National Transportation Safety Board
Aviation Accident Final Report

Location:	Rialto, CA	**Accident Number:**	LAX03GA001
Date & Time:	10/03/2002, 1718 PDT	**Registration:**	N625SB
Aircraft:	McDonnell Douglas 600N	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	2 Serious
Flight Conducted Under:	Part 91: General Aviation - Public Aircraft		

Analysis

The sheriffs department helicopter was just beginning an evening patrol flight when the engine experienced a deceleration event during transition from climb out to cruise and the helicopter crashed into a residential street during an attempted autorotation. First responders to the accident site, which included sheriff's air unit mechanics, found the engine running at idle and a fire in the engine compartment. The helicopter had just come out of a scheduled 100/300-hour inspection and this was the first mission flight since the maintenance. During the inspection, the engine's fuel control Hydromechanical Unit (HMU) had been removed for compliance with a service bulletin. Prior to this flight, the helicopter had completed a 10-minute post maintenance flight check. The pilot in command (PIC) conducted the preflight inspection. The mission observer flight officer, who held a private pilot certificate with helicopter rating and was attempting to upgrade to a pilot position, had been given permission to fly the helicopter and installed the dual flight controls to the right side. No problems were noted during the preflight, and the takeoff was normal. About 500 feet above ground level during the transition from climb out to cruise, the pilot flying heard the LOW ROTOR voice warning (two times) followed by ENGINE OUT voice warning (two times). Without initiating an autorotation, he requested that the PIC take the flight controls. Simultaneously, the PIC had sensed a problem and took the flight controls. Prior to and during the departure up until the engine deceleration, the PIC performed the observer flight officer duties, which included radio communications with dispatch, and had not monitored the flight instrument readings or the progress of the departure. The LOW ROTOR voice warning activates when Nr falls below 95 percent. The voice warning system for ENGINE OUT activates when N1 falls below 55 percent or a high rate of decay in N1. No discrepancies were noted during the inspection of the airframe. A teardown of the engine disclosed no internal discrepancies; however, the fuel inlet line fitting to the engine IIMU was found loose by two flats of the nut. Functional testing of the fire damage ECU (electronic control unit) found no discrepancies. The HMU was installed in a test bench and passed a functional check. The fuel line inlet fitting nut was then loosened incrementally one flat at a time with a functional test conducted each time. Significant fluctuations in metered fuel output flow were noted during one test with the nut three flats loose, and again at one complete turn loose. These results could not be reliably duplicated in subsequent tests. The investigation found that the operator had not established guidance for

crew resource management pertaining to crew responsibilities, instrument monitoring responsibilities, emergency procedures initiation, or flight control transfer procedures when flying in a dual pilot operation.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: an engine deceleration event due to a loose HMU fuel line fitting, which was a result of inadequate maintenance procedures in the 100/300-hour inspection. Also causal was the flying pilot's and pilot-in-command's delayed recognition of the power loss, as well as, the flying pilot's failure to initiate an autorotation in a timely manner. The pilot-in-command's failure to regain and maintain adequate main rotor rpm was also causal. A contributing factor to the accident was the pilot-in-command's inadequate supervision and diverted attention due to his concentration on the flight officer observer duties.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (C) FUEL SYSTEM,LINE FITTING - LOOSE
2. (C) MAINTENANCE,100-HOUR INSPECTION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
3. (C) FUEL SYSTEM,FUEL CONTROL - ERRATIC

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
4. (C) AUTOROTATION - DELAYED - COPILOT/SECOND PILOT

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - EMERGENCY

Findings
5. OBJECT - TREE(S)
6. EVASIVE MANEUVER - INITIATED - PILOT IN COMMAND
7. (C) ROTOR RPM - NOT MAINTAINED - PILOT IN COMMAND
8. (C) SUPERVISION - INADEQUATE - PILOT IN COMMAND
9. (F) DIVERTED ATTENTION - PILOT IN COMMAND

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
10. TERRAIN CONDITION - GROUND

Factual Information

1.1 HISTORY OF FLIGHT

On October 3, 2002, at 1718 Pacific daylight time, a McDonnell Douglas 600N helicopter, N625SB, experienced a engine deceleration and crashed in a residential area located 3/4-mile south of the Rialto Municipal Airport (L67), Rialto, California, shortly after departure from a helipad. The San Bernardino County Sheriff's Department (SBSD) owned and operated the helicopter under the provisions of 14 CFR Part 91 as a public-use flight. The helicopter was substantially damaged. The commercial rotorcraft rated pilot and a deputy observer, a private helicopter pilot, were seriously injured. Visual meteorological conditions prevailed for the evening patrol flight. A company visual flight rules (VFR) flight plan had been filed.

The helicopter had just come out of a scheduled 100/300-hour inspection and this was the first mission flight since the maintenance had been completed. Prior to this flight, the helicopter had completed a 10-minute post maintenance flight check.

A mechanic for SBSD, located about 3/4-mile north of the accident site, observed the accident helicopter enter a left turn between 800-1,000 feet above ground level (agl). When he turned his back to go back inside, he stated that it "was quiet," so he looked back and saw the helicopter still in the air, but in a "dive towards the ground." The helicopter was in a "left diving steep turn," as if it were trying to gain airspeed. He lost sight of the helicopter as it passed behind the tree line. The mechanic reported that the helicopter was in a nose low attitude, approximately 70 degrees. He stated that he was able to see the top of the main rotor mast. He stated that the main rotor blades were turning fast enough that he was not able to count the blades. He did not hear any "popping noises, just silence." Prior to the diving turn, the helicopter had been in straight-and-level flight.

Mechanics from SBSD who arrived on-scene with first responders and found the engine running at idle. They attempted to shut the engine down by turning off the fuel-shutoff valve, but it was stuck in the open position. The engine was eventually shut down. They turned off the battery, but did not recall if there were any instrument warning lights illuminated. One mechanic noted that the collective twist grip on the pilot's side was broken and he was not able to check the position of the ECU (Electronic Control Unit) switch on the collective.

1.1.1 Witness Information

Witnesses in the surrounding area observed the helicopter traveling in a southerly direction when it made a descending turn to the north. The helicopter maneuvered around a house and descended through a tree prior to impacting the ground in a left nose and left skid low attitude. Witnesses indicated that the left landing gear and tail section separated from the helicopter after contacting the ground. The helicopter rotated around on it's left side and came to rest facing in a southerly direction.

A compilation of witnesses stated that the helicopter was "slow," going about 30-40 miles per hour. Witnesses further stated that the engine was "very loud" and "revving."

A witness, in a residence two blocks west of the accident site, observed the helicopter flying just above the rooftops. He lost sight of the helicopter as it descended out of his view.

Another witness, located about one block south of the accident site, reported that the helicopter was 50-70 feet above the rooftops, and appeared to be losing altitude. The witness

stated that the helicopter appeared to be "coasting." He also indicated that he did not see anything falling from the helicopter as it passed overhead.

One witness observed the helicopter-flying overhead in a northbound direction. He indicated that the helicopter was very low, and the engine sounded like it was "going to blow." The witness stated that it looked like it was going to crash into a residence; however, it turned "quickly towards the left" and descended out of his view.

A witness traveling southbound observed the helicopter traveling at an "extremely low level northbound." He saw the helicopter "drop" out of view, and did not see it rise above the houses or trees.

A ground witness at the accident site stated that he looked up and saw the helicopter traveling in a northbound direction. The helicopter appeared to be "wobbling" and then came down and collided with the ground.

1.1.2 SBSD Air Unit and Pilot Statements

1.1.2.1 Sergeant/Pilot/Maintenance supervisor

The National Transportation Safety Board investigator-in-charge (IIC) interviewed the sergeant, who is also a pilot and the maintenance supervisor. During the preceding 3 weeks while the helicopter was going through a 100/300-hour inspection, a series of ground runs had been conducted with no mechanical anomalies encountered. The day of the accident, he performed a preflight inspection in accordance with the manufacturer's Federal Aviation Administration (FAA) approved flight manual. The preflight inspection included a check of the engine compartment and engine for "any anomalies that would cause the aircraft to not function properly." The sergeant reported that he found no discrepancies during the preflight for the maintenance check on the day of the accident.

During the flight check the sergeant conducted crosswind hovers in "all gradients," traffic pattern work, and autorotations. He did not feel any binding of the flight controls during the maneuvers. When he completed the flight check he conducted a "cool down prior to shutdown," and then put the helicopter back in the hangar. The Sergeant indicated that during the flight check he did not experience any uncommanded yaws, unusual vibrations, and no lights illuminated during power recoveries. The helicopter was then released for flight. He reassigned the night flight crew to fly the accident helicopter for a couple of hours.

In a follow-up conversation with the Sergeant to clarify SBSD flight operational procedures, he noted that SBSD flight operations are conducted at a point on their facility that contains a concrete triangle with an "H" painted in middle of it. The pilots use this as the takeoff, departure, and arrival points.

1.1.2.2 Deputy/ Pilot-in-command

According to the pilot-in-command's (PIC) written statement, Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1/2), he arrived at his duty station at 1600, and began to preflight the accident helicopter. During the preflight, he "topped off" the fuel, and checked the fluid levels, and the engine compartment. He visually checked the air, fuel, and hydraulic lines for loose nuts ("slippage marks") in the engine compartment. He also visually checked the stabilizer for "play," main rotor assembly and fan, the tail section, and lights. According to the PIC, the helicopter was refueled to a total capacity of 650 pounds of Jet A fuel.

While the PIC was conducting the preflight, the observer installed the dual flight controls so that he could fly from the right side. The PIC indicated that he was seated in the left seat. The PIC reported that he was also a training pilot for the air unit. His responsibilities were to provide transition training and/or be PIC while a new pilot built up their flight time.

The PIC stated that the observer was flying the helicopter. They made a left-hand traffic departure from the sheriff's hangar, located on the southwest corner of the airport. Prior to and during the departure, the PIC was performing the job of observer flight officer, which included communicating with local area law enforcement agencies. A few minutes after takeoff, about 500 feet above ground (agl), he "sensed" something was wrong and that they were going down, he remembers grabbing the flight controls and looking for a place to land. He indicated that the helicopter was descending rapidly and he aimed for a street intersection. The PIC stated that they came close to houses and he had to maneuver between the houses. The PIC indicated that he could not recall the detailed events of the impact sequence.

The IIC interviewed the PIC. During the left-hand turn to depart the traffic pattern, he realized that the helicopter was descending and took over the flight controls from the observer. The PIC indicated that he didn't recall hearing any audio tones, nor did he scan the gages, nor did he have time to look at the gages during the onset of the emergency. The PIC decided that he had about "5 seconds to make the right decision." He knew he would have to stretch the glide to find a safe place to land. The PIC noted that the collective lever and the nose of the helicopter were heavy. He indicated that up to the point where they were departing the traffic pattern everything had been normal.

The PIC indicated that his responsibility was to be the flight observer on the accident flight. The other deputy would be the pilot flying the helicopter. The PIC recalled briefing the pilot flying that he (the PIC) would start the helicopter and if any emergencies took place the pilot flying would initiate the emergency procedures and then he (the PIC) would take the flight controls.

1.1.2.3 Deputy/ Observer/Pilot Flying

In the written statement (NTSB Form 6120.1/2) the flying pilot/deputy observer indicated that he arrived at his duty station about 1550. He asked the PIC what aircraft they were flying, and the PIC indicated that they were going to fly one of the EC-120Bs. While they were on the hangar floor, the maintenance supervisor approached them and asked if they could fly the accident helicopter as it had just come out of the 100-hour inspection. The maintenance supervisor indicated that the helicopter had just completed a 10-minute flight check with no problems encountered and that it needed to be flown for a couple of hours to make sure nothing was wrong with it.

The pilot flying asked the PIC if they could put in the dual flight controls so that he could fly. The PIC instructed him to get permission from the Lieutenant who subsequently approved the request for the addition of the dual flight controls. According to the pilot flying, the PIC was in the middle of the preflight when they were requested to respond to a callout. The request was cancelled prior to their departure.

The pilot flying stated that the PIC went through the start up procedures, and the helicopter started with no problems. The PIC told the pilot flying that all the gages were in the "green" and that it was his aircraft to fly.

The pilot flying stated that he took the helicopter to a hover and hovered to the "H". He

performed several 360-degree pedal turns to get a feel for the helicopter. He then made a clearing turn and took off from the helipad westbound and made a climbing eastbound turn. There were no problems encountered with this portion of the flight. They continued in an eastbound direction. As he set up for cruise flight, he "reduced collective," noted the altitude as 500-feet agl, and the airspeed was between 80-90 knots. He then heard a "pop" from the engine followed by the audio voice warning system: 'low rotor, low rotor,' followed by 'engine out, engine out.'

The pilot flying advised the PIC to take control of the helicopter. He then relinquished the flight controls to the PIC. The PIC made a northbound turn and entered an autorotation. The pilot flying indicated that their flight attitude was "almost straight down." The PIC turned the helicopter to avoid a house, and the pilot flying remembers the helicopter being almost level at that point. He did not recall anything about the impact.

The IIC interviewed the pilot flying. The pilot flying stated that prior to the "pop" the engine sounded normal. When the engine made the "pop" noise he recalled not hearing the engine anymore. He did not look at the gages prior to or during the accident sequence. He indicated that he was building flight time and that he believed the flight was a training flight as well as a patrol flight.

1.5 PERSONNEL INFORMATION

1.5.1 Deputy/Certified Flight Instructor/Pilot-in-command

According to SBSD, the pilot was hired on August 1, 1987, and assigned to the Aviation Division on April 22, 1989.

A review of FAA airman records revealed that the PIC held a commercial pilot certificate with ratings for rotorcraft-helicopters and single engine and multiengine land and instrument airplane. The pilot also held a certified flight instructor certificate with a rotorcraft-helicopter rating issued on April 26, 1996. The CFI certificate expired on April 30, 2002.

The PIC held a second-class medical certificate issued on September 27, 2001. It had the limitation that the pilot must wear corrective lenses. According to SBSD's Policy Manual under the section entitled PILOT PROFICIENCY/MEDICAL, "Pilots must hold a second-class medical certificate. The Commander may waive this requirement to accomplish a mission, but the pilot must obtain a current Class II medical within 30 days." Review of the pilot's records did not disclose a waiver for continued flight operations.

According to NTSB Form 6120.1/2, SBSD indicated that the PIC accumulated an estimated total flight time of 11,500 hours. He logged 100 hours in the last 90 days, with 10 hours in the accident make and model. In the last 30 days he logged 30 hours, with 5 hours in the accident make and model. In the last 24 hours he, logged 5 hours. The PIC had an estimated 400 hours in the accident helicopter make and model.

1.5.2 Deputy/ Observer/Pilot Flying

According to SBSD, the pilot flying was hired on April 4, 1988, and assigned to the Aviation Division on April 26, 1997. According to SBSD, there were no flight training records for the observer.

A review of FAA airman records revealed the pilot flying held a private pilot certificate with a

rotorcraft-helicopter rating issued on August 28, 2001.

The pilot flying held a second-class medical certificate issued on July 7, 2002. It had no limitations or waivers.

The pilot reported accumulating a total flight time of 83 helicopter hours. He logged 9.6 hours in the last 90 days, and 7.4 hours in the last 30 days. The pilot flying had 11.2 hours in the accident helicopter make and model.

1.5.3 San Bernardino County Sheriff's Department Aviation Division

A review of SBSD's Policy Manual, Standard Operating Procedures, and flight training manual revealed no formal written training program to upgrade a deputy observer to a pilot. None of the aforementioned manuals elaborated on crew resource management with regard to rotorcraft crew responsibilities, instrument monitoring responsibilities, emergency initiation, or flight control transfer procedures. The Policy Manual contained a section for cockpit crew procedures for fixed-wing aircraft; however, there was no cockpit crew procedures section for rotorcraft.

According to SBSD, in order to meet insurance requirements to act as PIC, the pilot must have 500 hours total time with 250 hours in turbine-powered rotorcraft, as well as complete a division recognized training program prior to be allowed to act as a PIC in department aircraft. According to SBSD, per the accident helicopter manufacturer's FAA approved flight manual, the PIC flies from the left seat.

1.6 AIRCRAFT INFORMATION

The helicopter was a McDonnell Douglas 600N, serial number RN033. A review of the helicopter's maintenance logbooks revealed that it had accumulated a total airframe time of 2,400 hours at the last 100/300-hour inspection, which was completed on the day of the accident. Following the inspection, maintenance personnel performed a compressor wash followed by a ground run and leak check with no discrepancies noted. An annual inspection was completed on May 31, 2002. A 100-hour inspection was completed on July 12, 2002. The Hobbs hour meter read 2,300 at the last inspection.

A Rolls-Royce Engine 250-C47M, serial number CAE 847832, was installed on the accident helicopter. Total time on the engine at the last 100/300-hour inspection was 2,400 hours. A hydromechanical unit (HMU), serial number JGALM0518, part number 23072725 (fuel metering unit part number 114070-03A5), was installed on the accident helicopter on January 30, 2002. The electronic control unit (ECU), serial number JG6ALW0027, part number 23070259 (113920-3A4-6002), was installed on the accident helicopter on December 5, 1999.

Examination of the maintenance and flight department records revealed no unresolved maintenance discrepancies against the helicopter prior to departure.

Two weeks prior to the accident, at the start of the 100-300-hour inspection, the HMU (Hydromechanical Monitoring Unit) was removed to comply with Rolls-Royce Commercial Engine Bulletin titled ENGINE, FUEL AND CONTROL - INSPECTION OF HMU DRIVE SPLINES. A portion of the bulletin was to perform a backlash inspection per Goodrich Pump & Engine Control Systems, Inc. Service Bulletin 73-13. The HMU was inspected in accordance with both bulletins, and the approved maintenance manual. There were no discrepancies noted, and the HMU was placed back onto the helicopter.

Preflight checks, 150-hour inspection, and post-flight checks of the Rolls-Royce 250-C47M Operation and maintenance Form 72-00-00, all contain verbiage to check the general condition of the engine and all accessible areas for "obvious loose bolts, broken or loose connections, security of attachment of all accessories, broken or missing safeties and evidence of fuel and oil leakage."

The McDonnell Douglas (MD) Helicopters, Inc., maintenance manual Form HOE005 entitled CONTINUED AIRWORTHINESS 100-HOUR OR ANNUAL INSPECTION CHECKLIST 05-20-00, indications under "engine compartment"

[to check] Entire engine for:

Loose bolts; loose or broken connections

Accessories for security and broken or missing lockwire

Fuel and oil lines for chafing and kinking

Fuel drain line valve for leakage

Oil cooler and cooler deflector for security and obvious damage

A review of the McDonnell Douglas MD600N rotorcraft flight manual for preflight and emergency procedures was conducted. In section four of the flight manual, entitled NORMAL PROCEDURES, under section 4-1 Preflight Requirements, the preflight inspection includes checking the engine compartment for loose oil and fuel lines.

The flight manual section entitled Emergency and Malfunction Procedures, under section 3-3 ENGINE FAILURE, instructs the pilots that a red ENGINE OUT light will illuminate followed by a voice warning "ENGINE OUT." The flight manual indicates that the "failure indicators and voice warning are actuated when N1 falls below 55-percent or N1 rate of decay is high."

According to the flight manual (section 3-5 Low Rotor Speed), there is no warning light for low rotor speed; however, a voice warning "LOW ROTOR" will sound. The "LOW ROTOR" voice warning activates when Nr falls below 95-percent. According to the manual the low rotor rpm [revolutions per minute]

"will most commonly be associated with the following:

Engine Failure

ECU Failure - either Manual Mode or Fuel Flow Fixed operation

ECU Degraded mode operation

Transient rotor droop during large, rapid increases in power"

According to the MD600N Maintenance Training Course manual section 11-9, entitled VOICE WARNING SYSTEM, voice warnings in order of priority are:

Engine Out

Fire

Low Rotor rpm.

The flight manual (section 2-1 Flight Restrictions) in part states that:

"Flight crew position:

The minimum flight crew consists of one pilot operating the helicopter from the left seat with left-hand command controls.

The right crew seat may be used for an additional pilot when the approved dual controls are installed."

1.12 WRECKAGE AND IMPACT INFORMATION

1.12.1 On-Scene

The accident site was situated at a T-intersection (Shamrock and Ironwood streets) in a residential area.

Investigators from the Safety Board and the FAA examined the wreckage at the accident scene. The helicopter came to rest facing a southeast heading. The main wreckage area distribution and associated debris field was contained in an area approximately 80 feet in diameter. The left skid and about 4 feet of the tail section remained at the first identified point of impact (IPI). The helicopter came to rest about 20 feet northwest of the IPI.

The helicopter was lying on its left side. The right landing gear skid remained attached to the fuselage structure. The Plexiglass from the left side door windows shattered. Both doors were crushed; however, they remained connected to the fuselage. The tail boom separation at the fan section was jagged in nature. The outside cabin area portion of the fuselage from the aft doors to the fan and engine sections were thermally damaged and soot marked.

1.12.2 Wreckage Layout

Investigators from the Safety Board, the FAA, Boeing, Rolls-Royce Corporation and SBSD, who were parties to the investigation, examined the wreckage in a hangar at the San Bernardino Airport, San Bernardino, California, on October 4, 2002.

1.12.2.1 Airframe

Investigators noted that the circuit breakers for the following systems had been tripped: FADEC, Instrument out, and Lojack (stolen vehicle recovery system).

Investigators noted that the upper flight controls to include the collective, lateral and longitudinal links; the collective/cyclic mixers, scissors assembly, and the rotation and stationary swashplates were intact. The control linkage from the collective control stick to the engine control linkage was continuous for the N1 (Gas Producer) and N2 (Power Turbine) linkages. According to the Boeing representative, full range motion of the collective control stick head, throttle twist grip, and related collective control linkages was not possible due to impact damage.

Investigators established flight control continuity to the cyclic control linkage in the cockpit. The cyclic control torque tube separated, which disconnected both the cyclic inputs. The separation was angular and granular in appearance. The longitudinal and lateral cyclic control linkage remained connected from the lower end of flight station (FS) 78.50 control column to the forward roof-mounted bellcrank, back to the aft roof-mounted bellcrank, to the longitudinal and lateral idler bellcranks, and the upper flight controls.

The collective linkage remained intact; however, it could not be moved due to the impingement of the left forward landing gear, and the damper and support structure on the collective linkage. Control continuity of the collective linkage remained connected from the lower end of

FS 78.50 control column to the forward roof-mounted bellcrank, the aft roof-mounted collective bellcrank, to the collective pitch mixer bellcrank.

The anti-torque flight control linkage from the pedals to FS 78.50 control rod were fractured and damaged, and were unable to be manipulated. The control linkage of the anti-torque flight control linkage remained connected from the lower end of FS 78.50 control column to the forward roof-mounted bellcrank, aft roof-mounted bellcrank, and the splitter assembly, to FS 137.0. According to the manufacturer, at FS 137.0 the thruster control center cable separated from the intercable connector due to the tail boom fracture at FS 160. The thruster cable remained connected to FS 230.0 bellcrank at the back of the tail boom. Continuity was established from the FS 230.0 bellcrank through the aft control rod to the cables for the input and output drum assemblies, and also to the control rod to the right and left moveable vertical fins. Continuity was also established from the control linkage of the splitter assembly of the fan pitch control.

According to the Boeing investigator, the main rotor system had visible damage, which was consistent with high flapping angles, and "lead lag excursions" from multiple ground and tail boom strikes. Four of the six main rotor blades had bent spars and skin delamination with trailing edge separations. The fifth main rotor blade had minor damage. A sixth blade had no damage. According to the manufacturer, the damage to the blades was consistent with a low rotor rpm operational state.

The main transmission displayed heat damage throughout the entire system. The main transmission rotated freely when manually turned. Investigators established drive continuity, through manual rotation, from the transmission to the anti-torque output pinion and fan gearbox drive shaft. The over-running clutch remained intact; however the lower KAMATICS coupling fingers separated, with the separation points being angular (irregular in shape) and granular in nature.

The helicopter was equipped with two interconnected crash-resistant non-self-sealing bladder type fuel cells that were certified in accordance with 14 CFR Part 27.952 (Fuel System Crash Resistance). Fire damage was noted to the lines at fittings at the firewall; however, no visible seepage was noted from the fuel system. According to the manufacturer, the fuel shutoff was in the open position and did not function due to the impingement of the control cable from damage sustained by the left forward cabin floor and lower left frame at FS 78.50.

1.12.2.2 Engine

Visual examination of the engine revealed that the fuel inlet line "B" nut connection to the HMU (hydromechanical unit) was loose by 2 flats or 1/3 of a turn. The ECU fault codes were downloaded during the field investigation with no recorded hard faults.

The engine and engine compartment sustained fire damage. The compressor, NG, and NP sections manually rotated with no binding encountered. Investigators established continuity of both the NG (gas producer) and NP (power turbine) to the accessory gearbox drive pads and to the power turbine output shaft.

The engine fuel filter contained a fibrous pink material. According to the engine manufacturer, the amount of fibrous material was not sufficient to result in a bypass condition.

The teardown inspection revealed that all shafting was continuous throughout the engine, the bearings were lubricated and rotated freely, and there were no hardware failures. The

inspection also revealed no contact between the turbine wheels and their respective stators and shrouds, as well as no contact between the compressor impeller and the impeller shroud.

1.16 TESTS AND RESEARCH

The power turbine section, bleed valve, and fuel nozzle were inspected at H.E.R.O.S., Inc., Riverside, California, on October 21, 2002, under the auspices of the Safety Board. Technicians noted no discrepancies with the power turbine section. They performed a functional check of the bleed valve. Test parameters were in the as received and the overhaul adjustment conditions. They noted no mechanical anomalies at the sea level test points. A functional check of the fuel nozzle in the as received condition and overhaul condition revealed no discrepancies for the flow limits or spray angle. There was an exception at test point 4 - inlet pressure (psi) at 125 psi. The value recorded was 56.0-lb/hr flow; the minimum flow limit for the functional check was 58.0 lb/hr. They noted no mechanical anomalies with the tested components.

An engineer in the Safety Board's materials laboratory examined the fuel filter from the helicopter and clusters of what appeared to be dark brown fibers that were entrapped on the exterior surface of the fuel filter's metal screen. Also sent in for comparative examination were sample fibers obtained from another helicopter and a fuel truck located at the same base of operations. The examination revealed that the submitted fibers were similar in appearance and pink in color. A Fourier Transform Infra-Red (FTIR) analysis was conducted and revealed that the fibers were a similar cellulose based compound.

The ECU (electronic control unit), serial number JG6ALW0027, and HMU (hydromechanical unit), serial number JGALM0518, was inspected on November 5, 2002, at the Goodrich Pump and Engine Control Systems (GPECS), West Hartford, Connecticut, under the auspices of the Safety Board. The visual inspection revealed that the ECU sustained fire damage. The non-volatile memory was downloaded, with no fault conditions found in the LAST ENG RUN or ACCUMULATED FAULT memory. The accident ECU did not contain the software for the incident recorder function. A functional and fault isolation vibration/temperature test was conducted with no anomalies noted. According to the manufacturer there were no defects with the ECU.

The visual examination revealed that the HMU (hydromechanical unit) sustained fire damage. A functional check/acceptance test of the HMU in the as received condition was conducted with no mechanical anomalies encountered. Following the acceptance test, an evaluation test was conducted on the effect of a loose inlet line fitting from the fuel line to the HMU. Two test trials were conducted. According to GPECS technicians the initial conditions were set at:

Pump speed: 3500 rpm

Metered fuel flow: 350 lb/hr

Discharge Pressure: 450 psig

Elevation of HMU: 3 feet

Introduced error: inlet fitting initially loosened by two flats, then by one flat increment.

Time: At each step, the HMU was run for 2 minutes.

According to GPECS technicians, during the first test, they noted significant fluctuations in

metered flow with the fitting (nut) loosened by three flats (1/2 turn). During the second test, disruptions in the metered flow were not evident until the fitting (nut) had been loosened to one full turn. Personnel from GPECS reported that the HMU was functional in both the auto and manual modes. The functional checks met the new part acceptance limits, and there was no evidence of a mechanical malfunction that would have "contributed to the accident."

Saybolt LP laboratory tested the 2 gallons of fuel retrieved from the fuel tank. The results for particulate contamination were 0.81 mg/l. The maximum allowable particulate contamination is 1.0 mg/l.

1.18 ADDITIONAL INFORMATION

According to fuel receipts, Air Petro delivered 8,000 gallons of fuel to SBSD on September 9, 2002. Dispenser inspection records obtained from SBSD indicated no discrepancies with the daily fuel sump inspection. Daily fuel inspections take place at the beginning of each day.

The Rolls-Royce Engine 250-C47M FADEC (Full Authority Digital Electronic Control) was installed on the accident helicopter. The ECU did not have incident recorder (IR) software installed, nor was the option available for the accident helicopter.

Witnesses stated that they could not unlatch the harness restraints/lap belts that both pilot's were wearing. The witnesses cut the webbing of the restraint system to get them out.

The Safety Board IIC released the wreckage to the owner's representative on March 3, 2003.

Pilot Information

Certificate:	Flight Instructor; Commercial	**Age:**	54, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim.	**Last FAA Medical Exam:**	09/27/2001
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	11500 hours (Total, all aircraft), 400 hours (Total, this make and model), 11300 hours (Pilot In Command, all aircraft), 100 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Other Flight Crew Information

Certificate:	Private	**Age:**	38, Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	07/10/2002
Occupational Pilot:		**Last Flight Review or Equivalent:**	08/28/2001
Flight Time:	83 hours (Total, all aircraft), 11 hours (Total, this make and model), 66 hours (Pilot In Command, all aircraft), 10 hours (Last 90 days, all aircraft), 7 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	McDonnell Douglas	**Registration:**	N625SB
Model/Series:	600N	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	RN033
Landing Gear Type:	Skid	**Seats:**	7
Date/Type of Last Inspection:	10/03/2002, 100 Hour	**Certified Max Gross Wt.:**	4250 lbs
Time Since Last Inspection:	0.3 Hours	**Engines:**	1 Turbo Shaft
Airframe Total Time:	2400 Hours as of last inspection	**Engine Manufacturer:**	Rolls-Royce
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	250-C47
Registered Owner:	San Bernardino County Sheriff's Department	**Rated Power:**	650 lbs
Operator:	San Bernardino County Sheriff's Department	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ONT, 944 ft msl	**Observation Time:**	1653 PDT
Distance from Accident Site:	11 Nautical Miles	**Direction from Accident Site:**	65°
Lowest Cloud Condition:	Clear	**Temperature/Dew Point:**	25°C / 2°C
Lowest Ceiling:	None	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	11 knots, 240°	**Visibility (RVR):**	
Altimeter Setting:	29.94 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:			
Departure Point:	Rialto, CA (L67)	**Type of Flight Plan Filed:**	Company VFR
Destination:		**Type of Clearance:**	None
Departure Time:	1715 PDT	**Type of Airspace:**	Class E

Airport Information

Airport:	RIALTO MUNI/MIRO FLD/ (L67)	**Runway Surface Type:**	Unknown
Airport Elevation:	1455 ft	**Runway Surface Condition:**	Unknown
Runway Used:	NA	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced Landing

Wreckage and Impact Information

Crew Injuries:	2 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Serious	**Latitude, Longitude:**	34.118889, -117.403056

Administrative Information

Investigator In Charge (IIC):	Tealeye C Cornejo	**Adopted Date:**	09/13/2005
Additional Participating Persons:	Ron Gonzales; Federal Aviation Administration; Riverside, CA Shawn Moore; San Bernardino Sheriff's Department; Rialto, CA John Swift; Rolls-Royce Corporation; Indianapolis, IN Adrian Booth; The Boeing Company; Mesa, AZ		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report.