National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA17CA321 06/05/2017 830 PDT	**Regis# N80083**	**Tulelake, CA**	**Apt: Tulelake Muni O81**
Acft Mk/Mdl AG-CAT CORPORATION G 164-B	**Acft SN 837B**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl HONEYWELL TPE331-1-151G	**Acft TT 4681**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 137**
Opr Name: MACYS FLYING SERVICE INC	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: SPR

Summary

The pilot reported that he was maneuvering to perform an agricultural application. He noticed a ground application operator was located inside of the cab of the ground application equipment. The pilot decided to perform a "close fly-by" over the ground equipment. The left main landing gear struck the ground equipment cab, and the pilot chose to return to the airport. He landed on the gravel taxiway that paralleled the runway. The airplane sustained substantial damage to the left main landing gear attachment points.

Per the National Transportation Safety Board Pilot Aircraft Accident Report, the pilot reported that the accident could have been prevented if "the pilot [had] used better judgement and not done a close fly-by the ground application equipment," which was also owned by the operator. ÿ

The pilot reported that there were no preaccident mechanical malfunctions or failures with the airplane that would have precluded normal operation.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's improper decision to perform a low altitude fly-by over ground equipment, which resulted in the airplane striking the equipment.

Events

1. Maneuvering-low-alt flying - Collision with terr/obj (non-CFIT)
2. Maneuvering-low-alt flying - Part(s) separation from AC

Findings - Cause/Factor

1. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Altitude-Incorrect use/operation - C
2. Personnel issues-Action/decision-Info processing/decision-Decision making/judgment-Pilot - C
3. Environmental issues-Physical environment-Object/animal/substance-Ground equipment-Effect on operation - C

Narrative

The pilot reported that he was maneuvering to perform an aerial application. He noticed a ground application operator whom was located inside of the cab of the ground application equipment. The pilot decided to perform a "close fly-by" over the ground equipment. The left main landing gear struck the ground equipment cab, and the pilot elected to return to the airport. He landed on the gravel taxiway that paralleled runway 30. The airplane sustained substantial damage to the left main landing gear attachment points.

Per the National Transportation Safety Board Pilot Aircraft Accident Report, the pilot reported that the accident could have been prevented, "had the pilot used better judgement and not done a close fly-by the ground application equipment" which was also owned by the operator.

The pilot reported that there were no preaccident mechanical malfunctions or failures with the airplane that would have precluded normal operation.

Accident Rpt# CEN16LA291	**07/28/2016 1530 CDT**	**Regis# N2033N**	**David City, NE**	**Apt: N/a**
Acft Mk/Mdl AIR TRACTOR AT602		**Acft SN 602-1208**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl PRATT & WHITNEY PT6A-65AG		**Acft TT 1932**	**Fatal 1 Ser Inj 0**	**Flt Conducted Under: FAR 137**
Opr Name: EMRICH AERIAL SPRAYING, LLC		**Opr dba:**		**Aircraft Fire: NONE**
				AW Cert: SPR

Summary

The commercial pilot was performing an aerial application flight when the airplane struck the ground in a right wing low, 60ø nose-down attitude. Flight track data from an onboard aerial guidance system revealed that the airplane had completed 6 previous aerial applications that morning, and was engaged in a seventh application when the accident occurred. During the last application, the airplane made 4 passes followed by shallow turns to reverse direction. During these turns, the airplane climbed until it reached 90ø abeam the direction of application, then descended as it completed the turn on the opposite heading. The accident occurred during the turn between the fourth and fifth passes. Postaccident examination of the airframe, engine, and propeller revealed no evidence of any mechanical malfunctions or anomalies that would have precluded normal operation. The flap actuator was found extended 3-7/8 inches, correlating to a flap extension of 30ø.

Based on the recorded data, the characteristics of the airplane's last turn before impact did not vary greatly from that of the other turns performed during the accident flight. It is likely that, during the turn, the pilot allowed the airspeed to decay and the airplane exceeded its critical angle of attack, which resulted in an inadvertent aerodynamic stall at an altitude which did not allow for recovery.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's exceedance of the airplane's critical angle of attack while maneuvering at low altitude, which resulted in an aerodynamic stall and impact with terrain.

Events

1. Maneuvering - Loss of control in flight
2. Uncontrolled descent - Collision with terr/obj (non-CFIT)

Findings - Cause/Factor

1. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Angle of attack-Not attained/maintained - C

Narrative

On July 28, 2016, about 1530 central daylight time (CDT), an Air Tractor AT-602, N2033N, impacted A corn field 3 miles northeast of David City, Nebraska. The pilot, the sole occupant on board, was fatally injured. The airplane was destroyed. The airplane was registered to Rayne Aviation, LLC, and operated by Emrich Aerial Spraying, LLC, both of Dorchester, Nebraska, under the provisions of 14 Code of Federal Regulations (CFR) Part 137 as an aerial application flight. Visual meteorological conditions (VMC) prevailed at the time, and no flight plan had been filed. The flight originated from Columbus Municipal Airport (OLU), Columbus, Nebraska, about 1430.

According to Federal Aviation Administration (FAA) inspectors who were on-scene, the airplane had been spraying Headliner Fungicide (pyraclostrobin - a Group 11 fungicide) on a corn field. The accident site was located 200 feet north of County Road 38 and west of County Road O. There was no fire and there were no witnesses to the accident.

The on-scene evidence was consistent with the airplane striking the ground in a right wing slightly low, 60ø nose-down attitude. The airplane rebounded about 20 feet from the initial impact point and came to rest upright facing south. Witness marks in the field were consistent with a large sweep of the right wing through the corn crop, consistent with some right wing-down rolling motion at impact. All impact signatures and crop damage were in a northerly direction, and the debris field was small.

The aft cockpit wall immediately behind the pilot's seat was deformed. Elevator and rudder control continuity was confirmed. Aileron controls were found to be continuous except for fractures at both wing roots. All hardware was found to be properly installed. The Hobbs Meter was destroyed. The airplane was equipped with an inflatable restraint system, and it had deployed. The airplane was equipped with an inflatable restraint system and it had deployed. The flap actuator was found extended 3-7/8". According to Air Tractor, this setting correlated to a flap deflection of 28ø to 30ø. Examination of the engine revealed the fuel control unit (FCU) low pressure fuel filter had dark colored debris on the filter and in the bottom of the filter bowl. The FCU high pressure fuel filter had a chalky gray sediment in the housing. The propeller assembly had fractured off the engine propeller shaft on impact. Two blades remained attached. The other three blades had broken off the hub. One blade was found near the propeller assembly, a second blade was found in front of the fuselage, and the third blades was found several weeks later in a corn field some distance from the main wreckage.

On August 18, 2016, FAA and Pratt & Whitney examined the airplane, engine, propeller, and fuel system at the facilities of Dodson International in Rantoul. Kansas. According to Pratt & Whitney, the engine displayed contact signatures to its internal components, characteristic of the engine making significant power at impact. Engine components displayed no indications of malfunction or pre-impact failure. Examination of the recovered propeller blades and propeller hub bore no indications that the propeller may have been in Beta mode or reverse pitch.

On December 1, 2016, the propeller assembly was further re-examined under the auspices of two FAA inspectors at the facilities of Stallings Aircraft Propeller in Wynne, Arkansas. Representatives from Hartzell Propellers and Air Tractor were in attendance. According to Hartzell's report, blade butt, piston, cylinder, and rod impact marks indicated the propeller was operating at a blade angle range of approximately 16ø to 19ø at impact. The beta ring low pitch for this propeller is 13.9ø and the "hydraulic" (aka "running") low pitch is approximately 7.9ø. The estimated blade angle at impact was above the low pitch stop and in the normal operating range. The report concluded, "There were no discrepancies noted that would prevent or degrade normal propeller operation prior to impact. All damage was consistent with high impact forces with objects and/or terrain."

A SATLOC (an aerial guidance system that allows aerial applicators to view flight information, such as spray and waypoints, and companies to track the position of their aircraft) was recovered from the wreckage and sent to NTSB's Vehicle Recorder Division for download and readout. According to the GPS Specialist's factual report, the airplane had made six previous aerial applications that morning, and was engaged in a seventh application when the accident occurred. During this last application, the airplane made four passes followed by shallow turns in the opposite direction. During these turns, the altitude increased until the airplane reached 90ø abeam the direction of application and descended as it completed the turn on the opposite heading. The last data point was captured at 15:03:57 as the aircraft was turning to complete its fifth pass. The recorded altitude showed the aircraft was at 1,841 feet msl and at a groundspeed of 96 miles per hour. The spray condition was off. The measured diameter of the airplane's last turn, from the impact point to a point abeam the impact point, was measured to be approximately 750 feet. The diameter of the previous turns throughout the entire accident flight ranged from 600 feet in diameter to over 1,000 feet in diameter. Based on the recorded data, the characteristics of the airplane's last turn prior to impacting the field did not greatly vary from other turns the airplane performed during the accident flight. According to the SATLOC manufacturer, up to six seconds of data may be lost in the volatile memory during a high impact.

According to an Arkansas Air Tractor pilot familiar with this accident, agricultural pilots often make turns with flaps extended to give the airplane greater stability. He said, "Most all the Air Tractors need flaps in turns when carrying a load. There are 3 notches of flaps in the AT-602: 15, 30 and 45ø. Most Air Tractor pilots use 30ø of flaps and keep their speed above 100 knots. There are some pilots who use 45ø but let the airspeed get down to 80 to 90 knots in turns. There are other pilots who do wing-over turns. Some pilots pull their stall warning circuit breaker on the panel to keep it from annunciating during the turn. This 'on the edge' kind of flying is just a bad combination that gets worse as the weather warms up and the density altitude climbs."

The pilot's autopsy report attributed death to "massive blunt trauma secondary to a plane crash." His toxicology report revealed no evidence of carbon monoxide, ethanol, or drugs. Cyanide testing was not performed.

Accident Rpt# CEN17CA294	**07/26/2017 1530 CDT**	**Regis# N421CA**	**Harrold, SD**	**Apt: N/a**
Acft Mk/Mdl AIR TRACTOR INC AT 502B-B		**Acft SN 502B-2672**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
			Fatal 0 Ser Inj 0	**Flt Conducted Under: FAR 137**
Opr Name: CUSTOM AIR INC		**Opr dba:**		**Aircraft Fire: NONE**
				AW Cert: SPR

Events

2. Maneuvering-low-alt flying - Miscellaneous/other

Narrative

The pilot of an agricultural airplane reported that he planned to apply a herbicide and test the spray system at maximum pressure at a specified airspeed. He added that a ground tractor was also in the field applying the same chemical. During the flight, he saw the tractor and passed over it at 50 to 100 ft. While spraying at 10 ft agl, he noted pressure, output, airspeed, and ground speed. At the end of the field, he climbed and made a left 180-degree turn for another pass. The pilot reported that he "lost focus" outside of the airplane, while looking at the spray results and when he noticed the tractor, it was too late; the airplane's wheel collided with the tractor. Examination of the airplane found substantial damage to the fuselage.

The driver of the tractor reported that he heard someone call him on the radio, he answered the pilot on the radio and saw the airplane coming "directly at him, very low." The tractor operator heard and felt the impact and was knocked from his seat by the collision. The tractor driver then called his supervisor for help. The tractor driver added that his supervisor and another ground sprayer had been "buzzed" by the pilot before.

Accident Rpt# CEN17LA165	**04/21/2017 1300 CDT**	**Regis# N653LA**	**Vidrine, LA**	**Apt: N/a**
Acft Mk/Mdl AIR TRACTOR INC AT 602-NO SERIES		**Acft SN 602-0653**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl P&W PT6A		**Acft TT 8636**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 137**
Opr Name: CENTRAL FARMERS FLYING SERVICE		**Opr dba:**		**Aircraft Fire: NONE**

Events

1. Maneuvering-low-alt flying - Loss of engine power (total)

Narrative

On April 21, 2017, about 1300 central daylight time, an Air Tractor AT602 agricultural airplane, N653LA, conducted a forced landing near Vidrine, Louisiana. The pilot was not injured and the airplane was substantially damaged during the landing. The airplane was registered to and operated by Central Farmers Cooperative dba Central Farmers Flying Service under the provisions of 14 Code of Federal Regulations Part 137 as an aerial application flight. Visual meteorological conditions prevailed at the time.

The pilot reported that he was conducting spray operations, adding that during turns, the fuel pressure would vary from 19 to 20 psi. Even though he hadn't seen the variance before, he thought the it appeared normal. Then during a turn, the engine lost power. He turned on the [fuel] boost pump, and engine ignitor, but the engine did not restart. The pilot then conducted a forced landing in a rice field.

During the landing, the airplane impacted several levees. The airplane's main landing gear were torn off during the landing, and the airplane came to a stop on its belly. The pilot then looked in the fuel tanks and reported that fuel was visible in both left and right fuel tanks. Two other people who were assisting the pilot, who arrived on scene, reported there was 3 to 4 inches of fuel in each tank, and fuel was leaking from the tanks.

The responding Federal Aviation Administration (FAA) inspector noted substantial damage to the airplane's left and right wings. He added that the fuel tanks were empty when he arrived, but it appeared that both tanks had been breached and leaked their contents on the ground.

The airplane was partially dismantled, including removal of the wings, for recovery and then transported to a repair facility. An examination was then conducted by the NTSB Investigator-in-Charge and a technical representative from the airframe manufacturer.

The engine fuel lines, including the Py line, were checked and there were no apparent damage or leaks in the lines. The airframe fuel filter, located on the firewall, was opened; the filter/canister was full of fuel. The engine high pressure fuel pump filter bowl was opened, and the fuel level was about one inch below the top; no debris or contaminates were found. Approximately 1 quart of fuel was drained from the airplane's fuel header tank; the fuel appeared clean.

Without electrical power, (and the wings removed from the airplane) the left and right fuel gauges read about 1/16 inch and 1/8 inch above empty, respectively. Electrical power was applied to the airplane, and a self-test was successful on the Shadin fuel flowmeter. The unit displayed 52.1 for fuel remaining, and 157 for fuel used. The airplane was equipped with a 210-gallon fuel system. The flowmeter does not have a fuel level sensing capability, but subtracts fuel from what the user (pilot) input into the meter. The flowmeter was programed to 209, at the last refueling or instrument reset.

The engine was separated from the airframe and sent to overhaul/repair facility. Prior to overhaul, the engine was placed in an engine test cell. Under the supervision of an FAA inspector, an engine test run was conducted. The engine started and ran, with no abnormalities noted.

A reason for the loss of engine power was not found.

Accident Rpt# ERA16LA320	**09/21/2016 1620 CDT**	**Regis# N66804**	**Jackson, TN**	**Apt: Mc Kellar-sipes Rgnl MKL**
Acft Mk/Mdl BEECH B100		**Acft SN BE-82**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl GARRETT TPE-331-6-251		**Acft TT 4013**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: BILLY DOUGLAS		**Opr dba:**		**Aircraft Fire: NONE**
				AW Cert: STN

Events

1. Landing-flare/touchdown - Hard landing

Narrative

On September 21, 2016, about 1620 central daylight time, a Beech B100, N66804, was substantially damaged when the right main landing gear collapsed during landing at the Mc Kellar-Sipes Regional Airport (MKL), Jackson, Tennessee. The commercial pilot was not injured. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed for the business flight that originated from Memphis International Airport (MEM), Memphis, Tennessee. The airplane was registered to OIA Enterprises LLC, and operated by a private individual under the provisions of 14 Code of Federal Regulations Part 91.

According to the pilot, he was flying businessmen to different airports all day and was returning from MEM to his home airport. The en route portion of the flight was uneventful, and on the final approach leg of the traffic pattern for landing at MKL, he verified that the three green landing gear indicator lights were illuminated, and all instruments were indicating normal. He further stated that the airplane landed "firmly" and the right wing dropped down far enough that the right engine propeller blades contacted the runway. The pilot then pulled back on the control yoke and the airplane became airborne again momentarily, before settling back down on the runway. The right main landing gear collapsed. The airplane then veered off the right side of the runway, struck a runway sign and contacted a weather antenna.

According to witnesses, they watched the airplane land hard on the runway, then the airplane flew back up in the air and landed hard again on the runway. The right landing gear folded-up under the airplane and the airplane slid off the right side of the runway.

Examination of the wreckage by a Federal Aviation Administration inspector revealed that the airplane was resting on its right wing, against the airport's weather service antenna. The right landing gear was inside the wheel-well. The left engine was hanging loose from the motor mounts. After the airplane was raised, the inspector noticed that the right main landing gear actuator was fractured in half.

Accident Rpt# GAA17CA402	**06/30/2017 1400 CDT**	**Regis# N60KH**	**Uniontown, KY**	**Apt: N/a**
Acft Mk/Mdl BELL 206-B		**Acft SN 1326**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl ALLISON (ROLLS ROYCE) 250-C20B		**Acft TT 16139**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 137**
Opr Name: KASH HELICOPTER SERVICES LLC.		**Opr dba:**		**Aircraft Fire: NONE**
				AW Cert: SPR

Summary

The pilot of the helicopter reported that, while maneuvering low around power lines during an agricultural spray, he "pulled up," and the right spray boom contacted a power line. He added that the "fuselage pitched forward and the main rotor blade cut the tail boom off just aft of the horizontal stabilizer." Subsequently, the helicopter began to rapidly spin, and after one or two rotations, the pilot "closed the throttle which stopped the rotation" and "cushioned the impact."

The fuselage and tailboom sustained substantial damage.ÿ

The pilot reported that there were no preaccident mechanical malfunctions or failures with the helicopter that would have precluded normal operation.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to maintain adequate separation from power lines, which resulted in a loss of helicopter control.

Events

1. Maneuvering-low-alt flying - Low altitude operation/event
2. Maneuvering-low-alt flying - Loss of control in flight
3. Autorotation - Collision with terr/obj (non-CFIT)

Findings - Cause/Factor

1. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Pitch control-Not attained/maintained - C
2. Personnel issues-Psychological-Attention/monitoring-Monitoring environment-Pilot - C
3. Environmental issues-Physical environment-Object/animal/substance-Wire-Effect on operation - C

Narrative

The pilot of the helicopter reported that while maneuvering low around power lines during an agricultural spray, he "pulled up" and the right spray boom contacted a power line. He added that, the "fuselage pitched forward and the main rotor blade cut the tail boom off just aft of the horizontal stabilizer." Subsequently, the helicopter began to rapidly spin, and after 1 or 2 rotations, the pilot "closed the throttle which stopped the rotation" and "cushioned the impact."

The fuselage and tail boom sustained substantial damage.

The pilot reported that there were no preaccident mechanical malfunctions or failures with the helicopter that would have precluded normal operation.

Accident Rpt# DCA17CA197	**09/13/2017 1545 EDT**	**Regis# N261PS**	**Charlotte, NC**	**Apt: Charlotte/douglas Intl CLT**
Acft Mk/Mdl BOMBARDIER INC CL 600 2B19-100		**Acft SN 7959**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Prelim** **Prob Caus: Pending**
			Fatal 0 **Ser Inj 1**	**Flt Conducted Under: FAR 121**
Opr Name: PSA AIRLINES INC		**Opr dba:**		**Aircraft Fire: NONE**

Accident Rpt# GAA17CA574	**07/21/2017 1720 EDT**	**Regis# N802TW**	**New York, NY**	**Apt: N/a**	
Acft Mk/Mdl CESSNA 208-A		**Acft SN 20800300**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Prelim**	**Prob Caus: Pending**
		Acft TT 1909	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 135**	
Opr Name: TAILWIND AIR SERVICE LLC		**Opr dba:**		**Aircraft Fire: NONE**	

an airsafety.com e-product
Prepared From Official Records of the NTSB By:
Air Data Research
9865 Tower View, Helotes, Texas 78023
210-695-2204 - info@airsafety.com - www.airsafety.com

Accident Rpt# CEN15LA057 11/21/2014 1010 CST	**Regis# N584JS**	**Sugarland, TX**	**Apt: Sugarland Regional Airport KSGR**
Acft Mk/Mdl EMBRAER S.A. EMB-500	**Acft SN 50000140**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl P&W CANADA PW617F-E	**Acft TT 3854**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: SUPERIOR AIR CHARTER, LLC	**Opr dba: JETSUITE AIR**		**Aircraft Fire: NONE**

Summary

The pilots of the very light jet were conducting a positioning flight in instrument meteorological conditions. The flight was cleared by air traffic control for the instrument landing system (ILS) approach; upon being cleared for landing, the tower controller reported to the crew that there was no standing water on the runway. Review of the airplane's flight data recorder (FDR) data revealed that the airplane reached 50 ft above touchdown zone elevation (TDZE) at an indicated airspeed of 118 knots (KIAS). The airplane crossed the runway displaced threshold about 112 KIAS, and it touched down on the runway at 104 KIAS with about a 7-knot tailwind.

FDR data revealed that, about 1.6 seconds after touchdown of the main landing gear, the nose landing gear touched down and the pilot's brake pedal input increased, with intermediate oscillations, over a period of 7.5 seconds before reaching full pedal deflection. During this time, the airplane achieved its maximum wheel braking friction coefficient and deceleration. The cockpit voice recorder recorded both pilots express concern the that the airplane was not slowing. About 4 seconds after the airplane reached maximum deceleration, the pilot applied the emergency parking brake (EPB). Upon application of the EPB, the wheel speed dropped to zero and the airplane began to skid, which resulted in reverted-rubber hydroplaning, further decreasing the airplane's stopping performance. The airplane continued past the end of the runway, crossed a service road, and came to rest in a drainage ditch. Postaccident examination of the brake system and data downloaded from the brake control unit indicated that it functioned as commanded during the landing. The airplane was not equipped with thrust reversers or spoilers to aid in deceleration.

The operator's standard operating procedures required pilots to conduct a go-around if the airspeed at 50 ft above TDZE exceeded 111 kts. Further, the landing distances published in the airplane flight manual (AFM) are based on the airplane slowing to its reference speed (Vref) of 101 KIAS at 50 ft over the runway threshold. The airplane's speed at that time exceeded Vref, which resulted in an increased runway distance required to stop; however, landing distance calculations performed in accordance with the AFM showed that the airplane should still have been able to stop on the available runway. An airplane performance study also showed that the airplane had adequate distance available on which to stop had the pilot continued to apply maximum braking rather than engage the EPB. The application of the EPB resulted in skidding, which increased the stopping distance.

Although the runway was not contaminated with standing water at the time of the accident, the performance study revealed that the maximum wheel braking friction coefficient was significantly less than the values derived from the unfactored wet runway landing distances published in the AFM, and was more consistent with the AFM-provided landing distances for runways contaminated with standing water.

Federal Aviation Administration Safety Alert for Operators (SAFO) 15009 warns operators that, "the advisory data for wet runway landings may not provide a safe stopping margin under all conditions" and advised them to assume "a braking action of medium or fair when computing time-of-arrival landing performance or [increase] the factor applied to the wet runway time-of-arrival landing performance data."

It is likely that, based on the landing data in the AFM, the crew expected a faster rate of deceleration upon application of maximum braking; when that rate of deceleration was not achieved, the pilot chose to engage the EPB, which only further degraded the airplane's braking performance.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's engagement of the emergency parking brake during the landing roll, which decreased the airplane's braking performance and prevented it from stopping on the available runway. Contributing to the pilot's decision to engage the emergency parking brake was the expectation of a faster rate of deceleration and considerably shorter wet runway landing distance provided by the airplane flight manual than that experienced by the crew upon touchdown and an actual wet runway friction level lower than the assumed runway fiction level used in the calculation of the stopping distances published in the airplane flight manual.

Events

1. Landing - Other weather encounter
2. Landing - Landing area overshoot

3. Landing - Collision during takeoff/land
4. Landing - Runway excursion

Findings - Cause/Factor

1. Personnel issues-Action/decision-(general)-(general)-Pilot - C
2. Organizational issues-Development-Selection/certification/testing-Document/info verification-FAA/Regulator - C

Narrative

HISTORY OF FLIGHT

On November 21, 2014, about 1010 central standard time, an Embraer EMB-500 (Phenom 100) airplane, N584JS, overran the runway after landing at Sugar Land Regional Airport (SGR), Sugar Land, Texas. The airline transport-rated pilots were not injured and the airplane was substantially damaged. The airplane was being operated by Superior Air Charter, LLC, Irvine, California (doing business as JetSuite Air), as a 14 Code of Federal Regulations (CFR) Part 91 positioning flight. Instrument meteorological conditions existed at the airport at the time of the accident, and the flight operated on an instrument flight rules flight plan. The flight originated from William P. Hobby Airport (HOU), Houston, Texas.

According to the pilots, the purpose of the flight was to reposition the airplane from HOU to SGR. During the approach to SGR, the tower controller provided the pilots vectors to the airport and then told them to expect the instrument landing system (ILS) 35 approach at SGR. After the accident, the copilot reported that the tower controller cleared the flight to land and that there was no standing water on the runway. The copilot added that, during the approach, there was a tailwind of 15 kts that decreased to 9 kts on touchdown.

After landing, the pilot, who was flying the airplane, applied the brakes and noted no appreciable deceleration. She then pulled the emergency brakes twice, but the airplane continued past the end of the runway and onto a grassy area. The airplane then crossed a service road and came to rest in a drainage ditch facing opposite the direction of travel with the empennage section partially submerged in water.

A review of flight data recorder (FDR) data revealed that, while on the ILS approach to runway 35, the airplane slowed to 120 knots (kts) and that it maintained that airspeed until about 155 ft mean sea level (msl), at which point it slowed to about 118 kts. The airplane remained on the glideslope until about 380 ft msl, when the cockpit voice recorder (CVR) recorded an electronic voice stating "autopilot," consistent with autopilot disconnection. Shortly after, the airplane descended below the glideslope. The airplane crossed the displaced threshold about 100 ft msl and at 112 kts indicated airspeed (KIAS), and touched down at 1010:37, about 1,040 ft from the threshold, at an airspeed of 104 KIAS. During the landing roll, the CVR recorded the pilots concern about the airplane's lack of deceleration.

About 1.6 seconds after touchdown, the nose landing gear touched down, and the pilot's brake pedal increased, with intermediate oscillations, over a period of 7.5 seconds and reached full pedal deflection. About 4 seconds later, the emergency/parking brake (EPB) was applied, at which point the wheel speed dropped from 70 to 0 kts, consistent with a locked-wheel skid. Concurrently, the FDR recorded an engine indication and crew alerting system ANTI-SKID FAIL message, consistent with the application of the EPB and locking of the wheels. The airplane departed the runway at 1011:15 at a groundspeed of about 30 KIAS. Shortly after, the FDR recorded accelerations consistent with the impact and airplane coming to a stop.

PERSONNEL INFORMATION

Pilot

The pilot held an airline transport pilot certificate with airplane single-engine land, multi-engine land, and instrument ratings. Additionally, she held an instructor's certificate with airplane single-engine and instrument ratings. She reported that she had 6,311 total flight hours and 1,110 hours in the accident airplane make and model. The captain was issued a Federal Aviation Administration (FAA) first-class medical certificate on July 29, 2014.

Copilot

The copilot held an airline transport pilot certificate with airplane single-engine land, multi-engine land, and instrument ratings. He reported that he had 4,232 total flight hours and 814 hours in the accident airplane make and model. The copilot was issued an FAA first-class medical certificate on July 26, 2014, with the restriction, "must wear corrective lenses."

AIRCRAFT INFORMATION

The Embraer EMB-500 Phenom 100 is included in the very light jet (VLJ) class of airplane. The Phenom 100 can seat four passengers in its normal configuration, but it can be configured to carry up to seven passengers. The airplane is equipped with two Pratt & Whitney Canada PW617-F turbofan engines each rated at a takeoff thrust of 1,695 lbs. The accident airplane's serial number was (S/N) 50000140 and was certified as a 14 CFR 23 normal category airplane. The EMB-500 is not equipped with thrust reversers, and prior to serial # 50000325 not equipped with spoilers. All EMB-500s from serial # 50000325 onwards are equipped with spoilers when delivered from the factory. The accident airplane was not equipped with spoilers.

Brake System

The Phenom 100's hydraulic brake system delivers hydraulic pressure to the brakes via input on the brake pedals. The hydraulic pressure to the brake system is supplied at a maximum of 3,000 pounds per square inch (psi). The copilot's (right seat) brake pedals are mechanically linked to the pilot's (left seat) brake pedals. Each pilot brake pedal is connected to a pedal position transducer (PPT), each of which produces two independent electrical outputs to the brake control unit (BCU) that were proportional to the respective pedal displacement. The BCU controls the main brake system. The brake system is a brake-by-wire system with an antiskid function. There are no hydraulic components on the brake control; therefore, the only pedal force feedback to the pilots is from a force spring installed on the pedals. This provides a consistent pedal resistance regardless of the runway condition and the pressure applied.

Wheel speed information is sent to the BCU via two axle-mounted speed transducers. The BCU uses the output from the wheel speed transducers, the PPTs, and two brake line pressure transducers to generate an electrical command to the associated brake control valve (BCV).

Anti-skid protection is provided when the BCU detect a skid by monitoring the two-wheel speed transducer signals. If a skid is detected, the BCU sends a signal to the BCV to reduce pressure to the brakes. The antiskid protection cannot be turned off in the cockpit.

The Phenom 100 is equipped with an EPB to stop the airplane if the main brake system fails and to provide means to keep the aircraft parked even when the hydraulic power system is turned off. The EPB is operated by a T-handle on the control pedestal. The handle is mechanically linked to the emergency brake valve.

Upon using the EPB, the pressure applied is proportional to the handle displacement. No anti-skid protection is available.

Certification

In general, 14 CFR Part 23 certification regulations require that dry-runway landing distances be published in airplane flight manuals (AFM) and that they be based on performance demonstrated during flight tests on smooth, dry, hard-surfaced runways. Certification regulations do not require the publication of landing distances on other-than-dry runways, although certification applicants may choose to present this information to the regulator. If the applicant provided this information, it would not necessarily be based on flight tests (largely because of the difficulty of achieving a consistent "wet" or "contaminated" runway surface) but rather derived by calculations based on assumptions agreed to by the regulator.

The EMB-500 was first certified by the Brazilian regulator (the Agˆncia Nacional de Aviaŧao Civil), which, like the FAA, does not require the publication of

landing distances on other-than-dry runways. However, the European Aviation Safety Agency (EASA) does require the publication of landing distances on other-than-dry runways if the airplane is to be operated on such runways. The unfactored landing distance is the actual distance from the runway threshold required to land the airplane and stop it without any safety factors applied. The factored landing distance is the actual distance from the runway threshold required to land the airplane and stop increased by a safety factor.

Therefore, to certify the airplane in Europe, Embraer proposed to EASA that the unfactored wet runway landing distances presented in the EMB-500 AFM would be computed as 125% of the demonstrated, unfactored dry-landing distance, and EASA accepted this proposal.

The factored wet-runway landing distances in the EMB-500 AFM are 115% of the factored dry distances or 192% of the unfactored dry distances. The EMB-500 is certified in the "normal" category, not the "commuter" category; therefore, 135.385(c) did not apply to the accident airplane. However, in practice, JetSuite operates the EMB-500 in compliance with 135.385(c).

The EMB-500 AFM also provides a table of landing distances for landings on runways covered with standing water, slush, or wet snow at depths of 0.125, 0.250, and 0.375 inches.

METEOROLOGICAL INFORMATION

At 1012, the SGR automated weather observation system (AWOS) reported wind from 130ø at 8 kts, 6 miles visibility, light rain and mist, broken clouds at 3,300 ft and an overcast ceiling at 4,200 ft, temperature 66øF, dew point 64øF, and a barometric pressure of 30.15 inches of mercury.

At 1025, the SGR AWOS reported wind from 130ø at 8 kts, 10 miles visibility, few clouds at 600 ft, and broken clouds at 1,800 ft and an overcast ceiling at 4,400 ft.

AIRPORT INFORMATION

SGR is a public-use, towered airport, located 17 miles southwest of Houston, Texas. SGR has a single concrete runway, 35/17, which is 8,000 ft long and 100

ft wide. Runway 17 has a 380 ft displaced threshold; runway 35 has a 1,984 ft displaced threshold. Runway 35 touchdown zone elevation is 78 ft.

FLIGHT RECORDERS

The CVR were removed from the airplane and examined at the National Transportation Safety Board's Vehicle Recorder Lab in Washington, DC. The FDR data file was downloaded by the operator and sent to the NTSB's Vehicle Recorder Lab.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest about 100 ft beyond the end of runway 35 down a small embankment in a drainage creek filled with water. The airplane had spun around about 148ø opposite the direction of travel with the front of the airplane on the embankment The aft section of the airplane was submerged in water, and the tail cone was partly broken and separated from the empennage. The right main landing gear had collapsed, and the right-wing tip and aileron were damaged.

TESTS AND RESEARCH

BCU

The BCU was removed from the airplane and sent to the unit's manufacturer's facility in Ohio. No visual defects were noted, and the BCU was functionally tested, and it functioned normally. Data were downloaded from the BCU, and no abnormities were noted with the braking system.

Airplane Performance Study

The NTSB conducted an Airplane Performance Study for the accident flight to determine the airplane's position and orientation during the relevant portion of the flight and its responses to control inputs, external disturbances, ground forces, and other factors that could affect its trajectory. The study used various data sources, including FDR and airplane thrust and aerodynamic performance information.

According to the performance study, the airplane's approach to runway 35 complied with the operator's stabilized approach criteria, with the airplane tracking the RNAV final approach course and glideslope at an airspeed of about 130 knots.

The CVR recorded the copilot, who was the pilot monitoring (PM), call "1000 . stable" at 1009:10.3 when the airplane was at an indicated altitude of 1,103 ft (1,021 ft above the field elevation (AFE) of 82 ft) and about 147 KIAS, or 27 kts above the approach speed (Vap of 120 kts. Per JetSuite's Standard Operating Procedures (SOPs, the PM would have been required to call "1000 continue, speed" because the speed exceeded Vap + 5 kts.

As the airplane descended below an indicated altitude of 800 ft msl (about 722 ft above the touchdown zone elevation [TDZE] of 78.4 ft) while on the ILS approach to runway 35, it slowed to 120 kts, which is the flaps 3 Vap (approach speed) specified in JetSuite's SOPs. During the final approach, the airplane remained on the glideslope until about 380 ftmsl (302 ft above TDZE), when the CVR recorded an electronic voice stating "autopilot," indicating that the autopilot had been disconnected. Shortly after, the airplane descended below the glideslope. The airplane maintained 120 kts until about 155 ft msl (about 77 ft above TDZE), then slowed to about 118 kts at 50 ft above TDZE, and then slowed to 104 KIAS at touchdown.

The airplane crossed the runway 35 displaced threshold at an indicated altitude of about 100 ft msl (22 f above TDZE) and about 112 KIAS, and it touched down at 1010:37.4, 1,040 ft from the threshold at a groundspeed of 111 kts with about a 7 tailwind.

The CVR did not record the pilots making any speed callouts between 500 ft above field elevation (AFE and 50 ft above TDZE, even though at least one speed callout in this band is required by the SOPs. In addition, the EMB-500 AFM specified that at the landing weight of about 8950 lbs, the flaps 3 Vref is 101 kts. The SOPs required pilots to go-around if the airspeed at 50 ft above TDZE exceeded about 111 kts. As noted above, at an indicated altitude of 50 ft above TDZE (128 ftmsl), the indicated airspeed was about 118 kts, 7 kts, above the approximate 111-kts limit.

The landing distances published in the EMB-500 AFM are predicated on the airplane slowing to reference speed (Vref at 50 ft over the threshold. During the accident landing, the speed at 50 ft exceeded Vref by about 17 kts and resulted in an increased runway distance required to stop. Runway 35, even with the higher threshold crossing speed and assuming that the airplane braking performance implied in the AFM landing distances could be achieved, had an available landing distance of 6,016 ft, which met JetSuite's General Operations Manual (GOM) wet-runway dispatch ("planning") requirement of 1.92 times the unfactored dry landing distance, which for this landing would have been 2,695 ft times 1.92 or 5,174 ft.

About 1.6 seconds after touchdown, the nose landing gear touched down, and the pilot's brake pedal increased, with intermediate oscillations, over a period of 7.5 seconds and reached full pedal deflection at about 1010:46.6. During this time, the airplane maintained a deceleration (longitudinal load factor, nx) that oscillated between -0.05 and -0.10 G's; and averaged about -0.07 G's. At 1010:49.7, 3.1 seconds after the brake pedals reached maximum deflection, the nx suddenly decreased to a minimum (i.e., a maximum deceleration) of -0.162 G's. Between 10:10:50 and 10:10:58, the nx oscillated between about -0.11 and -0.14 G's. At 10:10:50.7, the Emergency / Parking Brake (EPB) was applied, and the right and left wheel speeds decreased to 0 at 1010:55.2 and 10:10:58.2, respectively. After both wheel speeds reached zero, the nx increased (indicating decreased deceleration) to between about -0.08 and -0.11 G's until about 1011:11, when the airplane started to yaw to the left and drift to the right. The airplane departed the runway at 1011:15, at a groundspeed of about 30 knots, and came to rest in a drainage ditch about 500 feet past the end of the runway.

For about the first 12 seconds after touchdown, the computed braking coefficient oscillated about a value of 0.03 (the assumed unbraked, rolling braking coefficient) with peaks between 0 and about 0.1. The braking coefficient remained at this low value even as the brake pedals were depressed and then jumped to an average of between 0.13 and 0.14 at 1010:50, coincident with the decrease in nx (that is, increased deceleration).

As part of the performance study, in May 2015, the NTSB and the parties to the investigation conducted tests on runway 35 at SGR to measure the runway macrotexture depth, cross-slope, and friction characteristics. The tests did not indicate any discontinuity or sudden change in the runway friction that could explain the computed braking coefficient jump. Further, the rainfall rate at the time of the accident and the runway's measured macrotexture and cross-slope characteristics precluded the possibility that dynamic hydroplaning caused the braking coefficient jump. The investigation was unable to determine the reason why the airplane's antiskid system, which normally controls the slip ratio, maintained a low slip ratio even as the braking command from the pedals was increasing.

The airplane manufacturer provided a possible explanation noting that the EMB-500 antiskid system is a wheel deceleration control algorithm (MABS proprietary), not a slip ratio control algorithm; therefore, slip control is indirect and may be affected by wheel dynamics other than the ratio between wheel speed and aircraft ground speed.

Embraer also notes that the EMB-500 antiskid system is sensitive to pedal input variations, as the input variation will immediately cause a pressure variation, so its effectivity is directly affected by the pilot inputs. At pedal deflections greater than 90% and above, the brake system considers full brake application. Pedal variations above the 90% threshold have no effect on the system.

Brake pedals variations below 90% were observed throughout landing until actuation of the emergency brakes, therefore not allowing the antiskid system to reach maximum efficiency. The Embraer landing technique recommended in AFM is to apply and maintain full brake pedal application upon touchdown.

The decrease in braking coefficient after the EPB was applied and the wheel speed dropped to zero is consistent with research indicating that the braking

friction achieved in a full locked-wheel skid is significantly lower than the maximum braking coefficient that can be achieved at lower slip ratios. Examination of the airplane's tires revealed evidence of reverted-rubber hydroplaning, which is also consistent with a locked-wheel skid and reduction in braking coefficient.

The findings in this accident and similar accidents investigated by the NTSB confirm that the actual braking coefficient that can be achieved on a wet runway may be significantly lower than the braking coefficient predicted by industry-standard models or the braking coefficient required to match the manufacturer's published unfactored, wet-runway landing distances. The results are also consistent with an Embraer Flight Operations Letter that states that the AFM landing distances corresponding to "standing water" contaminated runways may be more indicative of the airplane performance than the AFM "wet runway" landing distances, even for runways that would not normally be considered flooded (for example, even in the case of "light rain over a non-grooved runway or a concrete polished surface.") In this case, the AFM braking performance was not achieved because the actual braking coefficient generated between the tires and the runway was far less than the braking coefficient implied by the wet runway landing distances published in the AFM.

In the comments on the draft Aircraft Performance Study for this case, Embraer disagreed with the NTSB's interpretation of Flight Operations Letter (PHE500-002/15) regarding the AFM landing distances on wet and flooded runways, as outlined above. Instead Embraer stated that "the "FOL highlights the difficulty in assessing the runway conditions (especially between "wet" and "standing water contaminated") and recommends operators to take a conservative approach to calculate the required landing distance.

If the EPB had not been set and the braking friction had continued at levels attained early in the landing roll, then the airplane should have been able to stop on the remaining runway (about 795 ft from the runway threshold). Before landing, the pilots received a report from an air traffic controller that there was "no visible standing water on the runway." Given such a report, it would have been reasonable for the pilots to assume that the AFM wet runway landing distances, rather than the standing water distances, were more appropriate, when in fact the opposite was true. This scenario seems to indicate that, in the absence of prior experience on a given wet runway, if the runway is known or reported to be anything but dry, then the most conservative assumptions about the required landing distance should be used.

See the Airplane Performance Study in the public docket for this accident for additional details.

ADDITIONAL INFORMATION

JetSuite's P100 STANDARD OPERATING PROCEDURES (SOP) and General Operations Manual (GOM) excerpts:

P100 STANDARD OPERATING PROCEDURES

1.5 Briefings

1.5.2 Descent & Approach

In addition to the elements of the approach procedure required for safe operations the following items must also be covered prior to any arrival:

- Configuration - Planned Landing FLAPS, ICE PROTECTION, and approach type (NPA or Precision-like).

- Runway - sufficient for the planned settings.

- ATIS - Allows for the planned operation and settings.

- Fuel - Amount remaining allows for the planned operation with sufficient reserves.

- Terrain/Threats - Dominating terrain and any other considerations that may affect decision-making.

2.9 Before Landing

For all approaches, there are a minimum of three occasions when the PM is required to verbalize his/her assessment of the stability of the approach. All three occasions are required to ensure the approach does not become destabilized. The first is at 1,000' AFE, at which point any combination of the 4 parameters may be out of limits. The second is at 500' AFE, at which point SPEED is the only parameter that is allowed to be outside limits. This allows a decelerating approach to be flown. The third is at not less than 50' Above TDZE, at which point SPEED must be no greater than Vref +10. This ensures that SPEED is within limits prior to touchdown.

At 1000' AFE: If any of the following criteria are outside the stated limits, the PM will use the callout "1000 Continue" and add the quoted descriptor to make the PF aware of the items requiring correction:

"FLAPS": Not indicating the briefed Landing Configuration.

"GEAR": Not indicating 3 Green DN indications.

"PROFILE": Outside 1 dot laterally/vertically if IMC, or visual equivalent.

"SPEED": Mean speed above Vap + 5 knots.

At 500' AFE: If any of the following criteria are outside the stated limits, the PM will use the callout "500 Go-Around":

"FLAPS": Not indicating the briefed Landing Configuration.

"Gear": Not indicating 3 Green DN indications.

"Profile": Outside 1 dot laterally/vertically if IMC, or visual equivalent.

If the speed is outside the following stated limits, the PM will use the callout "500 Continue, SPEED" to make sure the PF is aware that a speed correction is required:

"SPEED": Means speed above Vap + 5 Knots.

Between 500' AFE and 50' Above TDZE:

The callout "REF +/-____" will be made at least once prior to reaching 50" Above TDZE. This call may be made as often as necessary to aid the PF ensuring that SPEED is not excessive, and will be within limits prior to touchdown.

At 50' Above TDZE: If the mean speed is greater than Vref + 10 Knots, the PM will make the callout "Go-Around".

NOTE: Speeds in excess of Vref + 10 at 50' Above TDZE require a mandatory Go-Around.

4.8 CW [Cold Weather] Before Landing

Conduct a positive landing to ensure initial wheel spin-up and initiate firm ground contact upon touchdown, achieving wheel load as quickly as possible. Such technique avoids hydroplaning on wet runways and reduces the strength of any ice bond that might have been formed on brake and wheel assemblies during

flight. The factors that influence the occurrence of hydroplaning are high speed, standing water and poor runway macro texture. When hydroplaning occurs, it causes a substantial loss of tire friction and wheel spin-up may not occur. Icy runways can be very slippery at all speeds depending on temperature. Stopping the airplane with the least landing run must be emphasized when landing on wet or slippery runways.

- Anticipate the approach procedures and speeds: A well-planned and executed approach, flare and touchdown minimize the landing distance.

- Lower nose wheel immediately to the runway. It will decrease lift and will increase main gear loading.

- Apply brakes with moderate-to-firm pressure, smoothly and symmetrically, and let the anti-skid do its job.

- If no braking action is felt, hydroplaning is probably occurring. Do not apply PARKING BRAKE, as it will remove anti-skid protection.

- Maintain runway centerline and keep braking until airplane is decelerated.

GENERAL OPERATIONS MANUAL (GOM)

ALL OPERATIONS - WET OR SLIPPERY RUNWAY CRITERIA: A runway is considered wet (or slippery) when conditions indicate:

- Showers or occasional showers.

- Heavy drizzle.

- Continuous light rain, moderate or heavy rain, freezing rain of any intensity.

- Snow of any intensity other than "light" with surface temperature below 28ø F.

- A runway is considered contaminated if it cannot be defined as dry or wet.

NOTE: THE FAA HAS TAKEN THE POSITION THAT A RUNWAY DOES NOT HAVE TO BE REFLECTIVE TO BE CONSIDERED WET. IF A RUNWAY IS CONTAMINATED OR NOT DRY IT IS CONSIDERED WET. REF: AC 91-79 APPENDIX 4.

ALL OPERATIONS - "WET RUNWAY" EFFECTIVE LENGTH REQUIREMENT: If required by the type of operation, the additional 15% for wet or slippery runways and 15% for visibility conditions below 3/4 mile or RVR 4000 is not cumulative. Adding 15% to the dry runway length requirement satisfies either or both requirements. Although alternate airports are not always subject to the "wet runway" rule, to avoid inadvertent errors, JetSuite Air has chosen to enforce the "wet runway" rule at all alternate airports.

EXECUTION - ALL OPERATIONS: All JetSuite Air P100 flight operations will use an additional 1000 feet operating margin to account for minor variations in aimpoint, Vref, negative slope, flare technique and delayed or insufficient braking. No pilot will land a JetSuite Air P100 aircraft if that weight exceeds:

- Maximum landing weight in JS Logbook, OPERA, or the AFM.

- A weight that will allow a full stop landing within the effective length of the most suitable runway for the following conditions:

- Dry runways = dry performance +1000 feet.

- Wet non-RFSC/AFSC = dry performance +25%+1000 feet.

- Wet RFSC/AFSC runways = 6500 feet minimum.

- Contaminated runways = applicable contaminated value + 1000 feet.

For contaminated runways of any kind, the landing distance available must be the greater of dry distance * 1.67 * 1.15 or, the applicable contaminated value + 1000 feet.

JetSuite pilots in the P100 will:

- Use Flaps 3 for planning and execution on all wet runways.

- Apply the brakes in one continuous application for approximately five seconds or until an appropriate level of deceleration is felt.

- If no deceleration is felt after 5 seconds, pilots will initiate a go-around.

14 CFR Part 23 Certification Regulations

In accordance with 14 CFR Part 23 Section 23.75, "Landing distance,"

The horizontal distance necessary to land and come to a complete stop from a point 50 feet above the landing surface must be determined, for standard temperatures at each weight and altitude within the operational limits established for landing, as follows:

(a) A steady approach at not less than VREF, determined in accordance with ⊥23.73 (a), (b), or (c), as appropriate, must be maintained down to the 50 foot

height and-

(1) The steady approach must be at a gradient of descent not greater than 5.2 percent (3 degrees) down to the 50-foot height.

(2) In addition, an applicant may demonstrate by tests that a maximum steady approach gradient steeper than 5.2 percent, down to the 50-foot height, is safe. The gradient must be established as an operating limitation and the information necessary to display the gradient must be available to the pilot by an appropriate instrument.

(b) A constant configuration must be maintained throughout the maneuver.

(c) The landing must be made without excessive vertical acceleration or tendency to bounce, nose over, ground loop, porpoise, or water loop.

(d) It must be shown that a safe transition to the balked landing conditions of ⊥23.77 can be made from the conditions that exist at the 50 foot height, at maximum landing weight, or at the maximum landing weight for altitude and temperature of ⊥23.63 (c)(2) or (d)(2), as appropriate.

(e) The brakes must be used so as to not cause excessive wear of brakes or tires.

(f) Retardation means other than wheel brakes may be used if that means-

(1) Is safe and reliable; and

(2) Is used so that consistent results can be expected in service.

(g) If any device is used that depends on the operation of any engine, and the landing distance would be increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of other compensating means will result in a landing distance not more than that with each engine operating.

Section 23.1587, "Performance Information," stated the following:

(a) For all airplanes, the following information must be furnished.

(3) The landing distance, determined under ⊥23.75 for each airport altitude and standard temperature, and the type of surface for which it is valid;

(4) The effect on landing distances of operation on other than smooth hard surfaces, when dry, determined under ⊥23.45(g); and

(5) The effect on landing distances of runway slope and 50 percent of the headwind component and 150 percent of the tailwind component.

FAA Safety Alert for Operators (SAFO)

The FAA has previously issued two SAFOs relevant to the circumstances of this accident.

SAFO 06012, "Landing Performance Assessments at Time of Arrival (Turbojets)," dated August 31, 2006, stated the following:

This SAFO urgently recommends that operators of turbojet airplanes develop procedures for flightcrews to assess landing performance based on conditions actually existing at time of arrival, as distinct from conditions presumed at time of dispatch. . Once the actual landing distance is determined an additional safety margin of at least 15% should be added to that distance.

SAFO 06012 noted that the dry-runway landing distances established during flight tests and that are the basis for the factored landing distances used by dispatch are shorter than the landing distances achieved in practice. In addition, AFM landing distances for wet and contaminated runways may also be based on the minimum dry distances obtained during flight tests. Consequently, landing distances on wet or contaminated runways computed from AFM data with little or no additional safety margin may be too short for normal operations. The SAFO recommended a conservative approach to assessing the landing distance requirements, including using the most adverse reliable braking action report or expected conditions for the runway and using values for air distances and approach speeds that are representative of actual operations. The SAFO recommended that a 15% safety margin then be added to the computed (unfactored) landing distance because "the FAA considers a 15% margin between the expected actual airplane landing distance and the landing distance

available at the time of arrival as the minimum acceptable safety margin for normal operations."

SAFO 15009, "Turbojet Braking Performance on Wet Runways," dated August 11, 2015, warned that "the advisory data for wet runway landings may not provide a safe stopping margin under all conditions" and stated the following:

Several recent runway landing incidents/accidents have raised concerns with wet runway stopping performance assumptions. Analysis of the stopping data from these incidents/accidents indicates the braking coefficient of friction in each case was significantly lower than expected for a wet runway as defined by the Federal Aviation Administration (FAA) in Federal Air Regulation (FAR) 25.109 and Advisory Circular (AC) 25-7C methods. These incidents/accidents occurred on both grooved and un-grooved or non-Porous Friction Course overlay (PFC) runways. The data indicates that applying a 15% safety margin to wet runway time-of-arrival advisory data as recommended by SAFO 06012, may be inadequate in certain wet runway conditions

The root cause of the wet runway stopping performance shortfall is not fully understood at this time; however, issues that appear to be contributors are runway conditions such as texture (polished or rubber contaminated surfaces), drainage, puddling in wheel tracks and active precipitation. Analysis of this data indicates that 30 to 40 percent of additional stopping distance may be required in certain cases where the runway is very wet, but not flooded. Possible methods of applying additional conservatism when operating on a runway which experience has shown degraded when very wet are assuming a braking action of medium or fair when computing time-of-arrival landing performance or increasing the factor applied to the wet runway time-of-arrival landing performance data.

Advisory Circular 91-79A

The FAA issued AC 91-79A, "Mitigating the Risks of a Runway Overrun Upon Landing," on September 17, 2014. The AC stated the following:

Section 6 - DISCUSSION - HAZARDS ASSOCIATED WITH RUNWAY OVERRUNS

j. A Wet or Contaminated Runway. Landing distances in the manufacturer-supplied AFM provide performance in a flight test environment that is not necessarily representative of normal flight operations. For those operators conducting operations in accordance with specific FAA performance regulations, the operating regulations require the AFM landing distances to be factored to ensure compliance with the pre-departure landing distance regulations. These factors should account for pilot technique, wind and runway conditions, and other items stated above. Pilots and operators should also account for runway conditions at the time of arrival (TOA) to ensure the safety of the landing. Though the intended audience of SAFO 06012 is turbojet airplanes, it is highly recommended that pilots of non-turbojet airplanes also follow the recommendations in SAFO 06012.

(4) Know you can stop within the landing distance available. The cumulative effect of the conditions that extend the airplane's landing distance, plus the 15 percent safety margin, can be a substantial increase to the AFM/POH data, unless the pilot is aware of the items presented, and possesses the knowledge and flying discipline to mitigate the risk of a runway overrun.

Embraer Actions

On June 6, 2016, Embraer issued Revision 2, Flight Operations Letter PHE505-018/14 Landing Procedure Best Practices and Recommendations," which highlight some information contained in FAA AC91-79A in and add information specific to the Phenom fleet.

The letter state that due to the antiskid function, the BCU will automatically calculate the maximum pressure delivered to the brakes based on the pavement condition. As a result, pilots will notice lower deceleration on a contaminated runway compared to a dry runway.

The FOL contained the following:

CAUTION: The emergency parking brake will always deliver worse performance when compared to the normal brakes with anti-skid protection. Its use is only recommended on abnormal conditions, when the BRK FAIL CAS message is annunciated. In these conditions, applying the landing correction factors, determinate by the QRH [Quick Reference Handbook], are mandatory.

Accident Rpt# GAA17CA267 05/08/2017 915 CDT	**Regis# N6944K**	**Walnut Ridge, AR**	**Apt: Private N/A**
Acft Mk/Mdl GRUMMAN ACFT ENG COR-SCHWEIZER	**Acft SN 526B**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
		Fatal 0 Ser Inj 0	**Flt Conducted Under: FAR 137**
Opr Name: WILSON FLYING SERVICE INC.	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: SPR

Summary

The pilot of a tailwheel-equipped airplane reported that, during a go-around, the airplane veered to the left off the runway. He added that the main landing gear went into the mud, and the airplane nosed over.

The airplane sustained substantial damage to the empennage.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airplane that would have precluded normal operation.

The automated weather observation system about 4 nautical miles from the accident site reported that, about the time of the accident, the wind was from 200ø at 6 knots. The Federal Aviation Administration inspector reported that the pilot landed to the north.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to maintain directional control during the go-around with a tailwind.

Events

1. Landing-landing roll - Loss of control on ground

Findings - Cause/Factor

1. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Directional control-Not attained/maintained - C
2. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot - C
3. Environmental issues-Physical environment-Runway/land/takeoff/taxi surface-Soft surface-Contributed to outcome

Narrative

The pilot of a tailwheel-equipped airplane reported that, during a go-around, the airplane veered to the left off the runway. He added that, the main landing gear went into the mud and the airplane nosed over.

The airplane sustained substantial damage to the empennage.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airplane that would have precluded normal operation.

The automated weather observation system about 4 nautical miles from the accident site reported that, about the time of the accident, the wind was from 200ø at 6 knots. The Federal Aviation Administration Inspector reported that the pilot landed to the north.

Accident Rpt# CEN17LA314 08/10/2017 1400	**Regis# N58424**	**Villa Grove, CO**	**Apt: N/a**	
Acft Mk/Mdl HUGHES 369D	**Acft SN 1090593D**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual**	**Prob Caus: Pending**
Eng Mk/Mdl ROLLS ROYCE 250 C20B		**Fatal 0 Ser Inj 1**	**Flt Conducted Under: FAR 133**	
Opr Name: PATROL HELICOPTERS INC.	**Opr dba:**		**Aircraft Fire: NONE**	

Events

1. Maneuvering-low-alt flying - External load event (Rotorcraft)

Narrative

On August 10, 2017, about 1400 mountain daylight time, a Hughes 369D helicopter, N58424, had its tail rotor impact a powerline near Villa Grove, Colorado. The pilot received serious injuries. The helicopter sustained substantial tailboom and fuselage damage. The helicopter was registered to Quicksilver Air Inc. and operated by Patrol Helicopters Inc. as a 14 Code of Federal Regulations Part 133 rotorcraft external load flight. Day visual meteorological conditions prevailed in the area about the time of the accident, and the flight was not operated on a flight plan. The local flight originated from a field near the accident site.

According to the pilot's accident report, the purpose of the flight was to assist power line construction. After pulling a sock line through several structures, the helicopter was flown inside an angle tower. As the pilot was flying the helicopter away from the angle tower, he flew the helicopter to his right while planning on backing up at the same time. The next tower came into view and the helicopter's speed to the right was faster than planned. The helicopter's main rotors contacted a tower and the helicopter subsequently "crashed." The pilot indicated that the helicopter did not have any mechanical malfunctions. The pilot was not wearing a helmet.

Accident Rpt# ERA16LA195	**05/27/2016 1930 EDT**	**Regis# N1345B**	**New York, NY**	**Apt: N/a**
Acft Mk/Mdl REPUBLIC P 47D-D		**Acft SN 44-90447**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl PRATT AND WHITNEY R-2800-69		**Acft TT 553**	**Fatal 1 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: AMERICAN AIRPOWER MUSEUM		**Opr dba:**		**Aircraft Fire: NONE**
				AW Cert: SPE

Summary

The World War II-era fighter airplane was part of a three-ship formation performing a photo shoot. About 1,000 ft above the water, the pilot of the accident airplane made a distress call to air traffic control, stating that he had "smoke," and he subsequently ditched the airplane. The airplane landed on the water and subsequently sank. Another pilot in the formation reported that the canopy was partially open before the ditching. The pilot was unable to egress the airplane and drowned.

Examination of the engine revealed evidence of internal seizure. Damage to the inside of the crankcase prevented the removal of cylinders and disassembly of the engine. Oil and metallic fragments were found inside the engine's supercharger. Although the supercharger may have failed as the initiating event, the reason for the engine failure could not be determined due to the excessive internal damage to the engine.

Examination of the pilot's seat belt/shoulder harness restraints and canopy operation, including a functional test of the jettison T-handle, did not reveal evidence of any in-flight anomaly or failure. Although the airplane's operating instructions called for the pilot to jettison the canopy before ditching, the pilot did not do so, and was subsequently unable to fully open the canopy and egress the airplane as it sank.

Toxicology testing revealed diphenhydramine, an impairing medication that causes sedation, altered mood, and impaired cognitive and psychomotor performance in blood and urine specimens. However, the level of diphenhydramine in blood was too low to quantify and therefore any effects from it likely did not contribute to the accident.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: A catastrophic engine failure of undetermined origin, which resulted in a total loss of engine power and subsequent ditching. Contributing to the accident was the pilot's failure to jettison the canopy before ditching, which resulted in his inability to egress the airplane as it sank.

Events

1. Enroute-cruise - Loss of engine power (total)
2. Emergency descent - Ditching

Findings - Cause/Factor

1. Not determined-Not determined-(general)-(general)-Unknown/Not determined - C
2. Personnel issues-Task performance-Use of equip/info-Use of equip/system-Pilot - F
3. Aircraft-Aircraft power plant-Engine (reciprocating)-Recip eng supercharger-Failure - C
4. Aircraft-Aircraft power plant-Engine (reciprocating)-Recip eng cyl section-Damaged/degraded - C

Narrative

HISTORY OF FLIGHT

On May 27, 2016, about 1930 eastern daylight time, a Republic P-47D, N1345B, ditched in the Hudson River near New York, New York, following a total loss of engine power. The commercial pilot was fatally injured and the airplane was substantially damaged. The experimental, exhibition-category airplane was registered to a corporation and was operated by the American Airpower Museum under the provisions of 14 Code of Federal Regulations Part 91 as an aerial observation flight. Day visual meteorological conditions prevailed at the time of the accident, and no flight plan was filed. The local flight originated from Republic Airport (FRG), Farmingdale, New York, about 1900.

The accident airplane was part of a three-ship formation participating in a photo shoot. The #2 pilot in the formation reported that they flew along the beach, on the south side of Long Island, then into the visual flight rules corridor next to John F Kennedy International Airport (JFK). They were about 1,100 ft above the water and proceeding north along the Hudson River about 140 knots. Over the radio, he heard the pilot of the accident airplane report that he had "smoke." (The pilot made a distress call to the Newark Liberty International Airport (EWR) air traffic control tower.) The #2 pilot subsequently saw smoke from the accident airplane then saw the propeller "seize up." The accident pilot maneuvered the airplane for a forced landing in the Hudson River. The #2 pilot observed that the accident airplane's canopy was only partially open; as the airplane descended, touched down on the water, and sank a few seconds later in the

Hudson River south of the George Washington Bridge. Attempts by first responders to rescue the pilot were unsuccessful.

PERSONNEL INFORMATION

The pilot held a commercial pilot certificate with airplane single- and multi-engine land, airplane single-engine sea, rotorcraft-helicopter, and instrument airplane ratings. He also held a Federal Aviation Administration (FAA) airframe and powerplant mechanic certificate. The pilot held an FAA second-class medical certificate and reported 6,400 total hours of flight experience on his application for that certificate, dated August 5, 2015.

AIRCRAFT INFORMATION

The airplane was a low-wing, single-seat, World War II-era fighter airplane with retractable landing gear in a tailwheel configuration. It was powered by a Pratt and Whitney R2800-69, 18-cylinder radial engine and a Hamilton Standard four-bladed, constant-speed propeller.

According to maintenance logbook entries, a condition inspection was completed on May 9, 2015, at a Hobbs time of 553.0 hours. At that time, the engine oil was changed and the oil screen was inspected; no contaminants were observed.

A representative of the corporation that owned the airplane reported that the engine was "low time, less than 400 hours" and that the airplane was due for its next condition inspection on June 1, 2016. The airplane was maintained in a hangar, and the engine "ran well with no recent complaints."

METEOROLOGICAL INFORMATION

EWR was located about 9 miles southwest of the accident location. The 1951 weather observation included wind from 150ø at 8 knots, visibility 10 statute miles, few clouds at 5,500 ft, scattered clouds at 18,000 ft, a broken ceiling at 25,000 ft, temperature 28øC, dew point 19øC, and altimeter setting 29.99 inches of mercury.

WRECKAGE AND IMPACT INFORMATION

The wreckage was recovered from the river the following day near the 79th Street Boat Basin and transported to the West 30th Street Heliport, New York, New York. An initial examination of the wreckage revealed that the airframe was generally intact. The engine remained attached to the airframe. A cursory examination of the engine revealed that the No. 18 cylinder was damaged, consistent with an in-flight occurrence. Oil was present on the exterior of the engine.

The wreckage was moved to a storage facility where additional examinations were performed by an FAA inspector. The inspector noted that the engine was internally seized and would not rotate. He tried to remove the cylinders; however, all cylinders were damaged and could not be removed from the crankcase. Metallic debris and oil were found inside the supercharger. Four intake manifolds were removed for examination; they were also oil-soaked and contained metal particles. Due to the internal damage to the engine and the inability to remove cylinders, further examination of the engine was not attempted.

MEDICAL AND PATHOLOGICAL INFORMATION

The Office of the Chief Medical Examiner, City of New York, performed an autopsy of the pilot. The cause of death was drowning, and the manner of death was accident.

The FAA's Bioaeronautical Research Sciences Laboratory, Oklahoma City, Oklahoma, performed toxicology testing on specimens from the pilot. Diphenhydramine was detected in the blood and urine at levels too low to quantify.

Diphenhydramine is a sedating antihistamine used to treat allergy symptoms and as a sleep aid and carries the following Federal Drug Administration warning: "May impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g. driving, operating heavy machinery)."

SURVIVAL ASPECTS

An examination of the cockpit seat belt/harness restraints and the canopy system was performed by the NTSB Survival Factors Group Chairman. When

examined at the wreckage storage facility, the cockpit canopy was in the full-open position. The cockpit control stick and instrument panel were undamaged. The pilot seat, which was designed to move up and down by engaging a lever adjacent to the seat, operated in a normal manner. The four-point seat belt restraint system consisted of a lap belt and shoulder harness. The system was fastened and unfastened by the investigator and functioned in a normal manner.

The cockpit canopy was designed to be operated by hand, by a motor controlled from an internal switch in the cockpit, or by an external switch located forward of the left of the cockpit window in an access panel. The extremes of travel were limited by two limit switches mounted on the deck behind the pilot seat. The entire operating mechanism was covered by the aft portion of the canopy while in the closed position.

To operate the canopy from inside the airplane, the internal lock release is pushed forward to the full stop. This action disengages the clutch on the canopy motor. While holding forward pressure on the lock release, the pilot can manually move the canopy freely on its rails. To automatically move the canopy, the pilot would select the open or closed position on the canopy switch, which was located in front of the lock release on the left cockpit sidewall.

An examination of the internal and external lock release mechanism was performed. Both lock releases disengaged the motor and allowed the canopy to move freely on its rails. The automatic motor switches were not tested due to flammable fluids in the area and lack of a power source.

To jettison the canopy, the pilot was required to pull the jettison T-handle mounted on the front frame of the canopy. This action allowed the locking pins to be pulled from the two jettison fittings that held the canopy to the roller assemblies. All three fittings would then be free, and the canopy could be jettisoned in-flight or removed on the ground. An examination of the jettison handle was performed. The T-handle was pulled by the investigator and the canopy subsequently released from the rail and departed the cockpit area.

The procedures for ditching the airplane were found in the pilot's Flight Operating Instructions (AN 01-65BC-1A). Section IV, bullet 8 on page 37 described the procedures for ditching:

"If it becomes necessary to abandon the airplane over water and it is not desirable to bail out, the following procedure is suggested. (1) Make sure safety belt and shoulder harness are secure. (2) Lower flaps. (3) Jettison canopy. (4) Make normal approach glide into the wind. Hold off until stall speed is reached, then set down tail first. (5) Ditch into the wind on upslope wave."

The pilot's flight helmet was recovered at the accident scene. The flight helmet shell showed no signs of impact damage and all functions of the helmet operated normally.

Accident Rpt# GAA17CA457 07/28/2017 1115 CDT	**Regis# N541GF**	**Hondo, TX**	**Apt: South Texas Rgnl At Hondo HDO**
Acft Mk/Mdl SWEARINGEN SA26-AT	**Acft SN T26-173**	**Acft Dmg: SUBSTANTIAL**	**Rpt Status: Factual Prob Caus: Pending**
Eng Mk/Mdl HONEYWELL TPE331-6-252	**Acft TT 7205**	**Fatal 0 Ser Inj 0**	**Flt Conducted Under: FAR 091**
Opr Name: FMG AVIATION LLC	**Opr dba:**		**Aircraft Fire: NONE**
			AW Cert: STN

Summary

The pilot of a retractable-landing gear-equipped airplane reported that he landed with the landing gear extended. He added that, during the landing, the airplane bounced, and the "landing gear retracted and the aircraft settled onto its belly."

The airplane sustained substantial damage to the fuselage.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airplane that would have precluded normal operation.

The pilot reported that he "may have failed to deploy the landing gear" and did not recall hearing the gear warning horn.

A flight instructor witness reported that, while his student was performing an engine run-up, he saw the airplane on final about 400 ft from the threshold with the landing gear retracted. He added that he thought the airplane was going to do a low approach, so he turned to check on his student, but when he looked back up, he saw "the [airplane] was on the runway" sliding.

The Federal Aviation Administration inspector reported that, when he arrived on scene, he observed the gear handle in the "up" position.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The pilot's failure to extend the landing gear before landing.

Events

1. Landing - Landing gear not configured

Findings - Cause/Factor

1. Personnel issues-Action/decision-Action-Forgotten action/omission-Pilot - C
2. Aircraft-Aircraft systems-Landing gear system-Gear extension and retract sys-Not used/operated - C

Narrative

The pilot of a retractable landing gear equipped airplane reported that he landed with the landing gear extended. He added that during the landing, the airplane bounced and the "landing gear retracted and the aircraft settled onto its belly".

The airplane sustained substantial damage to the fuselage.

The pilot reported that there were no preaccident mechanical failures or malfunctions with the airplane that would have precluded normal operation.

The pilot reported that he "may have failed to deploy the landing gear" and does not recall hearing the gear warning horn.

A flight instructor witness reported that, while his student was performing an engine run-up, he saw the airplane on final about 400 ft from the threshold with the landing gear retracted. He added that he thought the airplane was going to do a low approach, so he turned to check on his student, but when he looked back up, he saw "the [airplane] was on the runway" sliding.

The Federal Aviation Administration Inspector reported that when he arrived on scene, he observed the gear handle in the up position.

Accident Rpt# WPR18LA004 **10/13/2017 1015 PDT** **Regis# N247PV** **Arbuckle, CA** **Apt: Private Strip N/A**

Acft Mk/Mdl WESTERN INTERNATIONAL AVIA INC UH **Acft SN 65-9649** **Acft Dmg: SUBSTANTIAL** **Rpt Status: Prelim** **Prob Caus: Pending**

Eng Mk/Mdl LYCOMING T53-L-13 **Fatal 0** **Ser Inj 0** **Flt Conducted Under: FAR 091**

Opr Name: JAMES MILLER **Opr dba:** **Aircraft Fire: NONE**

AW Cert: SPR

Events

1. Landing - Flight control sys malf/fail

Narrative

On October 13, 2017, about 1015 Pacific daylight time, a Williams Helicopter Corp UH-1H rotorcraft, N247PV, experienced a mechanical issue while repositioning the helicopter onto a cart at a private airstrip in Arbuckle, California. The pilot, sole occupant, was uninjured and the helicopter sustained substantial damaged throughout. The helicopter was registered to and operated by the pilot as a 14 Code of Federal Regulations Part 91 flight. Visual meteorological conditions prevailed and no flight plan was filed. The flight originated from the private airstrip about 1012.

The pilot reported that the helicopter had just come from maintenance and he was repositioning it to a nearby cart. While the helicopter was hovering over the cart, the collective started to surge up and down. The pilot attempted to land the helicopter, however, the collective "fell through," and the helicopter impacted the cart hard and bounced. The pilot stabilized a hover and he attempted to land a second time; however, the helicopter impacted hard, bounced, and the right skid went over the edge of the cart. The helicopter rolled onto its right side and impacted the ground below.

The helicopter has been recovered for further examination.