



# Aviation Investigation Final Report

<b>Location:</b>	Delray Beach, Florida	<b>Accident Number:</b>	ERA12TA251
<b>Date &amp; Time:</b>	March 23, 2012, 14:55 Local	<b>Registration:</b>	N31PB
<b>Aircraft:</b>	Bell 407	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Loss of lift	<b>Injuries:</b>	2 Minor
<b>Flight Conducted Under:</b>	Public aircraft		

## Analysis

While in cruise flight during the law enforcement aerial surveillance and evaluation flight, the instructor induced a simulated engine failure. The pilot being evaluated rolled the throttle from the idle position back to the flight position instead of lowering the collective to maintain rotor rpm. The instructor then took control of the helicopter, but he did not lower the collective either, and the main rotor rpm subsequently decayed to well below the lower limit of the normal operating range. The low-rotor condition resulted in a loss of helicopter control and glide capability and a subsequent hard landing in trees. Examination of the flight department's training program revealed that the conditions and standards for the performance of a simulated engine failure were not outlined as a separate task within the manual and that the manual did not provide information regarding entry altitudes, callouts, recovery altitudes and procedures, or maneuver termination protocols. The instructor reported no mechanical deficiencies with the helicopter that would have precluded normal operation.

## Probable Cause and Findings

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

The pilot's improper response to a simulated engine failure and the instructor's delayed and improper remedial action.

## Findings

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<b>Personnel issues</b>	Delayed action - Instructor/check pilot
<b>Personnel issues</b>	Incorrect action performance - Pilot
<b>Personnel issues</b>	Incorrect action performance - Instructor/check pilot
<b>Organizational issues</b>	Upgrade training - Operator

## Factual Information

### History of Flight

<b>Maneuvering-low-alt flying</b>	Simulated/training event
<b>Other</b>	Loss of lift (Defining event)
<b>Autorotation</b>	Collision with terr/obj (non-CFIT)
<b>Autorotation</b>	Hard landing

### HISTORY OF FLIGHT

On March 23, 2012, about 1455 eastern daylight time, a Bell 407 helicopter, N31PB, operated by the Palm Beach County Sheriff's Office (PBSO), experienced a hard landing following a simulated engine failure induced while maneuvering near Delray Beach, Florida. The commercial pilots sustained minor injuries. Visual meteorological conditions prevailed, and no flight plan was filed for the public use aerial surveillance flight that originated from Palm Beach International Airport (PBI), West Palm Beach, Florida, about 1405.

Witnesses reported the helicopter was flying south along a main state road, at an estimated altitude of 800 feet above ground level (agl). It made a left turn heading east and continued the turn heading north just before it was seen losing altitude. The helicopter landed hard in a wooded area, and the nose section made contact with a masonry wall that separated a residential neighborhood from a construction site. The helicopter's main rotor and tail rotor blades, the skids, and the fuselage sustained substantial damage.

Both pilots provided written statements and their accounts of the flight were consistent throughout. The purpose of the flight was for the unit instructor pilot in the left seat to evaluate the pilot in the right seat for an upgrade to pilot-in-command duties on future aerial surveillance missions.

The instructor stated that the pilot showed a tendency to release the collective control in order to actuate switches and adjust radios, so the instructor elected to induce a simulated engine failure to evaluate the pilot's response to the emergency. While in cruise flight at 750 feet agl, the instructor gradually reduced the throttle, the helicopter yawed, the pilot responded verbally, but he did not respond to the loss of engine power with any control inputs.

The instructor stated he was surprised by the pilot's lack of response, announced that he was taking the flight controls, and increased the throttle back to the flight position. The instructor stated that due to the helicopter's low altitude, low airspeed, low rotor rpm, and high sink rate that 100 percent engine power was not be able to restore "flight" in order to reach the open forced landing area he had selected. The helicopter landed in trees along the border of a residential neighborhood and prior to the open construction area he attempted to reach.

According to the pilot, the helicopter was in cruise flight at 700 feet and 100 knots when an audio alarm sounded, he "reached" for the collective control, and scanned the instruments for caution lights or

gauges out of limits, but found none. He looked and noticed the throttle was at the idle position, asked the instructor if he had reduced the throttle, and then initiated an increase in throttle back to the flight position.

At that time, the instructor announced that he was taking the controls and the pilot released and then confirmed the transfer of the flight controls. The helicopter's altitude had decayed to 500 feet, and the instructor was "laboring" with the flight controls as the helicopter transitioned through a "series of unusual attitudes and a variety of G loads."

According to the instructor pilot, there were no mechanical malfunctions or failures with the helicopter.

#### PERSONNEL INFORMATION

The instructor held a commercial pilot certificate with ratings for airplane single-engine land, rotorcraft/helicopter and instrument airplane and helicopter. He also held a flight instructor certificate with ratings for rotorcraft helicopter. His most recent Federal Aviation Administration (FAA) second-class medical certificate was issued on November 7, 2011. The instructor reported 2,482 total hours of flight experience, of which 1,844 hours were in the accident helicopter make and model.

The pilot held a commercial pilot certificate with ratings for airplane single-engine land, rotorcraft/helicopter and instrument airplane and helicopter. He also held a flight instructor certificate with ratings for airplane single-engine and instrument airplane. His most recent FAA second-class medical certificate was issued on May 19, 2011. The Pilot reported 1,040 total hours of flight experience, of which 470 hours were in the accident helicopter make and model.

#### AIRCRAFT INFORMATION

According to FAA and maintenance records, the helicopter was manufactured in 2002. The helicopter was maintained under a Manufacturer's Inspection Program, and its most recent inspection was completed March 8, 2012, at 6201.6 total aircraft hours.

#### METEOROLOGICAL INFORMATION

At 1453, the weather conditions reported at PBI, 16 miles north of the accident site, included scattered clouds at 3,600 feet, 10 miles visibility; temperature 26 degrees C, dew point 18 degrees C, and an altimeter setting of 30.06 inches of mercury. The wind was from 100 degrees at 8 knots.

#### WRECKAGE AND IMPACT INFORMATION

Examination of photographs revealed the helicopter came to rest upright in dense vegetation with the nose resting against a masonry wall. The cockpit and cabin area were largely intact, with the pilot's windscreen broken. All four main rotor blades were secured in the hub, and each main rotor blade was fractured or separated at various points along their respective spans.

The helicopter was then moved to the operator's facility, and a detailed examination confirmed control continuity by exercising the various flight controls while observing a corresponding movement of the appropriate flight services. Preimpact drive continuity was confirmed as a result of the main and tail rotor blade damage, torsional twisting/fracture of the steel driveshaft just aft of the accessory gearbox,

and bending moment of the drive links. The fuel shutoff valve and the fuel boost pumps were confirmed operational; by positioning the battery to the "ON" position and systematically exercising the various switches and listening to the operation of each component. With the battery in the "ON" position the fuel quantity gauge indicated 632 pounds, and fuel in the tank was visually confirmed through the fuel port. The airframe fuel filter contents were drained and the sample contained no water or debris.

## TESTS AND RESEARCH

On May 14, 2012 Garmin GPSMAP 496 and a Rolls Royce Digital Electrical Control Unit (DECU) were examined in the NTSB Recorders Laboratory in Washington, D.C.

The Garmin GPSMAP 496 was a battery-powered portable 12-channel GPS receiver with a 256-color TFT LCD display screen. The unit included a built-in Jeppesen database and was capable of receiving XM satellite radio for flight information and weather information. The unit potentially stored date, route-of-flight, and flight-time information for up to 50 flights.

Examination revealed that the unit was undamaged. However, an examination of the unit settings revealed the track log record mode was set to off and zero percent internal memory was used. As such, no data pertinent to the investigation was retrieved from the unit.

The Rolls-Royce DECU, model EC-35R, was part of the Rolls-Royce engine 250-C47B full authority digital engine control (FADEC) system. The FADEC provided automatic engine starting, speed governing, flameout detection/reignition, exceedance limiting, surge detection/recovery, fault detection, engine condition monitoring and incident recording (IR). The DECU provided the control logic and recording functions of the FADEC system. The DECU recorded both engine condition monitoring and IR information. IR data was constantly being recorded, held in memory for 12 seconds, and then written over. When any one of various parameters reached a triggering value, an instantaneous snapshot of the data was recorded, plus the previous 12 seconds of data, and the ensuing 48 seconds of data were written to non-volatile memory. The data had a sample rate of 1.2 seconds. The IR was triggered by any of the following: excessive rate of engine torque increase (torque spike) or torque exceedance, engine overspeed, engine surge, main rotor droop, FADEC hard fault, engine temperature exceedance, gas generator or power turbine speed exceedance, uncommanded engine acceleration or deceleration, prolonged engine operation on the fuel limiter or a detected engine flameout.

The recording content began about 12 seconds prior to the first triggering event and continued for about 48 seconds. Two IR snapshot events were triggered at 12 and 24 seconds, respectively.

A decrease in main rotor speed was depicted from the beginning of the recording until about 9 seconds. The power lever angle and torque increased about 9 seconds until about 13 seconds. About 13 seconds, the torque reached a maximum recorded value of 118 percent. Fuel flow and gas generator speed began to increase about 7 seconds. After a decrease in torque, between 19 and 30 seconds, the torque achieved a maximum value of about 132 percent.

From the beginning of the recording, main rotor speed decayed from around 87 percent to about 55 percent before a spike in power lever angle, fuel flow, and the over-torque triggering event at 12 seconds. From that point, main rotor speed climbed to a high of 85 percent before it decayed and stabilized around 75 percent.

Collective pitch was at 45 percent until the 5 second interval, gradually increased to 70 percent at 7 seconds and remained there through the fuel increase and over-torque triggering event. Between 15 and 20 seconds, collective pitch increased to 100 percent where it stayed for the remainder of the recording.

#### ADDITIONAL INFORMATION

Examination of the PBSO Tactical Flight Officer Training Program revealed that the conditions and standards for the performance of a simulated engine failure were not outlined as a separate task within the manual. There was no discussion with regards to entry altitudes, call-outs, recovery altitudes and procedures, or maneuver termination protocols. According to the Bell 407 Operator's Manual:

#### ROTOR RPM – POWER ON

Continuous operation 99-100%

Maximum continuous 100%

#### ROTOR RPM – POWER OFF

Minimum 85%

Continuous operation 85 to 107%

Maximum 107%

CAUTION FOR AUTOROTATIVE TRAINING, MAINTAIN STEADY STATE  $N_r$  ABOVE 90%.

#### ENGINE FAILURE – IN FLIGHT

##### INDICATIONS:

1. Left yaw.
2. ENGINE OUT and RPM warning lights illuminated.
3. Engine instruments indicate power loss.
4. Engine out audio activated when NG drops below 55[percent].
5. NR decreasing with RPM warning light and audio on when NR drops below 95 [percent].

##### PROCEDURE:

1. Maintain heading and altitude control.
2. Collective – Adjust as required to maintain 85 to 100 percent NR.
3. Cyclic – Adjust to obtain desired autorotative airspeed..."

As a result of this investigation, the operator chose to suspend in-house emergency procedure training, and scheduled all future training at the Bell Helicopter Factory School.

### Pilot Information

<b>Certificate:</b>	Commercial; Flight instructor	<b>Age:</b>	56
<b>Airplane Rating(s):</b>	Single-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	Helicopter	<b>Restraint Used:</b>	4-point
<b>Instrument Rating(s):</b>	Airplane; Helicopter	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Helicopter	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 2 With waivers/limitations	<b>Last FAA Medical Exam:</b>	November 7, 2011
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	March 13, 2012
<b>Flight Time:</b>	2482 hours (Total, all aircraft), 1844 hours (Total, this make and model), 2283 hours (Pilot In Command, all aircraft), 67 hours (Last 90 days, all aircraft), 15 hours (Last 30 days, all aircraft)		

### Co-pilot Information

<b>Certificate:</b>	Commercial; Flight instructor	<b>Age:</b>	41
<b>Airplane Rating(s):</b>	Single-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	Helicopter	<b>Restraint Used:</b>	4-point
<b>Instrument Rating(s):</b>	Airplane; Helicopter	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane single-engine; Instrument airplane	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 2 With waivers/limitations	<b>Last FAA Medical Exam:</b>	May 19, 2011
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	March 15, 2011
<b>Flight Time:</b>	1040 hours (Total, all aircraft), 470 hours (Total, this make and model), 450 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 25 hours (Last 30 days, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Bell	<b>Registration:</b>	N31PB
<b>Model/Series:</b>	407	<b>Aircraft Category:</b>	Helicopter
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	53569
<b>Landing Gear Type:</b>	High skid	<b>Seats:</b>	7
<b>Date/Type of Last Inspection:</b>	March 8, 2012 100 hour	<b>Certified Max Gross Wt.:</b>	4500 lbs
<b>Time Since Last Inspection:</b>	19 Hrs	<b>Engines:</b>	1 Turbo shaft
<b>Airframe Total Time:</b>	6201 Hrs at time of accident	<b>Engine Manufacturer:</b>	ROLLS-ROYC
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	250-C47B
<b>Registered Owner:</b>	PALM BEACH COUNTY SHERIFFS OFFICE	<b>Rated Power:</b>	650 Horsepower
<b>Operator:</b>	PALM BEACH COUNTY SHERIFFS OFFICE	<b>Operating Certificate(s) Held:</b>	None

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	PBI, 20 ft msl	<b>Distance from Accident Site:</b>	16 Nautical Miles
<b>Observation Time:</b>	14:53 Local	<b>Direction from Accident Site:</b>	360°
<b>Lowest Cloud Condition:</b>	Scattered / 3600 ft AGL	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>	None	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	8 knots / 15 knots	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>	100°	<b>Turbulence Severity Forecast/Actual:</b>	/ N/A
<b>Altimeter Setting:</b>	30.05 inches Hg	<b>Temperature/Dew Point:</b>	26°C / 18°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	West Palm Beach, FL (PBI)	<b>Type of Flight Plan Filed:</b>	Company VFR
<b>Destination:</b>	West Palm Beach, FL (PBI)	<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	14:05 Local	<b>Type of Airspace:</b>	Class G



## Wreckage and Impact Information

<b>Crew Injuries:</b>	2 Minor	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>		<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 Minor	<b>Latitude, Longitude:</b>	26.455278,-80.196113(est)

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Obregon, Jose
<b>Additional Participating Persons:</b>	Edward M Dasilva; FAA/FSDO; Miramar, FL Robert B Lucas; Palm Beach County Sheriff's Office; Palm Beach, FL Jack Johnson; Rolls-Royce Corp.; Indianapolis, IL
<b>Original Publish Date:</b>	November 13, 2014
<b>Last Revision Date:</b>	
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	
<b>Investigation Docket:</b>	<a href="https://data.nts.gov/Docket?ProjectID=83206">https://data.nts.gov/Docket?ProjectID=83206</a>

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