Aviation Investigation Final Report

Location:	San Pedro, California	**Accident Number:**	WPR17FA047
Date & Time:	January 4, 2017, 17:36 Local	**Registration:**	N702JJ
Aircraft:	ROBINSON HELICOPTER R22 BETA	**Aircraft Damage:**	Substantial
Defining Event:	Fuel related	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Aerial observation		

Analysis

The purpose of the flight was to take nighttime aerial photographs of several cruise ships in a nearby harbor. The helicopter with the commercial pilot and the passenger/photographer aboard departed from the operator's ramp area, and proceeded to the harbor where it made numerous orbits. Following the orbits, the helicopter flew toward a jetty, and witnesses on one ship reported that the helicopter started spinning as it went straight down into the water. The helicopter came to rest upright in about 18 ft of water. All major components of the helicopter were recovered except the outboard 3/4 of one main rotor blade. The fracture surface at the separation point was jagged and angular consistent with an overstress failure at impact. The intact main rotor blade exhibited coning, which was indicative of low rotor rpm at impact. There were no rotational signatures between the cooling fan and scroll or the upper sheave and the airframe, which indicated that the engine was not operating at impact. Examination of the helicopter revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation.

The carburetor heat control knob in the cockpit was in the full down or "OFF" position and unlocked. The slider on the carburetor heat airbox was in a midrange position; the airbox was deformed, and the slider cable was displaced. At impact, if the airbox moves out of position, it will likely stretch the cable, which will move the slider valve. The helicopter was equipped with a carburetor heat assist device; lowering the collective mechanically added heat and raising the collective reduced heat. If the pilot was not manipulating the collective, the assist device would not have an effect. Carburetor heat would only be controlled by the pilot's manipulation of the carburetor heat control knob. If the control knob had been up in an "ON" position, it likely would have been bent and still up.

The airframe manufacturer has issued safety notices regarding carburetor ice and low rotor rpm blade stall. One safety notice stated that failure to maintain rotor rpm can result in low rotor rpm stall, and the helicopter can fall at an extreme rate. Another safety notice stated that main rotor blade stall due to low main rotor rpm caused a very high percentage of helicopter accidents. If the pilot had maintained main rotor rpm, he might have been able to make a successful autorotation and touch down less violently on

the water, which might have allowed the occupants to egress the helicopter. However, performing an autorotation to water on a dark night would be a difficult maneuver.

The meteorological conditions at the time of the accident were conducive for the formation of carburetor ice, but the carburetor heat control knob was in the "OFF" position. It is likely that the pilot's failure to apply carburetor heat resulted in a loss of engine power due to carburetor ice. During the ensuing forced landing, the pilot did not maintain adequate main rotor rpm, and the helicopter descended rapidly to impact.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to use carburetor heat while operating in conditions conducive to carburetor icing, which resulted in a loss of engine power due to carburetor icing. Also causal was the pilot's failure to maintain rotor rpm following the loss of engine power.

Findings

Aircraft	Fuel control/carburetor - Not used/operated
Personnel issues	Use of equip/system - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Lack of action - Pilot
Environmental issues	Conducive to carburetor icing - Decision related to condition

Factual Information

History of Flight

Maneuvering-low-alt flying	Fuel related (Defining event)
Maneuvering-low-alt flying	Loss of control in flight

On January 4, 2017, about 1736 Pacific standard time, a Robinson Helicopter Company (RHC) R22, N702JJ, collided with the water near San Pedro, California. The commercial pilot and the passenger sustained fatal injuries; the helicopter sustained substantial damage. JJ Helicopters was operating the helicopter under the provisions of 14 Code of Federal Regulations Part 91. The local photography flight departed Torrance Municipal Airport, Torrance, California, about 1635. Night visual meteorological conditions prevailed at the time of the accident, and no flight plan had been filed.

The operator reported that the purpose of the flight was to take aerial photos of several cruise ships in a nearby harbor.

Recorded radar data showed that the helicopter departed from Torrance Municipal Airport and proceeded toward the Los Angeles harbor area. The helicopter made numerous circles, and the last portion of the track showed the helicopter on a southeasterly course crossing perpendicular to a jetty that terminated at a lighthouse marking the west side of the harbor mouth. When the helicopter was southwest of the lighthouse, it made a sweeping left 270° turn that went past the lighthouse and then began a slightly curved course parallel to the ocean side of the jetty. The last few targets indicate a sharp turn to the right and terminated on the inland side of the jetty. The data points for the last 11 minutes recorded mode C altitudes that varied between 100 ft and 700 ft.

Numerous witnesses on a cruise ship that was exiting the harbor mouth at the time of the accident reported that the helicopter started spinning as it descended straight down into the water. One witness commented that it was "just dark enough to make it difficult to see the helicopter, all you could see clearly were the [spinning] lights."

Several local agencies initiated a search, and the wreckage was located about 1015 on January 5, 2017. The wreckage was on the inland side of the jetty, and southwest of the lighthouse at the end of the jetty.

Pilot Information

Certificate:	Commercial	**Age:**	42,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	September 9, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 9, 2016
Flight Time:	815 hours (Total, all aircraft), 77 hours (Total, this make and model), 705 hours (Pilot In Command, all aircraft), 11 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft)		

The pilot had 90 hours total time in rotorcraft, and 45 as pilot-in-command in the accident make/model. His initial training was in fixed wing airplanes, and all helicopter flight time had occurred during the current year.

Aircraft and Owner/Operator Information

Aircraft Make:	ROBINSON HELICOPTER	**Registration:**	N702JJ
Model/Series:	R22 BETA	**Aircraft Category:**	Helicopter
Year of Manufacture:	2005	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3791
Landing Gear Type:	N/A; Skid	**Seats:**	2
Date/Type of Last Inspection:	December 18, 2016 Annual	**Certified Max Gross Wt.:**	1369 lbs
Time Since Last Inspection:	11 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5000 Hrs at time of accident	**Engine Manufacturer:**	LYCOMING
ELT:	Not installed	**Engine Model/Series:**	O-360-J2A
Registered Owner:	On file	**Rated Power:**	145 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Fueling records established that the helicopter was last fueled on January 3, 2017, with the addition of 11.9 gallons of 100-octane aviation fuel. The owner flew the helicopter just before the accident flight, and said that 15 gallons of fuel remained at the conclusion of that flight.

Investigators drained the fuel tanks. Clear fluid was in the bottom of the buckets with blue fluid on top,

and investigators estimated that the 5 gallons of blue fluid looked and smelled like 100-octane aviation fuel.

The pilot and passenger recorded their weights before takeoff. Based on these weights, the operator determined that the helicopter was within both longitudinal and lateral weight and balance limitations at takeoff and at the time of the accident. RHC computations concurred with this determination. Using weights provided by the coroner, RHC determined that the helicopter was slightly out of longitudinal limits at takeoff and at the time of the accident.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KTOA,103 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	01:47 Local	**Direction from Accident Site:**	285°
Lowest Cloud Condition:	Scattered / 2200 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 20000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	300°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.07 inches Hg	**Temperature/Dew Point:**	13°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Torrance, CA (TOA)	**Type of Flight Plan Filed:**	None
Destination:	Torrance, CA (TOA)	**Type of Clearance:**	None
Departure Time:	16:35 Local	**Type of Airspace:**	

FAA Special Airworthiness Information Bulletin CE-09-35 contains a graph that illustrates the probability of carburetor icing for various temperature and relative humidity conditions. The conditions encountered in this accident (ambient temperature 55° F / dew point 52° F, 88% relative humidity), were in the area of serious icing at cruise power.

The passenger's camera was examined by the National Transportation Safety Board's Recorders Division. Most of the photographs were of Los Angeles harbor and several cruise ships in the area. The last photograph was an aerial shot of a cruise ship leaving the harbor area and depicted dark light conditions. The helicopter's location was outside of the breakwater and lighthouse at the entrance to the harbor.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	33.706943,-118.257774

The local agencies that recovered the helicopter reported that the helicopter came to rest upright in about 18 ft of water. The first responder dive team noted that the pilot was in the right seat, and the passenger was in the left seat; both victims still had their seat belts fastened. The pilot was wearing a helmet and an inflated life vest. All major components of the helicopter were recovered except the outboard 3/4 of one main rotor blade. The fracture surface at the separation point was jagged and angular. Multiple searches did not locate the missing portion of the main rotor blade.

The throttle, mixture, and carburetor heat controls were connected at both ends; the airframe structure was collapsed around the controls, and they would not move. The throttle arm at the carburetor was about 3/4 open. The mixture was in the full rich position. The carburetor heat control knob in the cockpit was in the full down or "OFF" position and unlocked. The slider on the carburetor heat airbox was in a midrange position; the airbox was deformed, and the slider cable was displaced.

There were no holes in the crankcase or cylinders that indicated a catastrophic failure of the engine. The tail pipe coloration was light gray with no oil residue. There were no rotational signatures between the cooling fan and scroll or the upper sheave and the airframe.

Investigators left the engine in place, and removed the valve covers. They manually rotated the crankshaft by turning the fan wheel. The crankshaft rotated freely, and the valves moved about the same amount of lift in firing order. The gears in the accessory case turned freely. Investigators obtained thumb compression on all cylinders in firing order.

A borescope inspection revealed no mechanical deformation on the valves, cylinder walls, or internal cylinder head.

Both main rotor blades were bent down at the hub, and then bent upward about 2 ft out from the hub. One blade separated at that point along a jagged angle. The other main rotor blade coned upward at that point; it retained its full length but had a tear at midspan from the trailing edge to the back of the spar.

Medical and Pathological Information

The Los Angeles County Coroner, Los Angeles, California, completed an autopsy on the pilot and determined that the cause of death was drowning.

Toxicology testing of specimens from the pilot by the FAA's Bioaeronautical Science's Research Laboratory, Oklahoma City, Oklahoma, were negative for carbon monoxide, ethanol and tested drugs.

Additional Information

RHC Safety Notice (SN) SN-10 stresses the importance of instantly adding throttle and lowering the collective to maintain main rotor rpm in an emergency. It states that failure to do so can result in low rotor rpm stall, and the helicopter can fall at an extreme rate. It notes that failure to maintain main rotor rpm is a leading cause of fatal accidents in light helicopters.

SN-18 states that flying a helicopter in obscured visibility or even on a dark night can be fatal.

SN-19 notes that flying over water is very hazardous. It recommends that a pilot maintain 500 ft above ground level (agl) whenever possible, and avoid maneuvers over water below 200 ft agl.

SN-24 emphasizes that rotor stall due to low rpm causes a very high percentage of helicopter accidents, both fatal and non-fatal. It states that when rotor stall occurs above 40 to 50 ft, it will most likely be fatal.

SN-25 discusses carburetor ice. It stated that carburetor ice could cause engine stoppage, and was most likely to occur when there was high humidity or visible moisture, and the air temperature was below 70° F. It stated that even in generally dry air, local conditions such as a nearby body of water could be conducive to carburetor ice. It stated that during descent or autorotation, the pilot should ignore the carburetor air temperature gauge, and apply full carburetor heat. RHC published a revision to SN-25 in July 2012 stating that carburetor heat may be required on takeoff, and the carburetor heat control knob should be left unlatched unless it was obvious that conditions were not conducive to carburetor ice. It also noted that carburetor ice could form at outside air temperatures as high as 30° C (86° F).

SN-29 states that there have been a number of fatal accidents involving experienced pilots with many hours in airplanes, but limited experience flying helicopters. The ingrained reactions to an emergency could have fatal results. All of the pilot's helicopter time was attained in the current year and was just over 10% of his total time.

SN-31 notes that the governor can mask carburetor ice. With the throttle governor on, carburetor ice will not become apparent as a loss of either rpm or manifold pressure. The governor will automatically adjust throttle to maintain a constant rpm, which will also result in a constant manifold pressure. It states that when in doubt, the pilot should apply carburetor heat as required to keep the carburetor air temperature out of the yellow arc during hover, climb, or cruise, and apply full carburetor heat when the manifold pressure is below 18 inches.

Safety Notice 34 emphasizes that aerial survey and photography flights are high risk.

The R22 Pilot's Operating Handbook (POH) stated that a carburetor heat assist device was installed on the helicopter. The device correlated application of carburetor heat with changes in the collective setting. Lowering the collective mechanically added heat and raising collective reduced heat. The system included a latch at the control knob to lock the carburetor heat off when not required. The system contained a friction clutch that allowed the pilot to override the system. It instructed the pilot to readjust carburetor heat as necessary following any change in power. The POH included "set as required" for the carburetor heat line of the starting engines and run-up checklist, and "adjust carb heat as required" to the takeoff procedure in the normal procedures section of the POH.

Administrative Information

Investigator In Charge (IIC):	Plagens, Howard
Additional Participating Persons:	Ben Harris; FAA FSDO; Long Beach, CA Thom Webster; Robinson Helicopter Company; Torrance, CA Mark Platt; Lycoming Engines; Williamsport, PA
Original Publish Date:	December 12, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=94565