Aviation Investigation Final Report

Location:	Ship Shoal 208H, Gulf of America	**Accident Number:**	CEN13FA491
Date & Time:	August 13, 2013, 13:10 Local	**Registration:**	N53LP
Aircraft:	Bell 407	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	3 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The helicopter departed from an offshore oil platform with the pilot and two passengers onboard. The pilot reported that he heard a loud "bang" just after the turboshaft-powered helicopter lifted off. The low rotor rpm horn sounded, and the pilot subsequently maneuvered the helicopter for a forced water landing and deployed the float system. The helicopter sustained substantial damage when its main rotor blades impacted the water, which resulted in the engine and transmission separating from the helicopter. The three occupants were subsequently rescued from the helicopter by boat. The platform was venting methane gas on the day of the accident; the pilot was not informed about the vented gas.

Examination of the helicopter's engine revealed no preaccident mechanical malfunctions or failures that would have precluded normal operation. A review of data from the helicopter's engine monitoring system (EMS) revealed that, just after liftoff, the engine accelerated at an excessive rate while the full-authority digital electronic engine control system reduced the metered fuel to the engine. The data also revealed that an engine surge occurred followed by an engine flameout. The pilot's report that he heard a bang during takeoff and the EMS data are consistent with the engine experiencing a compressor surge due to the ingestion of vented methane gas.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The ingestion of vented methane gas into the helicopter's engine during takeoff, which caused an engine compressor surge that led to a total loss of engine power.

Findings

Aircraft	(general) - Failure
Environmental issues	(general) - Effect on equipment

Factual Information

History of Flight

Enroute	Loss of engine power (total) (Defining event)
Emergency descent	Ditching

HISTORY OF FLIGHT

On August 13, 2013, about 1310 central daylight time, a Bell 407 helicopter, N53LP, was ditched in the Gulf of Mexico, Louisiana, following a loss of engine power. The pilot and two passengers received minor injuries. The helicopter sustained substantial fuselage damaged during the ditching. The helicopter was registered to and operated by Panther Helicopters, Inc., under the provisions of 14 Code of Federal Regulations Part 135, as a passenger flight. Day visual flight rules (VFR) conditions prevailed for the flight, which did not operate on a flight plan. The flight originated from Ship Shoal (SS) 208H, an off-shore production platform in the Gulf of Mexico, and was destined for SS 209A in the Gulf of Mexico.

According to the pilot, he had flown a "routine day" in the Gulf of Mexico. The first flight of the day was from the Harry P. Williams Memorial Airport (PTN), near Patterson, Louisiana, to carry passengers to SS 108, SS 208H, and SS 215L. He picked up two passengers at SS 215L and flew to SS 209A for fueling service. He then flew to PTN, dropped off the passengers, received additional fuel, picked up passengers, and flew to SS 208H where he dropped off the passengers. The pilot flew the helicopter without passengers to SS 209A and shut down the helicopter there for about an hour. He received fuel at SS 209A and picked up one passenger then flew to PTN to drop off the passenger. He received more fuel at PTN, picked up one passenger there, dropped off that passenger at SS 100DA, and then flew without passengers SS 208H to pick up two passengers. The pilot indicated that the weather was clear and estimated that the wind was 160 to 200 degrees at 10 knots.

At SS 208H, the pilot loaded and briefed the two passengers for the return flight to PTN, made a radio call to SS 209A for permission to land to get fuel there. He ensured the passengers had their seatbelts on again and were ready for takeoff, increased the throttle to "FLY," performed the pre-takeoff checklist, and noted that all engine and transmission gauges were in their normal operating range and that no warning/caution lights were illuminated. The pilot brought the helicopter into a stationary hover in the middle of the helideck, reconfirmed all engine and transmission gauges were normal, noted the hover power was 70 percent, and made a left pedal turn into the wind and in a direction to avoid the flare boom. He hovered the helicopter to the edge of the helideck so the tail would clear the skirting and deck if the engine quit and increased collective to 75-percent torque to perform the platform takeoff.

The pilot applied forward cyclic to rotate and increase airspeed. As soon as the helicopter began to increase airspeed, the pilot heard an extremely loud "BANG." He estimated that 10 feet lateral distance existed between the pilot seat and the helideck skirting when the helicopter yawed left, the low-rotor horn sounded, and its light illuminated. The pilot moved the collective to its full down position to

preserve rotor rpm, applied forward cyclic to attempt to gain some forward airspeed, and activated the float system. The engine out and the engine control system warnings sounded. The pilot was unable to gain much forward airspeed due to the high rate of descent, so he leveled the helicopter to provide a level contact with water, and applied "full collective" to cushion the landing. When the rotor system stopped spinning, the pilot instructed the passengers to exit the helicopter. He smelled what he thought was an electrical fire, so he turned the battery switch off, which did not disconnect the battery. The pilot was "slightly pinned" in his seat by the instrument panel. He dislodged himself from the seat and exited through the passenger door because his door would not open. All three occupants stayed with the helicopter until they were rescued by a crew/supply boat.

Witnesses on the helideck saw the helicopter depart, and they heard a noise that one witness described as a shotgun report. They saw the helicopter descend and impact the water. The helicopter's main rotor blades impacted the water, and those blades, transmission, and engine subsequently separated from the airframe.

PERSONNEL INFORMATION

The pilot, age 30, held a commercial pilot certificate and a certified flight instructor certificate with rotorcraft-helicopter and instrument helicopter ratings. His most recent second-class medical certificate was issued on November 15, 2012, with a limitation for corrective lenses.

The pilot's last Airman Competency/Proficiency Check was accomplished on June 12, 2013.

According to the operator, the pilot had accrued a total of about 1,136 hours of flight time, including 133.8 hours as pilot-in-command in the Bell 407. He accumulated 128.6 and 74.4 hours of flight time in the Bell 407 in the 90 days and 30 days before the accident, respectively.

AIRCRAFT INFORMATION

N53LP was a 1998 Bell 407 helicopter with serial number 53319. The single-engine helicopter was powered by a Rolls-Royce model 250-C47B turbo shaft engine with serial number CAE 847345, which drove a four-bladed main rotor system and a two-bladed tail rotor. The engine had a takeoff rating of 674 shaft horsepower for five minutes and a rating of 630 shaft horsepower for continuous operations. The helicopter was configured to carry one pilot and six passengers. The operator reported its maximum gross weight was 5,250 pounds and that it weighed 4,345 pounds at the time of the accident.

According to the operator, the helicopter was maintained in accordance with a manufacturer's inspection program on a continuous basis. The helicopter's last inspection, a 300-hour progressive inspection to include event 1, was completed on August 8, 2013. The helicopter's total time at that inspection was 4,253.6 hours.

The Rolls Royce Model 250-C47B engine incorporates a Triumph Engine Control Systems model EMC-35R full authority digital electronic control (FADEC) system that electronically controls engine fuel flow via a hydro-mechanical unit (HMU) and electronic control unit (ECU).

The function of the FADEC system is to assist the pilot by controlling the engine rpm to maintain the rotor rpm as the aircraft maneuvers. At any time, the pilot may de-select the FADEC system and acquire complete control of engine fuel modulation (a back-up mode of operation).

The FADEC ECU contains two embedded processor systems that execute application-specific engine control software. The primary system operates by sensing the pilot-controlled collective twist-grip throttle position (Power Lever Angle [PLA]), as well as other engine sensor inputs, to determine the engine fuel flow requirements necessary to maintain efficient engine operation. The reversionary system is a second level of electronic fuel control governing that would be automatically switched to should certain fault conditions be detected in the primary system. Both the ECU primary and reversionary systems control an electric motor in the HMU that modulates fuel flow to the engine.

In addition, the FADEC ECU monitors engine condition and records and stores engine operating exceedances and system fault information in a non-volatile memory device in the ECU. For certain system failures, the FADEC systems will automatically de-select the FADEC operation and transition to back-up (pilot control) operation.

The HMU consists of a gearbox-mounted fuel pump, a motor driven fuel metering valve, a back-up fuel control system, a PLA input shaft, and feedback position sensors. The HMU contains components that send/receive electrical signals to/from the ECU as a part of the FADEC operation and is the point of fuel flow in the FADEC or back-up modes of operation.

METEOROLOGICAL INFORMATION

At 1250, the recorded weather 63 nautical miles and 12 degrees from the accident site, at the Houma-Terrebonne Airport, near Houma, Louisiana, was: wind 210 degrees at 8 knots; visibility 5 statute miles; present weather rain and mist; sky condition broken clouds at 3,400 feet; temperature 29 degrees C; dew point 33 degrees C; altimeter 30.04 inches of mercury.

AIRPORT INFORMATION

According to the Bureau of Safety and Environmental Enforcement, the Gulf of Mexico is divided into three primary subdivisions: Western Gulf of Mexico, Central Gulf of Mexico, and Eastern Gulf of Mexico. The three subdivisions are further divided into areas and blocks. The blocks are about 3 miles long and 3 miles wide and are used to reference oil/gas lease identification. There are over 2,600 offshore production platforms in the Gulf of Mexico region.

SS 208H is an offshore platform (latitude: 28 degrees 32 minutes north; longitude: 90 degrees 55 minutes west) about 74.5 nm southeast of Patterson, Louisiana. SS 208H features a single helideck (about 24 feet long and 24 feet wide) outlined by a painted red line and owner identification in the center.

SS 209A is an offshore platform (latitude: 28 degrees 31 minutes north; longitude: 90 degrees 52 minutes west) about 75.5 nm southeast of Patterson, Louisiana. SS 209A features a single helideck (approximately 40 feet long and 52 feet wide) outlined by a painted red line and owner identification in the center.

WRECKAGE AND IMPACT INFORMATION

The helicopter's tailcone remained attached to the fuselage and the engine and transmission had separated from the fuselage. Large components of the helicopter were recovered from the surface of the water and brought to shore. The engine was located underwater near the accident site. It was recovered

to a ship and also brought to shore. The transmission was not recovered. Images from the recovery showed that a float bag exhibited a puncture.

MEDICAL AND PATHOLOGICAL INFORMATION

Postaccident toxicological testing was performed on samples collected from the pilot. The results were negative for the tests performed.

TESTS AND RESEARCH

Under the supervision of the National Transportation Safety Board (NTSB) investigator-in-charge, the accident engine was examined and disassembled at Rolls Royce, near Indianapolis, Indiana, on November 6, 2013. The examination revealed that none of the eight engine bearings displayed any discoloration or signs consistent with thermal distress. The inner and outer spool shafts were intact. The high-pressure and low-pressure turbines were intact. Damage consistent with rotation of the centrifugal compressor on its impeller shroud was observed. Witness marks were present on the third and fourth stage side blade paths, which is consistent with blade rubbing. The gearbox exhibited no damage other than corrosion consistent with salt-water immersion. No obstructions were noted in the oil filter. The fuel and oil bypass indicators were not activated. The brazing on the diffuser flange was intact.

The helicopter's ECU, serial number: JG6ALK0255, was sent to the NTSB's Vehicle Recorder Division for downloading and decoding. The ECU exhibited damage consistent with impact forces.

A Triumph Engine Control Systems representative performed a data download and interpretation process (from the ECU non-volatile memory device) using Triumph hardware and software under the supervision of NTSB staff.

The aircraft accident-related information recovered, in part, included:

1. A confirmation of the reported engine power loss condition.
2. Prior to the power loss, the FADEC was operating normally.
3. Data analysis found that, with no change in related engine environmental operating parameters or loading condition, the engine momentarily operated at an abnormally high level as indicated by the following:
   - high engine torque,
   - a high rate of accelerating engine gas turbine condition,
   - increased engine gas temperature,
   - decreasing fuel flow command from the FADEC,
   - constant engine loading (collective pitch) and PLA command,
   - constant ambient pressure and temperature,
   - an engine surge condition.
4. As engine power increased abnormally over the span of approximately one second, fuel flow was reduced by the FADEC engine control logic
5. A torque sensor fault was recorded due to the abnormal fluctuations in engine torque during the event.
6. Within the next 1/2 second, the engine power dropped significantly and an engine flameout was detected.
7. The rotor system slowed, causing the loss of lift to the helicopter.

8. Over the next 4 seconds, an automatic engine relight sequence was performed and power to the rotor system was recovered

After the recovery of the accident data from the ECU, a functional test of the FADEC was performed in accordance with Triumph's standard ECU acceptance procedures; the FADEC passed the functional test.

The accident HMU, serial number JGALM0270, was inspected at Triumph. The HMU was damaged during the helicopter accident. Because the HMU had been submerged in deep water, a functional test on the unit was not performed. Physical inspections of the HMU components (after teardown) found no anomalies or irregularities in material condition.

A recovered section of the helicopter's fractured KAflex coupling, marked in ink with SKCD 3202-11, was sent to the NTSB Materials Laboratory for examination. A senior metallurgist examined the coupling using scanning electron microscope and optical devices and he produced Materials Laboratory Report No. 14-046. The examination revealed that the coupling's flex frame was fractured through each of its four legs. The attached section of tail rotor driveshaft was fractured through the drive tube section adjacent to its end flange fitting. Examinations of the separations revealed features consistent with bending fractures, bending plus twisting fractures, shearing overstress, areas of tearing, and twisting overstress. No indications of pre-existing cracking or corrosion were noted at the separations and no pre-existing external contact damage was apparent. The senior metallurgist's report is appended to the docket associated with this case.

ORGANIZATIONAL INFORMATION

Panther Helicopters, Inc., was issued operating certificate number PBVA077H in 1983 to conduct on-demand air taxi operations. Their operating certificate is managed by the FAA Flight Standards District Office in Baton Rouge, Louisiana. Panther began helicopter operations in the Gulf of Mexico with a Robinson 22 and one pilot. The operator continues to conduct offshore helicopter air taxi operations in the Gulf of Mexico as well as inland operations. Panther's corporate headquarters, including the directors of operations, training, maintenance, and safety, and the chief pilot are located in Belle Chasse, Louisiana. Panther has satellite bases in Picayune, Mississippi, and Patterson, Louisiana.

At the time of the accident, Panther operated nine helicopters, including eight Bell 206-series and one Bell 407. The company employed 7 helicopter mechanics and 15 helicopter pilots. Prior to their employment, each pilot was required to have a minimum of 1,000 hours total time, 100 hours turbine time, and 3 months flying in gulf operations.

Panther pilots typically worked 14-hour duty days for 14 days on followed by 14 days off. Their pilots typically flew 70 to 100 hours per month. Panther provided monthly contracted services to the oil and gas industry to assist with crew changes and field operations on a daily basis. The operator also provided support to various law enforcement agencies and the film production industry.

ADDITIONAL INFORMATION

According to the Helicopter Safety Advisory Conference 2012 Gulf of Mexico Offshore Helicopter Operations and Safety Review, 497 helicopters performed flight activities in the region by the 13 helicopter operators in the region who voluntarily reported. The report indicated that, during 2012, 2,278,780 passengers were carried on 894,439 flights, which totaled 316,685 hours of flight.

EPL Oil & Gas Inc. (EPL), which was SS208's lessee, provided the NTSB a revised flaring and venting summary report of the platform's estimated venting release. The report, in part, indicated that on August 13, 2013, the SS 208H platform had 364 MCF [million cubic feet] of total vented gas.

According to the helicopter operator, the pilot was not informed by the platform operator of the vented gas.

According to NTSB report CEN11LA252, on March 24, 2011, about 1655 central daylight time, a Bell 206-L3 helicopter, N32041, impacted water shortly after takeoff from an offshore oil production platform, Main Pass 61A (MP61A), located in the Gulf of Mexico. The commercial pilot and two passengers received minor injuries. The helicopter was substantially damaged. The helicopter was registered to and operated by PHI, Inc., under the provisions of 14 Code of Federal Regulations Part 135 as an air taxi flight. Visual meteorological conditions prevailed for the flight and a company flight plan had been filed. The NTSB determined the probable cause of this accident was "the loss of engine power due to an engine compressor stall as a result of ingesting methane gas during takeoff."

The FAA Engine Certification Branch was advised of the methane ingestion cause listed in the CEN11LA252 case and the recorded engine data from N53LP. The branch's management was asked if the applicable engine certification offices (ECO) have looked into reliability analysis in reference to methane ingestion effects as part of the Failure Mode and Effects Analysis (FMEA) during helicopter engines' certification. Their response, in part, stated:

Part 33 certification standards for engines do not address methaneingestion, and neither the engine (Part 33) nor the rotorcraft (Part 27or29) FMEA'sconsider methane ingestion as part of their FMEA safety analysis.Methane gas is highly flammable, and ingestion is outside of the intended engine operation, so it would not beaddressed within engine certification standards. Of the engine manufacturerscontacted by the ECO, nonehave developed special guidance or procedures for methane ingestion.However, due to methane's highly flammable nature, our position is thatmethane ingestion should be viewed as beyondallowable engine operation and hazardous. As the certifying office, we wouldexpect that, like any other operational hazards,this would be fully evaluated and addressed or controlled by the operator,with oversight from the FAA Flight Standards organizations.

Rolls Royce has published a Commercial Service Letter in reference to engine operation in a methane laden atmosphere. The letter advises operators of a maximum acceptable level of methane present in the operating environment.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	30
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	November 15, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 12, 2013
Flight Time:	(Estimated) 1136 hours (Total, all aircraft), 133.8 hours (Total, this make and model), 1136 hours (Pilot In Command, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N53LP
Model/Series:	407	**Aircraft Category:**	Helicopter
Year of Manufacture:	1998	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	53319
Landing Gear Type:	Skid	**Seats:**	7
Date/Type of Last Inspection:	August 8, 2013 Continuous airworthiness	**Certified Max Gross Wt.:**	5250 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:	4254 Hrs as of last inspection	**Engine Manufacturer:**	Rolls Royce
ELT:	Not installed	**Engine Model/Series:**	250-C47B
Registered Owner:	PANTHER HELICOPTERS INC	**Rated Power:**	674 Horsepower
Operator:	PANTHER HELICOPTERS INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	PBVA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KHUM,10 ft msl	**Distance from Accident Site:**	63 Nautical Miles
Observation Time:	12:50 Local	**Direction from Accident Site:**	12°
Lowest Cloud Condition:		**Visibility**	5 miles
Lowest Ceiling:	Broken / 3400 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	29°C / 33°C
Precipitation and Obscuration:	N/A - None - Rain		
Departure Point:	Ship Shoal 208H, GM	**Type of Flight Plan Filed:**	None
Destination:	Ship Shoal 209A, GM	**Type of Clearance:**	None
Departure Time:	13:10 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Minor	**Latitude, Longitude:**	28.533332,-90.916664(est)

Administrative Information

Investigator In Charge (IIC):	Malinowski, Edward
Additional Participating Persons:	Arnold Turner; Federal Aviation Administration; Batton Rouge, LA Myron L Hillers; Panther Helicopters, Inc.; Belle Chasse, LA Chad Kaatz; StandardAero; Winnipeg, MB David McNair; Transprotation Safety Board of Canada; Gatineau, QC Casey Lehman ; Rolls Royce; Indianapolis, IN William E Sarles ; Bell Helicopter; Fort Worth, TX Bruce B Millar; Triumph Engine Control Systems; West Hartford, CT Glen McDermid; StandardAero; Winnipeg, MB
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