Aviation Investigation Final Report

Location:	Fossil, Oregon	**Accident Number:**	WPR10FA012
Date & Time:	October 12, 2009, 08:50 Local	**Registration:**	N527SH
Aircraft:	MCDONNELL DOUGLAS HELI CO 369FF	**Aircraft Damage:**	Substantial
Defining Event:	Collision with terr/obj (non-CFIT)	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

The pilot of the helicopter was pulling a rope along a line of wood power poles, and placing the rope within the lowest traveler (pulley) attached to each power pole. The placement of the rope into the traveler required maneuvering the helicopter in close proximity to the pole, while the rope was attached to a long-line that was shorter than the distance from the top of the pole to the traveler that the rope was being placed in. The pilot had already placed the rope in the traveler on the first pole of the line, and had just completed the placement of the rope into the traveler on the second pole, when he began to maneuver the helicopter in order to proceed to the next pole. At the beginning of that maneuver, the pilot inadvertently allowed the helicopter to come close enough to the pole that he had just finished working on for its main rotor blades to come in contact with the pole. Immediately thereafter, all five of the main rotor blades separated from the helicopter, whereupon the helicopter's tail boom separated from its fuselage. The helicopter then fell to the down-sloping terrain near the base of the pole. No pre-accident anomalies were found with the helicopter's airframe, engine, or flight control system.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to maintain clearance from a power pole to which he was connecting wire-pulling ropes.

Findings

Personnel issues	Incorrect action performance - Pilot
Environmental issues	Pole - Contributed to outcome
Environmental issues	Pole - Response/compensation
Environmental issues	(general) - Effect on personnel

Factual Information

History of Flight

Maneuvering-hover	Collision with terr/obj (non-CFIT) (Defining event)

HISTORY OF FLIGHT

On October 12, 2009, about 0850 Pacific daylight time, a McDonnell-Douglas 369FF helicopter, N527SH, collided with a wood power pole about 18 miles southeast of Fossil, Oregon. The commercial pilot, who was the sole occupant, was killed in the accident, and the helicopter, which was owned and operated by Pacific Rim Helicopters LLC, sustained substantial damage to most of its structure. The 14 Code of Federal Regulations Part 133 external load long-line flight was being operated in visual meteorological conditions. The pilot's initial point of departure was Spray, Oregon, but he subsequently refueled the helicopter at a remote landing site, and then had been airborne again for about 20 minutes when the accident occurred. No flight plan had been filed.

According to witnesses, on the morning of the accident the pilot flew in support of installing travelers/pulleys on the wood power poles, so that later ropes could be pulled through these travelers. The plan was that once all the ropes were in place on the travelers, then they would be used by ground crews to pull power lines into place on the poles. After assisting with the traveler installation from about 0700 to about 0815, the pilot landed and refueled the helicopter. He then took off again, and began to string the ropes through the travelers around 0830. The poles the rope was being connected to were between 400 feet and 500 feet apart. The rope that was being pulled at the time of the accident was being placed in the lowest traveler on the pole, which was located 32.4 feet from the top of the pole. This traveler was connected directly to the pole, not on an extended cross-arm (see Image 6).

The pilot had already placed the rope in the traveler on the first pole of the run, and had just finished placing the rope in the traveler of the second pole when the accident occurred. There were a number of witnesses that heard the helicopter's main rotor blades come in contact with the power pole, but only one of them was looking at the helicopter at the moment it contacted the pole. Upon hearing the sound of the blade impact, all of the witnesses immediately looked toward the helicopter in time to see the remaining main rotor blades impacting the pole. The one witness that was looking directly at the helicopter as its main rotor blades initially came in contact with the pole had been watching the helicopter from the time it first approached the area around the pole. All the witnesses reported that they could see the rotor blades separating from the helicopter as each blade impacted the pole, and that immediately thereafter the helicopter rolled slightly to the right and fell to the ground. They also all agreed that the winds were calm at the time of the impact.

The closest witness was about 120 to 140 feet away from the helicopter. He had been holding onto the 5/16th inch diameter rope in order to provide some degree of tension on it. This added tension kept the rope from moving around, and helped the pilot pull the rope through the gates on the travelers. According to this witness, the rope had just clicked past the gate on the traveler, and the pilot appeared to turn his head to look toward the pole that he was going to go next. The pilot then looked back at the pole where he had just placed the rope, and then he appeared to look down at the mirror on his skid; which had been placed there to allow him to observe the area aft of the helicopter. It appeared to the witness that the pilot was just then starting to maneuver away from the pole, so he turned away from the helicopter in order to walk over to his truck so that he could make radio contact with the pilot on the truck-based radio as the pilot moved to the next pole. At that time the witness estimated that the helicopter fuselage was about 30 feet laterally from the pole, and that the bottom of the helicopter was about 10 feet higher than the pole.

About three to five seconds after he turned away, he heard what he described as a loud impact noise, whereupon he quickly turned his head back toward the helicopter. As he did so, he saw the helicopter's main rotor blades hitting the pole and coming off the helicopter one at a time. He said that he could clearly hear each blade hit the pole. According to this witness, he did not hear any unusual noises before he heard what he believed was the sound of the first rotor blade coming in contact with the pole. He said that prior to when the first blade impacted the pole, the sounds coming from the engine appeared normal. He reported that he did not hear any popping, coughing, or rpm change coming from the engine prior to the impact. He said that what he did hear was what he thought was the engine rpm beginning to wind down after all the blades impacted the pole.

This witness further stated that when he first looked back at the helicopter after hearing the first impact noise, the long-line that was pulling the rope was still attached to the helicopter. He said that he was aware that after the accident the long-line was found released from the helicopter and laying next to it, but he said he did see it at the moment of release.

Another witness was about 800 to 900 feet away, helping to get travelers set up on the power poles further down the line that the helicopter was working. He momentarily paused from what he was doing, and looked back at the helicopter just as it was laying the rope onto the traveler gate. He then saw the helicopter descend, and watched as the downward force created by the descent pulled the rope past the traveler gate. He then saw the helicopter climb back up a few feet, so he went back to what he was doing because he assumed the pilot was then starting to move on to the next pole. Soon after he turned away, he heard a "funny sound," that he described as kind of a "woosh." He then quickly looked back toward the helicopter, which was already making contact with the pole. Almost immediately thereafter the helicopter fell to the ground.

This witness said that he did not notice any change in the sound of the engine rpm, nor did he hear any loud pops or bangs prior to hearing the "woosh" sound. He also said that he felt that only about one second had elapsed between the time he heard the "woosh" and when he was

looking directly at the helicopter; which was already in contact with the pole.

A third witness was about 800 to 900 feet away at the spool from which the rope was being fed out. He was responsible for making sure that there were no snags as the rope unwound from the spool, and to operate the spool clutch if necessary (which it was not during this operation). Since his primary focus was on the spool, he only occasionally looked at the helicopter. He was not looking at the helicopter at the moment that it came in contact with the pole, but he did hear a loud "bang or pop." He therefore looked very quickly toward the helicopter, whereupon he saw that it was already in contact with the pole, and its blades were coming off. He had not heard any unusual noises prior to the loud bang or pop, and he did not notice whether the long line was still attached or not.

A fourth witness was about 800 feet away from the pole, and was positioned on a paved road to stop any traffic that approached during that part of the pull operation. This witness said that he was watching the helicopter almost the whole time. He watched the pilot place the rope onto the traveler on the first pole of the run, and then watched him as he moved on to the second pole. Because the pole was in a direct line between the witness and the helicopter, the witness could not tell what the lateral distance was between the helicopter and the pole. He said that the helicopter was only slightly above the top of the pole, but that his position was no different than at other poles he had seen him work near. From the distance he was at, he could not tell when the rope went into the traveler, but during the process he saw the helicopter rotate slowly counter-clockwise about 20 degrees, and slowly descend to a level where the main rotor blades came in contact with the pole. He said that the rate of turn and rate if descent were consistent with the other maneuvers he had seen the pilot make, and that the movements appeared to him to be under control and at a normal rate.

He said that as the first main rotor blade came in contact with the pole it made a very loud and sharp "crack" that sounded like a large piece of wood snapping. He saw the tail rotor come off the helicopter as the main rotor blades were coming off, and then the helicopter rolled to the right and fell to the ground. He also stated that he did not hear any change in the engine sound, or any bang or pop prior to the blades coming in contact with the pole. He felt that all of the helicopter's movements were consistent with what he had seen before, except for the fact that the blades contacted the pole. He was aware that that the witness nearest the pole was applying a small amount of tension to the rope, and stated that the tension was necessary because of the size of the rope and the force required to get it past some of the stiffer gates.

PERSONNEL INFORMATION

The 37 year old pilot held a commercial pilot certificate with certified flight instructor rating (CFI). He was rated in helicopters, but not airplanes. He did not hold an instrument rating. His last FAA airman's medical, a class 2, was completed on May 6, 2009. Of his 1,378 total flying hours, 1,156 were in the same make and model as the accident helicopter.

AIRCRAFT INFORMATION

The accident aircraft was a McDonnell Douglas 369FF helicopter, with a Rolls-Royce 250-C30S turboshaft engine. The installed engine (SN: CAE-890352S) was a loaner, which had been installed on July 30, 2009, while engine SN: 900076 was being overhauled at Premier Turbine. The loaner engine had been installed 102.4 hours prior to the accident. The helicopter's total at the time of the accident was 1,883.4 hours.

METEOROLOGICAL INFORMATON

The accident took place during daylight hours, under clear skies and calm wind conditions. The temperature was about 35 degrees Fahrenheit.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed by the office of the Oregon State Medical Examiner, and the cause of death was determined to be, "Head and Neck Injuries."

The Federal Aviation Administration's (FAA's) Civil Aeromedical Institute (CAMI) performed a forensic toxicological examination on specimens taken from the pilot, and the results were negative for carbon monoxide and cyanide in the blood, ethanol in the vitreous, and drugs in the urine.

WRECKAGE AND IMPACT INFORMATION

After impacting the pole, the helicopter fell to the ground on a rocky dirt slope of about 30 degrees. It came to rest on its right side, about 30 feet down-slope from the power pole. All five main rotor blades had separated from the hub. Four of the blades (yellow, green, white, and blue) had separated from the rotor hub at their roots (inboard of the pitch housings), and their respective pitch housing units were still attached to each of the individual blades. One blade (red) separated about a foot outboard of the root fitting, and its pitch housing remained attached to the hub. In addition to its separation just outboard of the root fitting, the red blade was separated again about mid-span. The blue blade had a second separation just outboard of the root fitting doubler, and the green blade had a second separation just inboard of station 142. The blue blade had a bolt from the power pole hardware bent around its leading edge. The bolt, which was straight when installed on the pole, had been reshaped in the form of a "J" due to the force of the blade impact. All of the blades showed significant impact damage, and the blade tip weights had separated from each of the five blades.

The tail boom had separated from the fuselage just aft of the tail boom attach joint, and the portion of the tail boom aft of station 220, to include the vertical and horizontal stabilizers and the tail rotor, had separated from the tail boom structure forward of that station. The forward portion of the tail boom had come to rest against a barbed wire fence about 20 feet down-slope of the fuselage, and the aft portion of the tail boom had come to rest about 15 feet

down-slope of the forward portion.

The long-line was found released from its side-hook, with the ball-hook lying less than 10 feet down-slope from the base of the power pole. The line's side-hook attachment eye was lying further down-slope near the helicopters main rotor hub.

After being removed from the accident site, the wreckage was taken to the facilities of AvTech Services, in Maple Valley, Washington, for further teardown and inspection. There it was determined that the fuselage structure had sustained significant structural impact damage. The canopy frame and all canopy glass had separated from the main fuselage. The battery box structure that had been mounted in the front part of the canopy frame had also separated. The right side of the A-frame structure was distorted from waterline 34.5 to the mast support structure, with the associated skins and frames being severely wrinkled and crushed. The instrument panel had been torn from the instrument mounting pedestal at station 44.65, and the panel remained attached to the rest of the structure only through electrical wires and cables. The seatbelt webbing and attachments remained intact, except where the webbing was cut while removing the pilot. The inertial reel system was checked, and functioned properly. The vertical frame of the pilot's seat box pan was deformed at station 64.37, and the left cyclic longitudinal torque tube was broken near the center control bracket, allowing the cyclic control tube to fall forward to a point where it rested upon the cabin floor (note: the cargo hook release button is mounted on the cyclic control handle, and the manual cargo hook emergency release lever is attached to the cyclic control tube so that it sits just forward of the control handle). Both the left and right collective control sticks were broken near their base, and the left collective switch housing was broken where it attaches to the collective stick. The cyclic and collective main rotor controls were traced from under the seat, through the bellcranks, pitch links, swashplates, to the main rotor hub, with no pre-impact discrepancies noted. All fractures within the system appeared to be consistent with overload failures.

The main rotor transmission was able to be rotated freely by hand, and the main rotor hub rotated within the main rotor transmission, which is indicative of the main rotor driveshaft being intact. Due to the broken engine mounts and resultant shifting of the engine position, the engine to transmission driveshaft was fractured at the lower flex coupling. The main and tail rotor transmissions contained lubricating oil, and the chip detector on the main rotor transmission was inspected with no chips found. The tail rotor transmission rotated freely, and the over-running clutch functioned correctly. The tail rotor drive shaft was fractured in two places; one of which was near station 220, and the other near the forward tail rotor drive shaft damper.

It was further determined that there were impact marks on the tail boom near station 220 that were consistent with a main rotor blade strike(s). The horizontal stabilizer had been torn from the top section of the vertical stabilizer about one foot below the horizontal stabilizer attachment. The right horizontal stabilizer spars were severely damaged just outboard of their vertical stabilizer attach fitting, and the right horizontal stabilizer was bent downward about 75 degrees. Except for leading edge impact damage, the left horizontal stabilizer remained

undamaged. The top portion of the vertical stabilizer leading edge, as well as the majority of the right horizontal stabilizer leading edge exhibited significant impact damage. The tail rotor blades were undamaged, and the tail rotor swashplates, rotor fork, elastomeric bearings, and pitch change links were all free to function properly.

The engine had been dislodged from its mounting position by the impact, and both the left and right engine mounts were broken. The oil lines and engine controls had been damaged due to engine movement at impact. The engine was examined externally, and to a limited degree internally through the intake and exhaust openings. No pre-impact discrepancies were noted. The engine was then removed and shipped in the custody of the FAA to the Rolls-Royce facility at Indianapolis, Indiana. Once there, it underwent an FAA monitored and directed teardown inspection. That teardown inspection revealed that both chip plugs were clear of debris, except for what appeared to be a small piece of carbon in the upper plug. The N1 and N2 drive trains and the accessory gearbox rotated freely, with no binding, which is consistent with both drive trains being free and continuous. The engines pneumatic system was pressurized with 55 PSI of air, and no leaks were noted.

The compressor removal and disassembly revealed visual damage to the compressor blades consistent with ingestion of debris during operation. A number of blades had leading edge dents and dings, with damage penetrating about one-third of the chord of the blade. There were pieces of metallic debris still attached to the leading edge of a number of the compressor blades. The outboard edge (tips) of the compressor blades where purple in color, which is indicative of them rubbing on the compressor shroud during the impact sequence. On the back side of the compressor surface there was scarring that indicated the compressor contacted its aft support during the impact sequence; but at the time of the inspection the compressor rotated freely.

During the teardown inspection the turbine was removed, and no visual damage was noted to the gas producer or power turbine supports, turbine wheels, or turbine nozzles. There were no indications of circumferential scraping of the turbine case, and all bearings were well lubricated. There was some evidence of coking and wet oil on the disk and nozzles consistent with post-operation rollover. The N1 and N2 shafting was well lubricated, intact, and undamaged, and rotated freely through to the accessory gearbox.

The disassembly and inspection of the combustion case revealed no internal damage to the combustion liner, with only minor damage to the outer combustion case. There was some debris noted on the combustion liner aft end. The fuel nozzle displayed normal coking on its exterior, and disassembly revealed that the primary and secondary fuel orifices were clear and unobstructed. In addition, the fuel filter, fuel lines, and fuel nozzles contained varying degrees of a liquid that was consistent with the color and odor of jet fuel.

At the conclusion of the teardown and inspection, there had been no evidence found of any pre-impact anomaly or malfunction that would have kept the engine from producing rated power.

ADDITIONAL DATA AND INFORMATION

The helicopter's main rotor blades had been tracked and balanced on November 11, 2009. Reportedly, because of a main rotor-induced vibration, the main rotor blades were again balanced and tracked on October 1, 2010. When the helicopter was flown from Modesto, California to Condon, Oregon, on October 5, 2010, there was still a vibration present at speeds above 70 knots. Therefore, in order to minimize the vibration, the pilot, who was the same individual who was flying the helicopter at the time of the accident, did not exceed 80 knots during the Modesto to Condon flight. On October 6, 2009, the helicopter was flown from Condon to the area where the power pole job was located (approximately 30 miles). During that flight, and for the rest of that day's work associated with the power poles, the accident pilot was accompanied by a more experienced pilot who provided oversight and assistance. According to the more experienced pilot, during the trip to the work site, during which the airspeed was kept below 70 knots, and throughout the day of work, during which the airspeed did not go over 40 knots, he did not detect any rotor-induced vibration, nor any indication of an issue with the flight controls.

The helicopter's total time at the time of the accident was 1883.4 hours (Hobbs 674.6). Although not all the maintenance records were able to be located, based on the ones provided, the most recent maintenance was replacement of the overrunning clutch on 9/20/2009 at 1793.2 hours (Hobbs 584.4). The last annual inspection was completed on 3/20/2009 at 1355.5 hours. The last 100 hour inspection was performed on 6/14/2009 at 1729.2 hours. A review of the Manufacturer's Service Bulletin and Airworthiness Directive listing showed the helicopter to be in compliance.

The long-line rig that was being used to pull the rope and place it in the travelers was made up of the line itself, which was 25 feet long, and a weighted ball-hook, which was two feet long (for a total length of 27 feet). The line weighed eight pounds, and the ball-hook weighed 112 pounds (for a total weight of 120 pounds). According to the contractor who was installing and rigging the poles, the diameter of the poles at their top was 14 inches, and the distance from the top of the pole to the traveler for the neutral wire was 32.4 feet (a distance that was 5.4 feet greater than the length of the long-line rig).

The helicopter was released to Matt Teeuwen of Allianz Aviation Managers, on May 5, 2010. At the time of its release, the wreckage was located at AvTech Services in Maple Valley, Washington.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	37,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	May 6, 2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 18, 2009
Flight Time:	1378 hours (Total, all aircraft), 1156 hours (Total, this make and model), 1259 hours (Pilot In Command, all aircraft), 146 hours (Last 90 days, all aircraft), 102 hours (Last 30 days, all aircraft), 9 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	MCDONNELL DOUGLAS HELICO	**Registration:**	N527SH
Model/Series:	369FF	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Utility	**Serial Number:**	0064FF
Landing Gear Type:	High skid	**Seats:**	5
Date/Type of Last Inspection:	June 15, 2009 100 hour	**Certified Max Gross Wt.:**	3100 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:	1883 Hrs at time of accident	**Engine Manufacturer:**	Rolls-Royce
ELT:	Installed, not activated	**Engine Model/Series:**	250-C30S
Registered Owner:	PACIFIC RIM HELICOPTERS LLC	**Rated Power:**	650 Horsepower
Operator:	PACIFIC RIM HELICOPTERS LLC	**Operating Certificate(s) Held:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	2°C / -5°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Spray, OR	**Type of Flight Plan Filed:**	None
Destination:	Fossil, OR	**Type of Clearance:**	None
Departure Time:	08:30 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	44.853054,-119.937774(est)

Administrative Information

Investigator In Charge (IIC):	Anderson, Orrin
Additional Participating Persons:	Bruce Stephanson; Portland FSDO; Hillsboro, OR
Original Publish Date:	October 21, 2010
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=74886