot was disengaged or if there was a failure of the autopilot module. In the event the autopilot was disengaged or a failure occurred, the pilot would actively have his/her hands on the flight controls and land the helicopter as soon as practicable.

MEDICAL AND PATHOLOGICAL INFORMATION

The State of Delaware Division of Forensic Science, Wilmington, Delaware, performed an autopsy of the pilot. The autopsy report indicated that the pilot died as a result of "multiple blunt force injuries."

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, conducted toxicological testing of specimens from the pilot. The testing was negative for ethanol and tested drugs.

ORGANIZATIONAL INFORMATION

Metro Aviation Operations Manual

Instrument Training

According to the company's operations manual, all pilots were required to go through initial and recurrent training in helicopter operations. The recurrent training required 4 hours of instrument training every year. In addition, its helicopter instrument proficiency program, which could be used for flight crew to maintain instrument proficiency skills and currency under the applicable regulations required quarterly checks during which the pilots would perform a training flight with a safety pilot that could also qualify as an instrument proficiency check in accordance with FAA regulations.

Approved Sources to Obtain Weather Information

According to the operations manual, the approved sources that pilots could use to obtain weather information included anything published by the National Weather Service (NWS) or an NWS-approved source. According to another company pilot, he and other company pilots often used the NWS HEMS Weather Tool, terminal area forecasts, ForeFlight, and Weathermeister (an online commercial service) to obtain weather information.

Helicopter Weather Minimums – Precision Approaches

According to the operations manual, the weather minimums needed for a straight-in category I precision instrument approach for helicopter operations, when a medium intensity approach lighting system with runway alignment indicator lights was present, was 1/4 mile visibility or 1,600 ft of runway visual range when the helicopter reached 200 ft agl while on the glideslope.

ADDITIONAL INFORMATION

Air Traffic Control and Pilot Interactions

At 1128, the pilot first contacted Philadelphia (PHL) Air Traffic Control Tower (ATCT) and reported the helicopter was flying at 4,000 ft msl and was headed direct to Cedar Lake (VCN). The radar south arrival (SA) controller issued the current altimeter and advised the pilot that automatic terminal information service information "tango" was current at ILG. The pilot acknowledged and said he would advise when he had received that weather information. The controller then provided radar vectors to the helicopter for the ILS approach to runway 1.

At 1135, the pilot requested an IFR clearance back to ACY after completion of his instrument approach into ILG. The SA controller advised the pilot that the next controller would be able to accommodate his request.

About 1139, the SA controller transferred communications with the pilot to the South Departure (SD) controller and advised the pilot the receiving controller had been made aware of his request to pick up his clearance to ACY following the completion of the ILS approach. The pilot acknowledged and established contact with the SD controller.

The SD controller continued vectoring the helicopter for the ILS runway 1 approach until about 1150, when he cleared the pilot for the approach with a restriction to maintain at or above 2,000 ft until established on the approach. The pilot acknowledged. While vectoring the helicopter, the controller instructed the pilot to turn the helicopter to intercept the ILS approach course, which resulted in the helicopter intercepting the approach course at a 30° angle, about 1 nautical mile outside the approach gate (see figure 2). The SD controller then transferred communications with the pilot to the local (LC) controller at ILG ATCT.

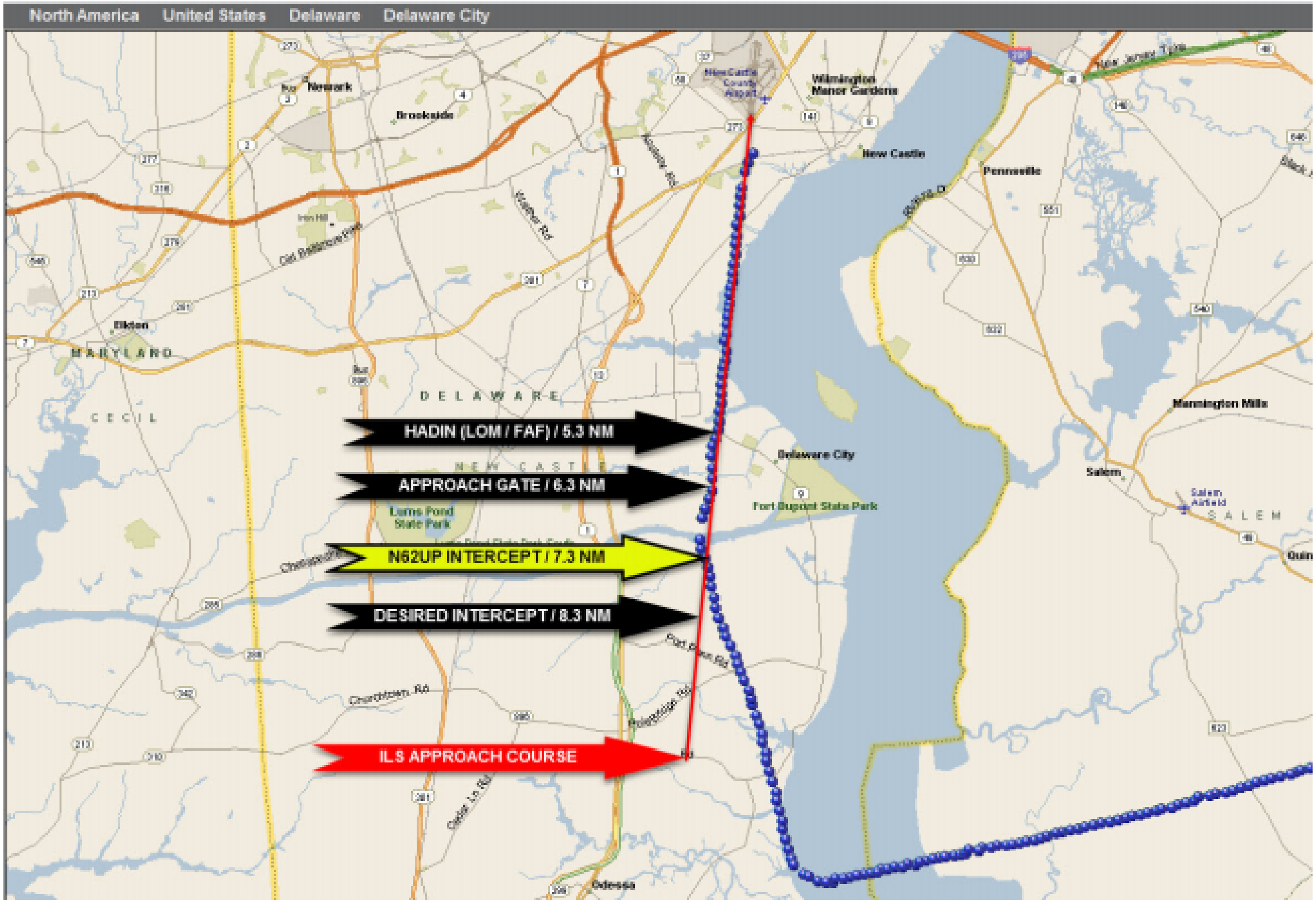

Figure 2. Radar flight track of the final segment of the accident flight. Key points along the route of flight have been depicted in order to illustrate the final approach intercept with relation to the final approach fix and approach gate.

At 1150, the pilot first contacted the LC at ILG ATCT and reported crossing the HADIN fix at 2,000 ft. The LC issued the current wind and cleared the pilot to land runway 1. The pilot acknowledged with a correct readback.

At 1151, a position relief briefing (PRB) took place on the LC position. The helicopter was the only traffic being handled by the ILG ATCT and was included in the PRB. Directly following the PRB, at 1152, the pilot reported that he would like to go around, start his missed approach, and come back around for another approach. The on-coming LC asked the pilot if he had previously coordinated the missed approach with PHL ATCT, and the pilot said "uh, we didn't want to ma'am."

At 1153, the on-coming LC asked the pilot if he was having trouble getting the airport in sight, and the pilot responded that he had received "some bad vectors at the very end" and wanted to "just line up and come back around again." The on-coming LC instructed the pilot to fly the missed approach, and then coordinated the approach with PHL ATCT. There was no response from the pilot, and radar contact was lost at 1153:18.

The on-coming LC attempted to contact the pilot for the next several minutes, and at 1157 stated to the PHL ATCT SD controller that they could see black smoke and could not reach the pilot.

Air Traffic Control (ATC) Guidance

According to FAA Order 7110.65W, "Air Traffic Control," chapter 5, section 9, paragraph 5-9-2, for final approach course interception, the controller was to assign headings that would permit final approach course intercept on a track that does not exceed a 20° angle if an aircraft intercepts the approach course less than 2 miles from the approach gate, or a 30° angle if an aircraft intercepts the approach course 2 miles or more from the approach gate.

Page 2-6-1 and 2-6-2, section 2-6-3, of the order stated, in part, the following regarding air traffic controller requirements to solicit and disseminate significant PIREP information to pilots:

Significant PIREP [pilot report] information includes reports of strong frontal activity, squall lines, thunderstorms, light to severe icing, wind shear and turbulence (including clear air turbulence) of moderate or greater intensity, volcanic eruptions and volcanic ash clouds, detection of sulfur gases (SO2 or H2S) in the cabin, and other conditions pertinent to flight safety.

a. Solicit PIREPs when requested or when one of the following conditions exists or is forecast for your area of jurisdiction:

1. Ceilings at or below 5,000 feet. These PIREPs must include cloud base/top reports when feasible.
2. Visibility (surface or aloft) at or less than 5 miles.
3. Thunderstorms and related phenomena.
4. Turbulence of moderate degree or greater.
5. Icing of light degree or greater.
6. Wind shear.

d. Handle PIREPs as follows:
1. Relay pertinent PIREP information to concerned aircraft in a timely manner.
2. En Route. Relay all operationally significant PIREPs to the facility weather coordinator.

A review of the ATC transcripts revealed that the air traffic controllers that interacted with pilot did not solicit or disseminate PIREPs.

Chapter 3 section 1, paragraph 3-1-9, "Use of Tower Radar Displays," stated, in part, the following:

Uncertified tower display workstations must be used only as an aid to assist controllers in visually locating aircraft or in determining their spatial relationship to known geographical points. Radar services and traffic advisories are not to be provided using uncertified tower display workstations…local controllers may use certified tower radar displays…to determine an aircraft's identification, exact location, or spatial relationship to other aircraft…to provide aircraft with radar traffic advisories…to provide a direction or suggested headings to VFR [visual flight rules] aircraft as a method for radar identification or as an advisory aid navigation…to provide information and instructions to aircraft operating within the surface area for which the tower has responsibility.

A review of the ATC transcripts revealed that the tower controller did not provide approach guidance to the accident helicopter in the form of radar vectors.

Workload Management

The Helicopter Flying Handbook (FAA-H-8083-21A) stated the following regarding workload management:

One component of Single-Pilot Resource Management is workload or task management. Research shows that humans have a limited capacity for information. Once information flow exceeds the person's ability to mentally process the information, any additional information becomes unattended or displaces other tasks and information already being processed [See Figure 3, which depicts task requirements and pilot capabilities in reference to a margin of safety.] *Once this situation occurs, only two alternatives exist: shed the unimportant tasks or perform all tasks at a less than optimal level. Like an overloaded electrical circuit, either the consumption must be reduced or a circuit failure is experienced.*

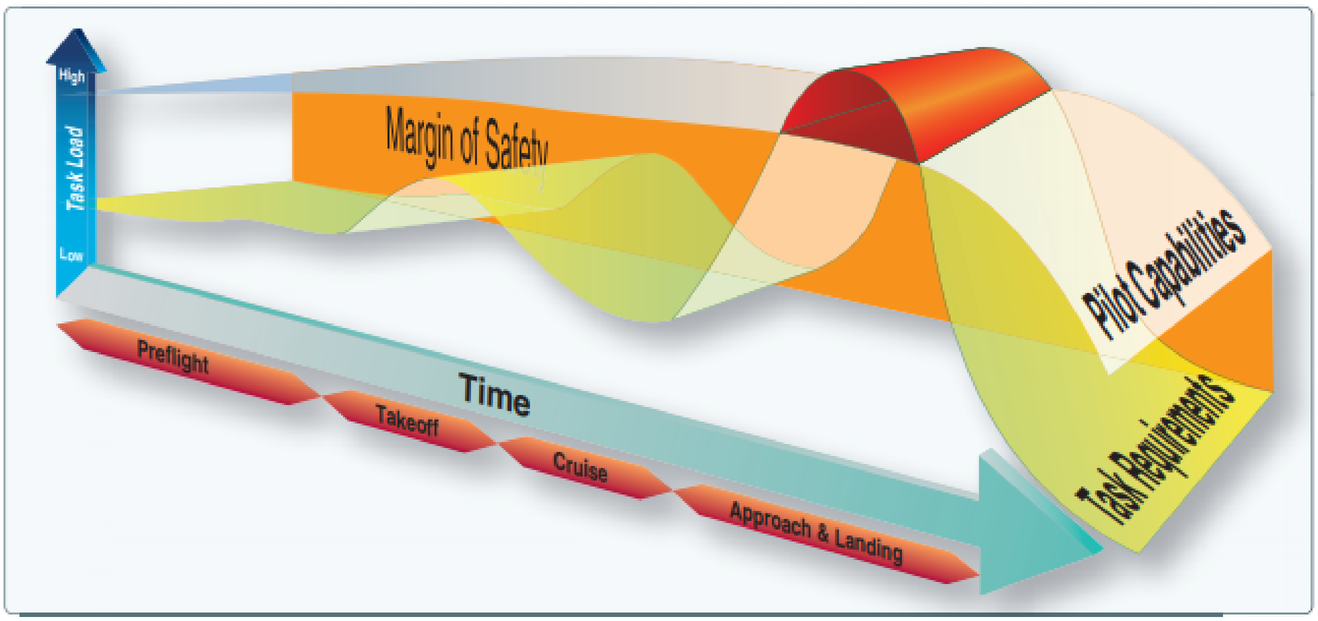

Figure 14-1. *The pilot has a limited capacity of doing work and handling tasks, meaning there is a point at which the tasking exceeds the pilot's capability. When this happens, either tasks are not done properly or some are not done at all.*

Figure 3. A depiction of task requirements and pilot capabilities in reference to a margin of safety.

Spatial Disorientation

The FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B) contained guidance on spatial disorientation, which stated the following:

…under normal flight conditions, when there is a visual reference to the horizon and ground, the sensory system in the inner ear helps to identify the pitch, roll, and yaw movements of the airplane. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references outside the airplane, there are many situations where combinations of normal motions and forces can create convincing illusions that are difficult to overcome.

The handbook also advised, "unless a pilot has many hours of training in instrument flight, flight in reduced visibility or at night when the horizon is not visible should be avoided."

Airplane Flying Handbook

The AFM stated the following about spatial disorientation:

The pilot must believe what the flight instruments show about the airplane's attitude regardless of what the natural senses tell. The vestibular sense (motion sensing by the inner ear) can and will confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in airplane attitude, nor can they accurately send the attitude changes which 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.

FAA Advisory Circular 60-4A, "Pilot's Spatial Disorientation," stated the following on spatial disorientation:

The attitude of an aircraft is generally determined by reference to the natural horizon or other visual reference with the surface. If neither horizon nor surface references exist, the attitude of an aircraft must be determined by artificial means from the flight instruments. Sight, supported by other senses, allows the pilot to maintain orientation. However, during periods of low visibility, the supporting senses sometimes conflict with what is seen. When this happens, a pilot is particularly vulnerable to disorientation. The degree of orientation may vary considerably with individual pilots. Spatial disorientation to a pilot means simply the inability to tell which way is 'up.'…Surface references and the natural horizon may at times become obscured, although visibility may be above flight rule minimums. Lack of natural horizon or such reference is common on over water flights, at night, and especially at night in extremely sparsely populated areas, or in low visibility conditions…. The disoriented pilot may place the aircraft in a dangerous attitude… therefore, the use of flight instruments is essential to maintain proper attitude when encountering any of the elements which may result in spatial disorientation.

Pilot Information

Certificate:	Airline transport; Flight instructor; Private	**Age:**	37,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	October 20, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	4200 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	EUROCOPTER DEUTSCHLAND GMBH	**Registration:**	N62UP
Model/Series:	EC 135 P2	**Aircraft Category:**	Helicopter
Year of Manufacture:	2006	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	0475
Landing Gear Type:	N/A; Skid	**Seats:**	5
Date/Type of Last Inspection:	April 25, 2017 AAIP	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	11 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	5163 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	C126 installed, not activated	**Engine Model/Series:**	PW206B2
Registered Owner:	UNIVERSITY OF PENNSYLVANIA	**Rated Power:**	447 Horsepower
Operator:	Metro Aviation, Inc.	**Operating Certificate(s) Held:**	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ILG,80 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	11:51 Local	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Thin Overcast / 500 ft AGL	**Visibility**	2.5 miles
Lowest Ceiling:	Overcast / 500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	50°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.53 inches Hg	**Temperature/Dew Point:**	16°C / 16°C
Precipitation and Obscuration:	Moderate - None - Mist		
Departure Point:	Atlantic City, NJ (ACY)	**Type of Flight Plan Filed:**	IFR
Destination:	Atlantic City, NJ (ACY)	**Type of Clearance:**	IFR
Departure Time:	11:15 Local	**Type of Airspace:**	

Airport Information

Airport:	NEW CASTLE ILG	**Runway Surface Type:**	Asphalt
Airport Elevation:	80 ft msl	**Runway Surface Condition:**	Wet
Runway Used:	01	**IFR Approach:**	ILS
Runway Length/Width:	7012 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	39.659168,-75.601112

Administrative Information

Investigator In Charge (IIC):	Kemner, Heidi
Additional Participating Persons:	Robert Drapala; FAA/FSDO; Philadelphia, PA Ed Stockhausen; Metro Aviation, Inc.; Shreveport, LA Curt Fisher; NATCA; Washington, DC Axel Rokohl; German Federal Bureau of Aircraft Accident Investi; Braunschweig Seth Buttner; Airbus Helicopters; Grand Prairie , TX Marc Belzile; Transportation Safety Board of Canada; Montreal Jeff Davis; Pratt & Whitney Canada; Bridgeport, WV
Original Publish Date:	October 10, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95234

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.