Aviation Investigation Final Report

Location:	Molokai, Hawaii	**Accident Number:**	WPR18LA010
Date & Time:	October 16, 2017, 19:18 Local	**Registration:**	N820DF
Aircraft:	ROBINSON HELICOPTER R44	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

During a night instructional flight in the helicopter, the commercial pilot receiving instruction and the flight instructor departed and flew uneventfully to an adjacent island, where they conducted a practice instrument approach to an airport before they initiated the published missed approach procedure. As the flight reestablished radio communication with air traffic control, the pilots obtained an instrument flight rules clearance for their return to the departure airport. Radar and radio contact with the helicopter were lost shortly thereafter. Air units from the United States Coast Guard and a local fire department located some floating debris in the ocean the night of the accident and the day following the accident, respectively. The wreckage was located about 12 months following the accident submerged in the Pacific Ocean at a reported depth of 298 ft. A portion of the located wreckage was recovered about 3 months later. A postaccident examination of the recovered wreckage revealed no evidence of any preexisting mechanical malfunctions that would have precluded normal operation of the airframe or engine.

Weather radar depicted an area of moderate-to-heavy rain showers along the helicopter's flight path about the time radar and radio contact were lost. Although the pilots had access to sufficient weather information to properly plan their flight around the weather and could have asked for further assistance in avoiding the weather from air traffic control, they elected to fly into an environment favorable to unexpected changes in wind direction and speed due to heavy rain showers, which could result in localized instrument meteorological conditions; however, because only a portion of the wreckage was recovered, the reason for the helicopter's sudden descent and impact with open ocean waters could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A descent and subsequent impact with open ocean waters for reasons that could not be determined based on the available information.

Findings

Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Enroute-change of cruise level	Loss of control in flight (Defining event)
Enroute-change of cruise level	Collision with terr/obj (non-CFIT)

On October 16, 2017, about 1918 Hawaii-Aleutian standard time, a Robinson Helicopter R44, N820DF, impacted the Pacific Ocean near Molokai, Hawaii. The flight instructor and commercial pilot receiving instruction are missing and presumed to be fatally injured. The helicopter was registered to Stasys Aviation Leasing LLC and was being operated by Hawaii Pacific Aviation, doing business as Mauna Loa Helicopters, as a Title 14 *Code of Federal Regulations* Part 91 instructional flight. Instrument and visual meteorological conditions existed in the area around the time of the accident, and an instrument flight rules (IFR) flight plan was filed for the flight, which originated from Daniel K. Inouye International Airport (PHNL), Honolulu, Hawaii, at an undetermined time.

Information provided by the Federal Aviation Administration (FAA) indicated that air traffic control (ATC) cleared the flight for a practice RNAV (GPS)-B instrument approach to the Molokai Airport (PHMK), at which time the pilots requested a pop-up IFR clearance to PHNL. The controller instructed the pilots to depart via the published missed approach to 4,000 ft, and expect clearance on departure, which the pilots acknowledged. The controller subsequently terminated radar service, approved a frequency change, and informed the flight to return to that frequency after conducting the missed approach.

The flight executed the missed approach as instructed and reestablished radio contact with ATC about 1 mile north of PHMK as it was climbing through 1,700 ft. The controller radar-identified the helicopter and subsequently issued a clearance to PHNL with instructions to fly a heading of 260° and climb to 4,000 ft. About 4 minutes later, the controller issued a heading change to 240° to intercept the Victor 8 airway; the pilots acknowledged. About 2 minutes later, the controller advised the flight that radar contact with the helicopter was lost. No further radio transmissions were received from the pilots.

Radar data showed that the flight's radar track started about 1.3 nautical miles (nm) northeast of PHMK and remained on a north-northeasterly heading while climbing from 1,700 ft to 3,500 ft msl for about 3 minutes. The helicopter then entered a left turn to a westerly heading while continuing a climb to 4,000 ft msl. The track continued on a westerly heading for about 2 more minutes before it began a right turn to an east-southeasterly heading. About 35 seconds later, the helicopter entered a left turn to a northwesterly heading and began descending from 4,000 ft msl to 3,700 ft msl over about 35 seconds. Shortly thereafter, the track continued in a left turn to a southeasterly heading for about 19 seconds while climbing to 3,900 ft. The helicopter then turned to a westerly heading and had descended to about 2,700 ft when radar contact was lost about 6 miles northwest of PHMK.

A representative from the United States Coast Guard reported that, after the helicopter was reported

missing, an air unit located debris and a red chemlight floating in the ocean northwest of Molokai. The following day, an air unit from the Maui Fire Department located an uninflated life jacket along the northwest shoreline of Molokai. The search for the helicopter was suspended on the evening of October 19, 2017. Reported water depths in the vicinity of the last radar target varied between 348 ft and 1,812 ft.

Student pilot Information

Certificate:	Commercial	**Age:**	27,Male
Airplane Rating(s):	None	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	October 12, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	June 27, 2017
Flight Time:	186.8 hours (Total, all aircraft), 18.5 hours (Last 30 days, all aircraft)		

Flight instructor Information

Certificate:	Commercial; Flight instructor	**Age:**	25,Male
Airplane Rating(s):	None	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	January 5, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	630 hours (Total, all aircraft)		

Flight Instructor

The flight instructor, age 24, held a commercial pilot certificate with rotorcraft-helicopter and instrument helicopter ratings. In addition, he held a flight instructor certificate with rotorcraft-helicopter and instrument-helicopter ratings. The flight instructor was issued a second-class FAA medical certificate on January 5, 2017, with the limitation, "must wear corrective lenses." On the application for that medical certificate, the flight instructor reported a total flight experience of 630 hours, of which 300 hours were in the previous 6 months.

Pilot Receiving Instruction

The pilot receiving instruction, age 27, held a commercial pilot certificate with a rotorcraft-helicopter rating. He held a second-class FAA airman medical certificate that was issued on June 2, 2017, with the limitation, "must wear corrective lenses." On the application for that medical certificate, the pilot

reported a total flight experience of 139 hours.

Review of the pilot's flight training records revealed that, as of the most recent entry, dated October 12, 2017, he had accumulated a total of 186.9 hours of flight experience, of which 18.5 hours were in the previous 30 days.

Aircraft and Owner/Operator Information

Aircraft Make:	ROBINSON HELICOPTER	**Registration:**	N820DF
Model/Series:	R44 UNDESIGNAT	**Aircraft Category:**	Helicopter
Year of Manufacture:	2002	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1164
Landing Gear Type:	N/A; Skid	**Seats:**	4
Date/Type of Last Inspection:	September 28, 2017 100 hour	**Certified Max Gross Wt.:**	2500 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	4209.2 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	Installed, not activated	**Engine Model/Series:**	O-540-F1BF
Registered Owner:	STASYS AVIATION LEASING LLC	**Rated Power:**	250 Horsepower
Operator:	Mauna Loa Helicopters	**Operating Certificate(s) Held:**	Pilot school (141)

The accident helicopter was a Robinson R44 II, four-place, two-bladed, single main rotor, single-engine helicopter with skid-type landing gear. The primary structure was welded steel tubing and riveted aluminum. The tailboom was a semi-monocoque structure consisting of an aluminum skin. The helicopter was equipped with a Lycoming IO-540-F1B5 engine, rated at 260 horsepower; however, according to the helicopter's type certificate, the de-rated engine had a 5-minute takeoff rating of 245 horsepower and a maximum continuous rating of 205 horsepower. The helicopter was certified for day and night visual flight rules operations only.

Review of the airframe and engine logbooks revealed that the most recent annual inspection was completed on September 28, 2017, at an airframe total time of 4,209 hours and an engine total time since major overhaul of 2,009.2 hours.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	PHMK,443 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	05:54 Local	**Direction from Accident Site:**	142°
Lowest Cloud Condition:	Few / 3500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	13 knots / 24 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	40°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	24°C / 19°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Honolulu, HI (PHNL)	**Type of Flight Plan Filed:**	IFR
Destination:	Honolulu, HI (PHNL)	**Type of Clearance:**	IFR
Departure Time:		**Type of Airspace:**	Class G

At 1854, the recorded weather conditions at PHMK, located 6.3 miles southeast of the last radar target, included wind from 030° at 8 knots gusting to 21 knots, 10 statute miles visibility, light rain, few clouds at 3,300 ft above ground level (agl), a broken cloud ceiling at 6,000 ft agl, a broken cloud layer at 7,000 ft agl, temperature 24°C, dew point 20°C, and an altimeter setting of 30.04 inches of mercury.

The closest National Weather Service (NWS) Weather Surveillance Radar-1988, Doppler (WSR-88D) to the accident site was the Molokai, Hawaii, radar (PHMO), which was located 6 nm south-southwest of the accident site at an elevation of 1,363 ft. The WSR-88D captured base reflectivity imagery at 1917 and 1918 (shown in figures 1 and 2, respectively; the black line shows the helicopter's flight path). The imagery depicts moderate-to-heavy values of reflectivity within the vicinity of the last radar target. Rain showers and convective clouds produce outflow boundaries and gust fronts throughout their life cycle. An outflow boundary or gust front can create an environment favorable for unexpected changes in wind direction and speed. There were no lightning strikes in the vicinity of the last radar target around the time of the accident.

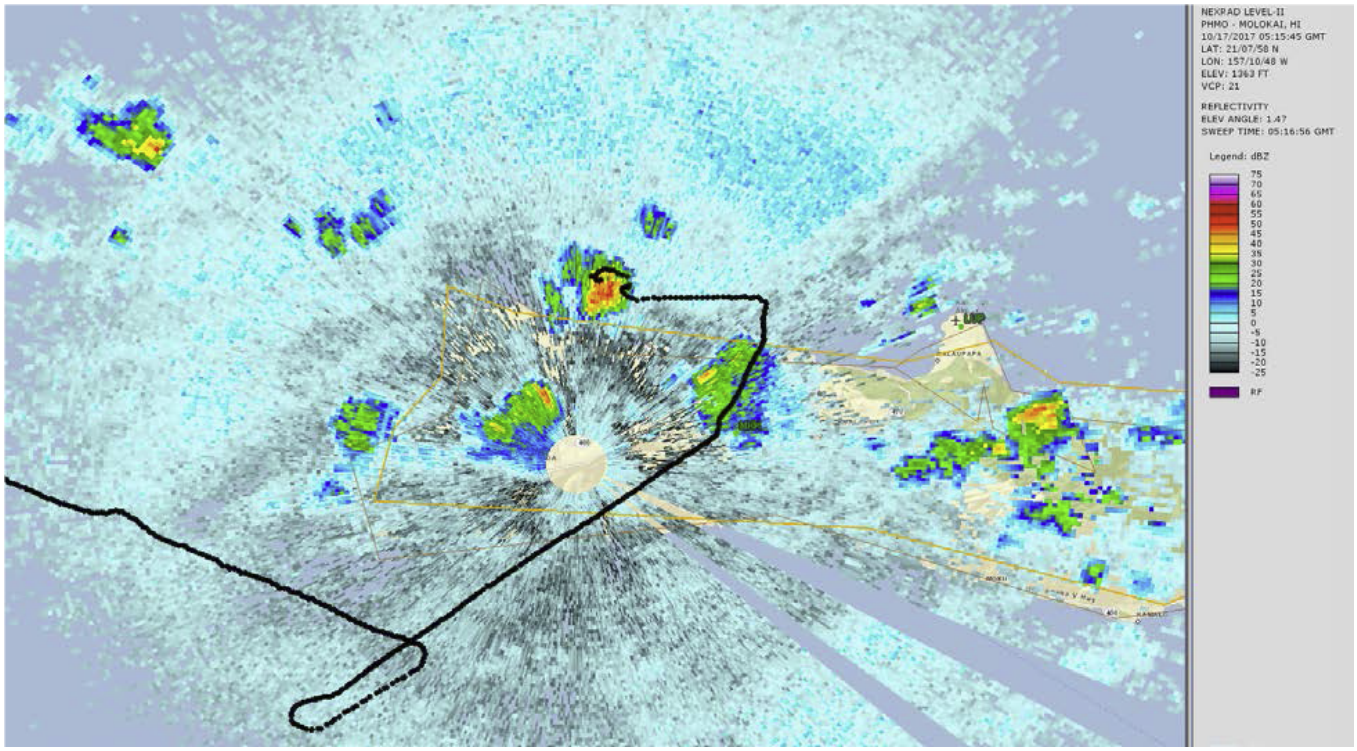

Figure 1: WSR-88D base reflectivity imagery at 1917

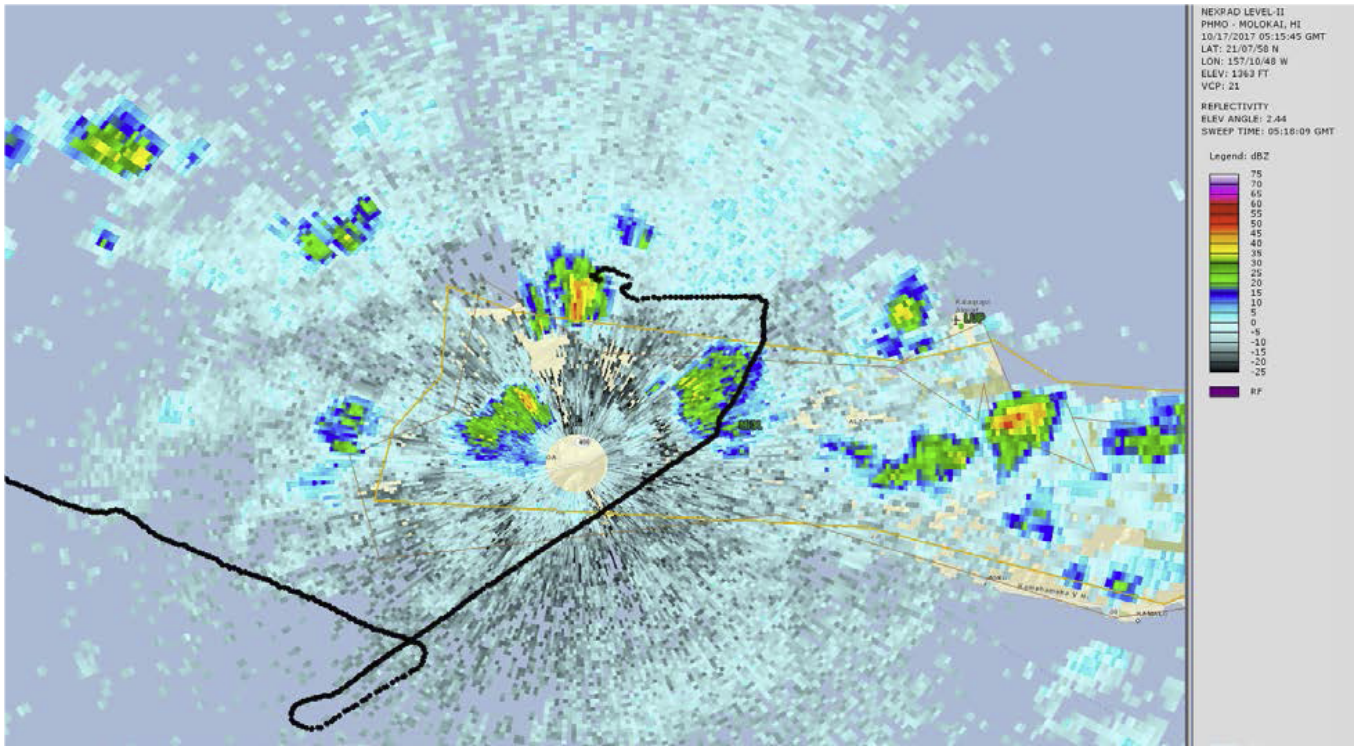

Figure 2: WSR-88D base reflectivity imagery at 1918.

The NWS office in Honolulu, Hawaii, issued an Area Forecast Discussion (AFD) at 1600, which was the closest AFD to the accident time. The aviation section of the AFD discussed that the trade winds would bring strong gusty northeast winds; AIRMET Tango was valid for temporary moderate turbulence. Scattered rain showers were forecast to continue through the day with reduced ceilings and visibility in the showers.

A search of official weather briefing sources revealed that neither pilot requested an official weather briefing from Leidos or DUATS; however, one of the pilots requested ForeFlight weather information at 1803. The weather information from ForeFlight contained the most recent METARs, AIRMETs, PIREPs, Area Forecast, TAFs, and Winds Aloft Forecast. It is unknown if either pilot checked any additional weather information before or during the accident flight.

For further meteorological information, see the weather study in the public docket for this investigation.

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	21.222778,-157.153335(est)

A private company hired by an individual to locate the helicopter reported that, in October 2018, they initially located the wreckage submerged about 2 miles offshore of Molokai at a depth of 298 ft. A representative from the company reported that they recovered a portion of the wreckage on January 24, 2019.

Review of video recordings from an underwater remotely-operated vehicle showed that the fuselage was severely fragmented and partially embedded within the ocean floor. Both main rotor blades remained attached to the hub, which remained attached to the drive shaft. Both main rotor blades appeared to be straight with visible damage to the tip of one blade. The main rotor pitch link on one blade remained attached to the blade and swashplate, the other was not visible. The main rotor drive shaft was bowed on the lower end. The tailboom was impact damaged and the tail rotor gearbox was separated. The tail rotor drive shaft remained inside the tailcone. The tail rotor drive shaft was disconnected about 10 inches aft of the intermediate flex coupling and appeared angular and jagged. The intermediate flex coupling was not bent or distorted. No visible damage to the grooves of the upper sheave were observed. The forward flex coupling was disconnected/fractured from the clutch shaft. The skid assemblies were separated. Portions of the fuel system, cyclic, and collective controls were not observed.

The recovered airframe components included the tail rotor gearbox, tail rotor blades, main rotor flight control jack shaft, tail rotor pedals including one removable pedal, several sections of interior panels, one section of aft left door frame (including a seatbelt), one forward seatbelt shoulder harness, all three main rotor flight control servos, hydraulic reservoir housing, several small sections of frame tubing, a small section of tail rotor flight control tubes, several small sections of main rotor gearbox housing, main rotor gearbox driveshaft bearing race, several instruments (one unidentified, compass housing, portion of the directional gyro), the warning light control box, a short section of fuel line with a portion of the fuel valve attached, a portion of the fuel cross-over fuel line, two landing light housings, a short section of a wire bundle, a section of the tail rotor guard, one V belt, and one life vest.

One forward hydraulic servo was separated from its mount. The other forward servo remained attached to the mount; however, the mount was separated from the airframe. The aft servo was separated from the airframe and was severely bent (in excess of 120°). None of the servos could be actuated by hand. The jackshaft was separated from its mount.

The tail rotor assembly was recovered separately from the airframe. The pilot's side right pedal was fractured at the bearing block. The pedal was recovered separately. The pilot's side left pedal pip/quick release pin was found displaced from the adjustable pedal assembly and exhibited no damage or bending. No damage was observed to the pedal pin holes.

The tail rotor gearbox was separated from the tailcone. The mounting flanges on the gearbox, along with a portion of bulkhead, were fractured and exhibited signatures consistent with overload. No additional damage was noted to the gearbox. The input and output shafts rotated more than 360° by hand with no anomalies noted. Blue oil was observed in the gearbox sight gauge. The chip detector revealed no evidence of any metallic chips. The output shaft was straight. The tail rotor pitch control would not move by hand. Both tail rotor blades were bent outward 90° near the blade root, with overload fractures in the area of the bends. One blade exhibited leading edge impact damage and the tip cap was missing. The aft flex coupling was disconnected at the flex plate ears. The remaining yoke ears on the input shaft were bent 45°. The mounting hardware remained secure.

The main rotor gearbox housing exhibited angular and jagged fracture surfaces. There was no evidence of any mechanical damage to the recovered inside areas of the main rotor gearbox housing.

The airframe tube sections exhibited overload signatures on all the fracture surfaces and were bent/distorted. The section of the aft rear doorframe exhibited severe wrinkling along with overload signatures on all fracture surfaces.

Portions of the airframe that remained attached to the engine included the horizontal firewall, small portions of the vertical firewall, portions of the upper frame tubes, portions of the main rotor gearbox housing, and small portions of interior components. Portions of the vertical firewall and lower airframe tubes were hydro-formed tightly around the aft portion of the engine (engine is installed rear facing forward). The forward portion of the upper frame was collapsed downward and aft. The aft portion of the upper frame had a dent in the center crosstube adjacent to the clutch with no rotational scoring observed. The horizontal firewall was dented and distorted throughout. Puncture marks were observed adjacent to the forward flex plate with no apparent rotational signatures. The oil cooler and cooling panels did not exhibit any signatures of contact with the starter ring gear.

Examination of the recovered engine revealed that the right magneto was separated and the alternator, entire bottom plenum, carburetor, induction pipes (partially displaced), and exhaust system were separated. The engine remained attached to the engine mount structure along with portions of the upper frame and horizontal firewall. All six cylinders remained attached. The cooling fan and lower sheave remained attached to the engine crankshaft. The upper spark plugs were removed. The crankshaft would not rotate freely.

Internal examination of each cylinder using a lighted borescope revealed varying degrees of corrosion, ocean byproducts, and sea life inside. No evidence of any foreign object ingestion was observed within the cylinder combustion chamber. The rocker box covers were removed and the rocker arm areas were cleaned using compressed air. All intake and exhaust rocker arms remained in place on each cylinder. All of the intake and exhaust pushrods were intact and impact damaged. The intake and exhaust valve springs were intact on each cylinder. The No. 2 cylinder hold-down nuts were removed. Despite numerous attempts utilizing various hand tools, the cylinder could not be removed.

Holes were drilled in various locations along the top part of the engine crankcase in line with the internal rotational plane of each connecting rod/cylinder. The crankcase was examined internally using a lighted borescope. The crankshaft, camshaft, and connecting rods were observed intact and undamaged. A significant amount of corrosion, ocean byproducts, and sea life was observed within the crankcase. No evidence of any mechanical damage or heat distress was observed throughout the internal area of the engine.

The accessory case was removed and examined. The internal areas of the accessory case exhibited varying degrees of corrosion, ocean byproducts, and sea life. The crankshaft gear, dowel pin and bolt were intact and secure. The accessory gears were intact and exhibited a significant amount of corrosion.

For further information, see the Video, Airframe, and Engine Examination Summary report within the public docket.

Administrative Information

Investigator In Charge (IIC):	Cawthra, Joshua
Additional Participating Persons:	Joseph Monfort; Federal Aviation Administration; Honolulu, HI Thom Webster; Robinson Helicopter Company; Torrance, CA Mark Platt; Lycoming Engines; Williamsport, PA
Original Publish Date:	November 6, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96202