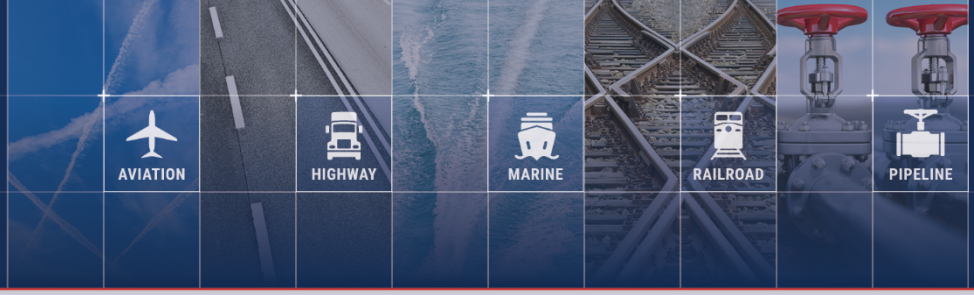

Aviation Investigation Final Report

Location:	San Clemente, California	**Accident Number:**	WPR09GA119
Date & Time:	February 19, 2009, 19:30 Local	**Registration:**	N608BP
Aircraft:	McDonnell Douglas Helicopter 600	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 Serious, 1 Minor
Flight Conducted Under:	Public aircraft		

Analysis

During cruise flight the helicopter experienced a loss of engine power. The pilot performed an autorotation, maneuvering the helicopter to avoid obstacles. The helicopter sustained substantial damage after landing hard, semi-submerged in the surf zone of a beach. During the landing sequence, a main rotor blade made contact with the tail boom and the helicopter sustained crush damage to the lower fuselage. Post accident examination of the airframe did not reveal evidence of any failure or malfunction. Examination of the engine revealed a failure of the number two bearing, resulting in a subsequent failure of the engine's gas generator and power turbine sections. Examination of the bearing revealed signatures consistent with the inner and outer bearing races experiencing misalignment. The misalignment resulted in the associated balls becoming mechanically locked against the ball cage, leading to raceway compromise, heat damage, and bearing failure. As a result of this accident, and other in-service wear issues related to the number two bearing, the engine manufacturer has embarked on a bearing redesign process for this engine series.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Failure of the engine's number two bearing during cruise flight, which resulted in a loss of engine power.

Findings

Aircraft	(general) - Failure

Factual Information

History of Flight

Enroute-cruise	Powerplant sys/comp malf/fail
Enroute-cruise	Loss of engine power (total) (Defining event)
Emergency descent	Off-field or emergency landing
Autorotation	Hard landing

HISTORY OF FLIGHT

On February 19, 2009, about 1930 Pacific standard time, a McDonnell Douglas Helicopter 600N, N608BP, force landed hard on a beach in San Clemente, California, as the result of an engine failure encountered during cruise flight. The airline transport pilot and commercial copilot received serious injuries. The passenger received minor injuries. The helicopter, which was operated by United States Customs and Border Protection (USCBP), sustained substantial damage. Night visual meteorological conditions prevailed for the public-use flight, and a company visual flight rules (VFR) flight plan was filed. The helicopter departed from Long Beach Airport (Daugherty Field), Long Beach, California, about 1900, with an intended destination of Brown Field Municipal Airport, San Diego, California.

The helicopter departed Long Beach with the commercially rated pilot at the controls, and seated in the left seat. Approximately 30 minutes into the flight, at an altitude of about 1,500 feet mean sea level (msl), the 'ECU Degrade' light illuminated on the helicopter caution panel. The airline transport pilot, who was positioned in the right seat, then took over control of the helicopter. A few seconds later the occupants heard an "explosion" coming from the rear of the helicopter, followed by multiple illuminations of lights on the instrument, warning, and caution panels. The passenger, located in the rear seat, then heard a sound similar to the engine increasing in speed and observed flames emitting from the rear of the helicopter.

The pilot performed an autorotation with the intention of landing on a parking lot. As the helicopter approached the lot, he observed power lines and the domes of the San Onofre Nuclear Generating Station; he then elected to turn the helicopter 180 degrees, and land on an adjacent beach. The helicopter landed hard semi-submerged in the surf zone of the beach. During the landing sequence a main rotor blade made contact with, and severed, the tail boom. Additionally, the lower fuselage and skids sustained crush damage.

PERSONNEL INFORMATION

Pilot

A review of the Federal Aviatin Administration (FAA) airman records revealed that the 47-year-

old pilot held an airline transport pilot certificate with ratings for airplane multiengine land, and a commercial pilot certificate with ratings for airplane single-engine land, helicopter, and instrument helicopter. The pilot held a flight instructor certificate with ratings for helicopter, airplane single-engine land, airplane multiengine land, instrument airplane, and instrument helicopter. According to the USCBP his total time in all aircraft was 6,000 hours, with 1,370 hours in the accident helicopter make and model.

Copilot

A review of the FAA airman records revealed that the copilot held a commercial pilot certificate with ratings for airplane single-engine land, helicopter, instrument airplane, and instrument helicopter. According to the USCBP his total time in all aircraft was 1,200 hours, with 18 hours in the accident helicopter make and model.

AIRCRAFT INFORMATION

Airframe

The no tail rotor (NOTAR) helicopter, serial number RN037, was manufactured in 1998. A review of the helicopter's maintenance logbooks revealed that it had accumulated a total airframe time of 3,571 hours at the time of the accident, which occurred 74 flight hours after its last 100-hour inspection in October 2008. The maintenance logbooks indicated that the helicopter was in compliance with all applicable service bulletins and airworthiness directives.

Engine

The engine is located in the aft section of the fuselage behind the main cabin. The design of the helicopter is such that the engine is mounted forward facing, at an angle of about 45 degrees relative to the longitudinal plane of the helicopter.

The helicopter was equipped with a Rolls-Royce 250-C47M gas turbine engine. The engine and its associated gearbox were overhauled in December 2005, and installed on the accident helicopter in May 2006. At the time of the overhaul, the engine and gearbox had accrued a total time in service of 2,278.9 hours. At the time of the accident, the engine and gearbox had accumulated 778.4 hours of total flight time since the overhaul. The last 150-hour inspection occurred in October 2008, 98.4 flight hours prior to the accident. The engine logbooks did not reflect any maintenance involving the separation of the engine and gearbox since its overhaul.

TESTS AND RESEARCH

Airframe

Examination of the airframe did not reveal any evidence of failure or malfunction.

Engine Control Unit

The Engine Control Unit (ECU) remained attached to the airframe and did not sustain obvious signs of damage. The unit was sent to the facilities of Goodrich Pump and Engine Control Systems (GPECS), Hartford, Connecticut. Data from the ECU was extracted under the supervision of the National Transportation Safety Board investigator-in-charge (IIC), and representatives from Rolls-Royce, USCBP, and MD Helicopters.

Data extraction, in part, revealed the following log:

Fault View: Last Engine Run Faults

Fault Name	Description
OSFlt	- Overspeed Fault
NpOSFlt	- Np Overspeed Fault
Np1Flt	- Np1 Fault
Np1RtFlt	- Np1 Rate Fault
Np2Flt	- Np2 Fault
Np2RtFlt	- Np2 Rate Fault
Np12Flt	- Np Hard Fault
MGTLmTOut	- MGT Limit Exceedance
MGTRLmTOut	- MGT Run Limit Exceedance for 12 seconds
SgFlag	- Surge Event Indicator
MGTFlt	- MGT Fault
MGTRgFlt	- MGT Range Fault
TempFlt	- MGT Temperature Fault
Al28Flt	- 28 Volt Alternator Fault
CPUHardFlt	- FADEC System Hard Fault
WDTHardFlt	- FADEC System Hard Fault

Engine

The engine was removed from the airframe, and examined at the Rolls-Royce facility in Indianapolis, Indiana. The examination was conducted under the supervision of the IIC, and representatives from Rolls-Royce, the FAA, USCBP, and MD Helicopters.

Inspection of the upper and lower engine chip detectors revealed the presence of metallic chips and flakes. The gas generator and power turbine drive trains could not be rotated manually.

During the examination, the accessory gearbox was separated from the engine. Further inspection revealed that the number two bearing retainer ring had become dislodged from its seat, and had come to rest against the oil delivery tube. The number two bearing was in place

within the housing; however, the majority of its separator cage was missing. The remaining sections of the cage were located within the bearing, which still retained its compliment of balls. The bearing, its oil delivery tube, and the surrounding areas appeared oil wetted.

Disassembly of the compressor section revealed rubbing in the area of the 'knee' around its full circumference. The associated number 1 bearing was in place and oil wetted.

Thermal damage was observed throughout the entire gas path. The damage began aft of the number 1 nozzle, compromising all of the turbine blades, turbine wheels, nozzles, and vanes.

Examination of the gas generator and power turbine shafting revealed them to be in the correct location and oil wetted.

Disassembly of the accessory gearbox revealed no significant damage to the gas generator or power turbine drive trains, both of which could be rotated by hand. Small metallic chips were observed throughout the gearbox casing, and all gears and internal surfaces were oil wetted. The remaining sections of the number two bearing cage were located within the gearbox housing.

Residual oil was noted throughout the lubrication system, and the external sump contained oil.

The number two bearing was further examined by the Rolls-Royce metallurgical department. The examination revealed that the bearing surfaces were dark in color and oil wetted. Extrusion deformation was noted on the shoulder of the aft inner ring shoulder and the forward outer ring shoulder; Rolls-Royce stated that this damage could indicate ball excursion. The remaining fragments of the ball separator exhibited fracture features along some of their surfaces, which the report stated were consistent with fatigue. All sections of the bearing exhibited signs of heat distress. According to Rolls-Royce, semi-quantitative x-ray energy dispersive analysis determined that the material for the bearing’s outer ring, inner ring, separator, and balls met design specifications.

The report was reviewed by the NTSB Office of Research and Engineering, Materials Laboratory Division.

The engine logbooks revealed that the number two bearing was replaced in January 2002, 1,756 hours prior to the accident. According to the logbooks, the bearing was replaced as part of a disassembly following the engine experiencing a 'compressor stall/erosion.' The number two bearing was not replaced during the engine’s overhaul in December 2005.

The Rolls-Royce overhaul manual applicable to the engine series defines specific criteria for bearing inspection during overhaul. It additionally states, "Used bearings, if properly processed, will have a reliability equal to that of a new bearing in most applications."

ADDITIONAL INFORMATION

As a result of this accident, and other in-service wear issues related to the number two bearing, Rolls-Royce has embarked on a bearing redesign process for this engine series.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	47,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	June 5, 2008
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 7, 2008
Flight Time:	6000 hours (Total, all aircraft), 1370 hours (Total, this make and model), 4828 hours (Pilot In Command, all aircraft), 55 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial	**Age:**	37,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	April 17, 2008
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 7, 2008
Flight Time:	1200 hours (Total, all aircraft), 18 hours (Total, this make and model), 136 hours (Last 90 days, all aircraft), 36 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas Helicopter	**Registration:**	N608BP
Model/Series:	600 N	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	RN037
Landing Gear Type:	High skid	**Seats:**	4
Date/Type of Last Inspection:	October 14, 2008 100 hour	**Certified Max Gross Wt.:**	4100 lbs
Time Since Last Inspection:	74 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	3571 Hrs at time of accident	**Engine Manufacturer:**	Rolls Royce
ELT:	C91A installed, not activated	**Engine Model/Series:**	250-C47M
Registered Owner:	Department Of Homeland Security	**Rated Power:**	650 Horsepower
Operator:	United States Customs and Border Protection	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KNFG,78 ft msl	**Distance from Accident Site:**	13 Nautical Miles
Observation Time:	19:56 Local	**Direction from Accident Site:**	110°
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:	30.11 inches Hg	**Temperature/Dew Point:**	12°C / -5°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Long Beach, CA (LGB)	**Type of Flight Plan Filed:**	Company VFR
Destination:	San Diego, CA (SDM)	**Type of Clearance:**	VFR
Departure Time:	19:00 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	2 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Serious, 1 Minor	**Latitude, Longitude:**	32.36861,-117.554725(est)

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Patrick R Tierney; Federal Aviation Administration FSDO; San Diego, CA Geoffrey P Harned; United States Customs and Border Protection; Washington, DC David Riser; Rolls-Royce; Indianapolis, IN John Hobby; MD Helictopters; Mesa, AZ
Original Publish Date:	April 22, 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=73366