Australian Government
Australian Transport Safety Bureau

Commonwealth Government statutory Agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB does not investigate for the purpose of apportioning blame or to provide a means for determining liability.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements.

When the ATSB issues a safety recommendation, the person, organisation or agency must provide a written response within 90 days. That response must indicate whether the person, organisation or agency accepts the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608
Australia

1800 020 616

+61 2 6257 4150 from overseas

www.atsb.gov.au

Publication Date: July 2011

ISBN: 978-1-74251-189-4

ATSB-July/ATSB03

Released in accordance with section 25 of the Transport Safety Investigation Act 2003

ATSB TRANSPORT SAFETY REPORT

AVIATION OCCURRENCE INVESTIGATION AO-2009-026
Final

Fuel starvation event, VH-JTI Coomera, Queensland 10 June 2009

Abstract

On 10 June 2009, at about 1545 Eastern Standard Time, the pilot of a Bell Helicopter Co Jetranger 206B helicopter, registered VH-JTI, was conducting a 20-minute scenic flight, with four passengers, from a helipad at an entertainment facility at Coomera, Queensland.

After about 15 minutes flying, the fuel boost pump low pressure (FUEL PUMP) warning light illuminated briefly. The pilot believed he had sufficient fuel on board and continued the flight. While the helicopter was descending to land at the helipad, the FUEL PUMP warning light illuminated again and shortly afterwards the engine lost all power.

During the final stages of the autorotative landing, the pilot was unable to arrest the helicopter's descent rate and the helicopter struck the ground heavily, resulting in substantial damage. Two passengers sustained serious injuries; the other two passengers and the pilot were uninjured.

A subsequent check of the helicopter and its fuel system showed that the fuel gauge may have been over reading. The operator's practice when calculating the quantity of fuel to be added during refuelling relied on the fuel gauge reading, without using an independent method to crosscheck that reading against the actual fuel tank quantity.

The investigation found that the helicopter departed with insufficient fuel to complete the flight. The low fuel quantity and manoeuvring combined to uncover the fuel boost pumps and the engine was starved of fuel. The helicopter's low speed, height and rotor RPM at that time precluded a safe landing from the subsequent autorotation.

FACTUAL INFORMATION

History of the flight

On 10 June 2009, at about 1545 Eastern Standard Time[1], the pilot of a Bell Helicopter Co Jetranger 206B, registered VH-JTI (JTI), was conducting a 20-minute scenic flight from an entertainment facility at Coomera, Queensland. There were four passengers on board.

The pilot flew seven previous scenic flights that morning before the accident flight. In addition to his normal duties, he had been demonstrating pre-flight procedures to a trainee pilot.

The accident flight route was initially south-east from Coomera to Broadbeach, then north along the coast to Porpoise Point, before returning in a north-westerly direction to Coomera (Figure 1).

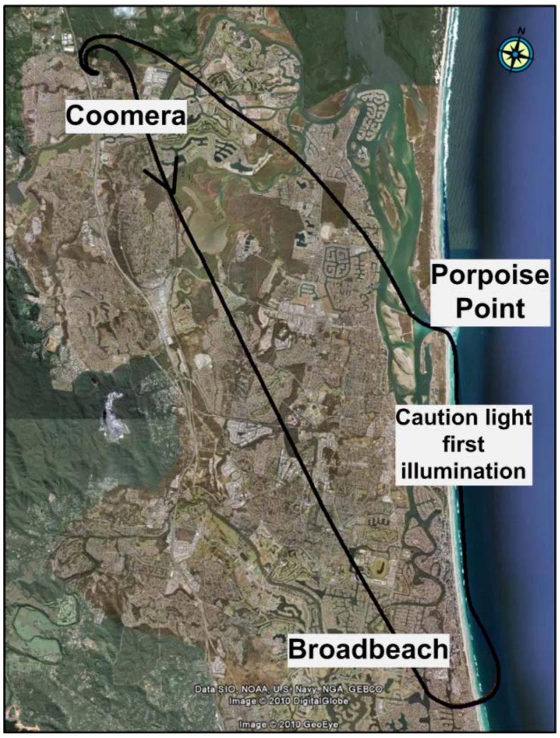
The pilot stated that the flight progressed normally until about 5 minutes before landing when the FUEL PUMP warning light illuminated, indicating low fuel pressure from one or both of the helicopter's electric fuel boost pumps. The pilot checked the fuel gauge, which he recalled

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

indicated 13 United States gallons (USG) (58 L)[2], and decided there was sufficient fuel to continue the flight.

The pilot reported that he had previously experienced a number of erroneous FUEL PUMP warnings that were caused by electrical faults in other Bell 206B helicopters, although not in JTI. Because of those previous experiences, he attempted to troubleshoot the FUEL PUMP warning by individually pulling and re-setting the FWD (forward) and AFT (aft) FUEL BOOST circuit breakers. He thought the aft electric fuel boost pump circuit might not be operating properly and jiggled the AFT FUEL BOOST circuit breaker, after which the FUEL PUMP warning light extinguished. The pilot stated that this confirmed his perception that the warning light had illuminated because of an intermittent electrical problem, not a fuel quantity problem. On that basis, the pilot continued the flight.

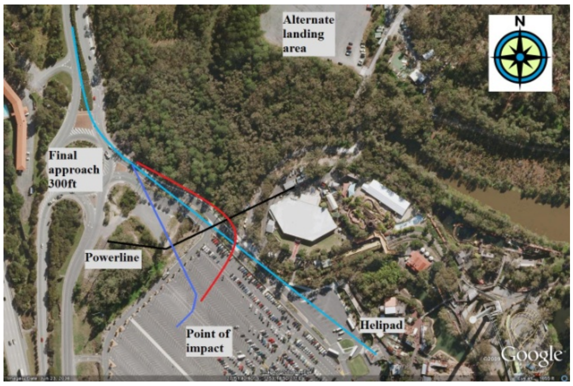
Figure 1: Flight route



The pilot indicated that at about 600 ft above ground level (AGL) during the approach to land, the FUEL PUMP warning light illuminated again. Believing that it was still a result of an electrical fault, he tapped the fuel gauge and the FUEL PUMP warning light on the annunciator panel. The warning light remained illuminated so he pulled the CAUTION LT circuit breaker on the overhead panel and the FUEL PUMP warning light extinguished. The pilot reported that, moments afterwards, when the helicopter was about 300 ft AGL with an indicated airspeed of about 40 kts, the engine lost all power.

The pilot recalled deciding that a forced landing (autorotation)[3] at the entertainment facility helipad would not be possible and elected to use the adjacent car park instead because of its open space (Figure 2). During the autorotation, the pilot had to alter his flightpath to avoid a powerline. The pilot stated that this required a higher collective[4] setting than would normally be used in autorotation, contributing to the main rotor speed reducing to about 74%. In consequence, he was unable to reduce the helicopter's rate of descent sufficiently before touchdown and the helicopter impacted the ground heavily.

Figure 2: Overview of the landing area showing the normal (in sky blue) and intended approach (in red), and actual autorotation (in darker blue) flightpaths



Injuries to persons

The passengers in the front left and rear right seats received serious injuries. The pilot and the other two passengers were uninjured.

2 The fuel gauge on the Bell 206B(II) was calibrated in USG.

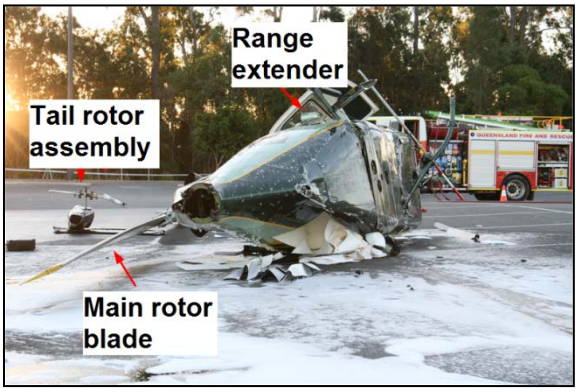
3 The free rotation of rotor blades without engine power.

4 The collective is the lever the pilot uses to alter the pitch of the main rotor blades in a helicopter. Raising the collective in autorotation increases lift at the penalty of reducing rotor RPM.

Damage to the helicopter

There was substantial damage to the underside of the helicopter's fuselage, cockpit plexiglass, skid-landing gear, transmission deck, tail boom, and tail rotor gearbox (Figure 3).

Figure 3: Wreckage site



The fuel tank was punctured by the skid-landing gear rear crosstube, which was driven up through the fuselage by vertical deceleration forces. The main rotor blades were slightly damaged. Examination of the wreckage confirmed that all of the damage was the result of impact forces.

There was no post-impact fire.

Personnel information

The pilot was endorsed on the Bell Jetranger 206B and held an Australian Air Transport Pilot Licence (Helicopter) and a current Grade 1 Instructor Rating (Helicopter). At the time of the accident his total flying time was 4,635 hours, including over 2,000 hours on Bell Jetranger 206B helicopters and over 3,000 hours operating scenic flights in south-east Queensland.

Aircraft information

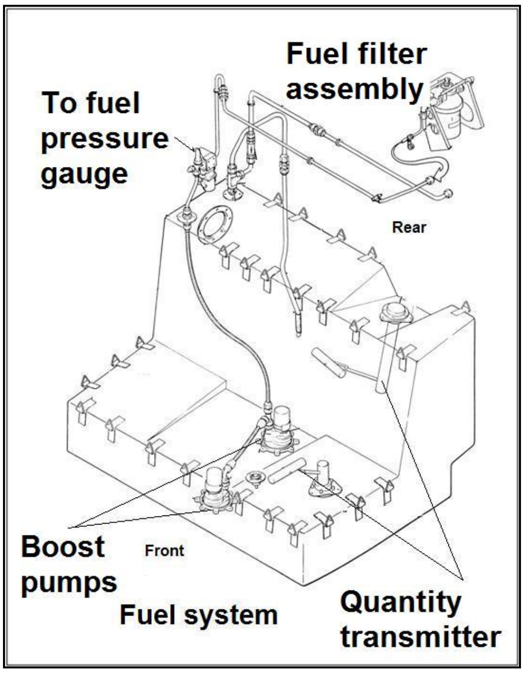
Helicopter fuel system

The helicopter's most recent fuel calibration was conducted in August 2007. The inaccuracy that was identified during that calibration was insignificant. A placard in the cockpit displayed the results of the calibration to pilots in terms of the difference between the fuel quantity in the tank in litres and the fuel gauge reading in USG.

The contents of the single, L-shaped fuel tank were measured by an upper and a lower float sensor unit. The upper float sensor measured the contents in the upper (vertical) section of the tank, while the lower float sensor measured the fuel in the lower (horizontal) section of the tank (Figure 4). The fuel quantity gauge displayed the sum of these two fuel quantity measurements.

Fuel was pumped to the engine by two submerged electric fuel boost pumps that were fitted to the bottom of the fuel tank, one behind the other as shown in Figure 4. The boost pumps supplied fuel to the engine-driven fuel pump under positive pressure. If either electric fuel boost pump failed, or if a pump's intake became uncovered, a pressure sensor on the combined pump outlet would detect the resulting loss of fuel pressure, causing the FUEL PUMP warning light to illuminate on the annunciator panel in the cockpit.

Figure 4: Fuel system



There was a non-return valve between each electric fuel boost pump and the engine. In the event that the inlet to an electric fuel boost pump was no longer covered by fuel, or if a pump ceased to operate, its non-return valve would be closed by the fuel pressure from the other pump. That ensured that fuel would not be pumped back into the tank, that the fuel supply to the engine would continue, and the FUEL PUMP warning light would illuminate.

The Bell Jetranger Aircraft Flight Manual (AFM) required the electric fuel boost pumps to be selected ON at all times during normal operations.

Whereas flight was possible with one or both boost pumps inoperative below 6,000 feet pressure altitude[5], the AFM required a pilot to land as soon as practical in those cases.[6] A warning in the AFM stated that:

> Due to possible fuel sloshing in unusual attitudes or out of trim conditions and one or both boost pumps inoperative, the unusable fuel is ten [US] gallons [38 L].

JTI was not equipped with an optional low fuel warning light system, which included a warning light that illuminated when about 20 USG (76 L) of fuel remained in the fuel tank. The AFM indicated that, in the case of the illumination of the FUEL LOW warning light, the pilot should land as soon as practical.

The helicopter was fitted with a RANGE EXTENDER® that was attached to the helicopter's filler cap assembly and increased the fuel capacity of the aircraft (Figure 3). The design of the RANGE EXTENDER® was such that, once fitted, it was not possible to determine the amount of fuel in the tank using a dipstick.

The AFM listed the fuel tank quantities with and without the RANGE EXTENDER® as shown in Table 1.

Table 1: Fuel tank quantities

Total fuel without RANGE EXTENDER®	291.7 L
Usable fuel without RANGE EXTENDER®	287.7 L
Total fuel with RANGE EXTENDER®	366.0 L
Usable fuel with RANGE EXTENDER®	362.0 L
Unusable fuel (derived from other AFM data)	4.0 L

The Operating Limitations section of the AFM did not include any fuel system limitations. The only reference to fuel quantity in that section of the manual concerned the fuel gauge markings, which included a red line on the empty mark. The AFM did not address minimum fuel quantities for operation.

5 Altitude referenced to a standard pressure of 1013 hPa.

6 The AFM allowed for the choice of landing site and remaining duration of the flight at the pilot's discretion. Extended flight beyond the nearest approved landing area was not recommended.

Warning systems

The helicopter was fitted with a caution system consisting of a row of warning lights on the instrument panel (the annunciator panel) and an aural low rotor RPM warning horn. The purpose of the warning system was to alert the pilot to a condition, fault, or system malfunction that could affect flight safety if not actioned correctly by the pilot.

The warning system was protected by the CAUTION LT circuit breaker. Pulling the CAUTION LT circuit breaker would cut electrical power to the warning lights and the low rotor RPM warning horn, rendering all of them inoperative.

Meteorological information

The weather during the accident was reported to be fine, with a light north-north-westerly breeze. There was no evidence that the weather conditions influenced the circumstances of the occurrence.

Helipad information

The entertainment facility's helipad was located on top of a fuel storage facility on the border between the facility and associated bus parking area. Takeoffs and landings were made to and from the west over a car park and entry road (Figure 2). The pilot reported that, prior to the flight, he had identified two suitable emergency landing areas in the vicinity of the helipad: the entertainment facility car park and an alternate landing area nearby (Figure 2).

Wreckage and impact information

Emergency services personnel noted a small amount of fuel on the ground after the accident.

The helicopter's engine and both fuel boost pumps were tested by the Australian Transport Safety Bureau (ATSB) after the accident and operated normally.

The fuel tank quantity indicating units and the fuel gauge were recovered and tested by the ATSB and found to operate normally. The fuel quantity system could not be tested intact because the wiring loom was severely damaged during the impact.

Contaminants were detected in the fuel system after the accident but the amount found was so small that fuel system contamination was not considered to have been a factor.

Organisational information

The operator had five standard scenic routes that varied in duration from 5 to 30 minutes. The operator's fuel management procedures are discussed in the following sections.

Fuel management practices

The amount of fuel on board was assumed to be that displayed on the helicopter's fuel gauge and there was no independent method of fuel quantity measurement used by the operator. There was no evidence that the pilot checked the fuel gauge reading against the computed fuel on board (see the following discussion titled *Civil Aviation Safety Authority regulations and guidance for fuel quantity measurement*).

The operator's standard operating procedures stated that, for flight planning purposes, cruise fuel consumption in JTI was 110 L/h. The pilot stated that he estimated the helicopter's fuel consumption to be a conservative 100 L/h during scenic flights. He stated that the actual fuel consumption varied depending on factors such as the time spent in the hover and at ground idle.

The operator's normal procedure was to fuel the helicopter to 95 L prior to the first flight of the day, which the pilot reported was sufficient for about 40 minutes flying time[7] plus 20 minutes fixed reserve.[8] The quantity of fuel to be added prior to the first flight of the day was determined by reading the helicopter's fuel gauge and subtracting that amount from 95 L to obtain the quantity to be added by the refueller.

Once a day's operations had commenced, the ground crew would indicate the next flight route to the pilot after each landing. The pilot could then assess whether there was sufficient fuel onboard or whether refuelling was required.

The operator's documentation included a Daily Flight Record Work Sheet and a Daily Aircraft Flight Book. Those were used to record the helicopter's fuel details, passenger numbers and flight times for each flight. The fuel burn on each flight was not recorded.

One means to establish an aircraft's fuel status is to fill its fuel tank and conduct a visual check or measure of the fuel tank's contents, independent of the aircraft's fuel gauges. Completely filling an aircraft's fuel tank on a regular basis also allows an operator to monitor the aircraft's fuel consumption, and to ensure that it corresponds to the fuel consumption figure used during flight planning.

In the case of JTI, the helicopter could often not be fully fuelled because of the routinely high total passenger weights carried.

Fuel

The helicopter's fuel records indicated that there were 57 L remaining on board after the previous day's flying. An additional 60 L were added before the first flight of the day. Four flights, two of 5 minutes duration and two lasting 20 minutes were flown before another 60 L was added. Another two 20–minute flights followed, after which a further 60 L was added. A fourth 20-minute flight preceded the accident flight itself.

Table 2 shows the operator's flight time and fuel added records, and an estimation of the fuel gauge readings before and after each flight. Those estimations were derived using the pilot's fuel consumption figure of 100 L/h. On that basis, 34 L would have remained at the planned completion of the accident flight, the same quantity estimated to have remained after the fourth and sixth flights that day (also see Table 2).

7 About 32 minutes at the operator's published cruise fuel consumption and about 37 minutes at the pilot's estimated fuel consumption for the flight.

8 The minimum amount of fuel that must remain in the tank at all times.

Table 2: Flight times, fuel added, and estimates of fuel used and fuel remaining (at a burn rate of 100 L/h)

Flt no.	Fuel added before the flight (L)	Estimated fuel for the flight (L)	Flight time[9] (minutes)	Estimated fuel burn[10] (L)	Estimated fuel remaining (L)
1	60	117	5	11	106
2	-	106	5	8	98
3	-	98	20	30	68
4	-	68	20	34	34
5	60	95	20	31	64
6	-	64	20	30	34
7	60	95	20	31	64
8	-	64	20	30	34
Total	180		130	205	

Based on the pilot's planned fuel consumption of 100 L/h, the stipulated 20-minute fixed reserve for this class of operation equated to 33 L of fuel.

Civil Aviation Safety Authority regulations and guidance for fuel quantity measurement

In respect of fuel quantity measurement and management, Civil Aviation Advisory Publication (CAAP) 234-1(1) *Guidelines for aircraft fuel requirements* (November 2006) was to be read in conjunction with Civil Aviation Regulations (CARs) 220 and 234. CAAP 234-1(1) Section 12.1 stated that:

> Fuel gauges, particularly on smaller aircraft may occasionally be unreliable. In addition, except when the tank is full, it is extremely difficult to establish the quantity of fuel in a tank unless the aircraft is perfectly level and the manufacturer has provided an accurately graduated dipstick, sight gauge, drip gauge or tank tab. Any direct reading of a partially filled tank must be discounted or rounded down to a figure consistent with the next lower tab or marking unless:
>
> a) The aircraft is level; and
>
> b) The fuel is at or above a tab with a clearly established value; or
>
> c) The fuel gauge reading corresponds to a dipstick value.

In addition, CAAP 234-1(1) Section 13.1 stated:

> Unless assured that the aircraft tanks are completely full, or a totally reliable and accurately graduated dipstick, sight gauge, drip gauge or tank tab reading can be done, the pilot should endeavour to use the best available fuel quantity cross-check prior to starting. The cross-check should consist of establishing the fuel on board by at least two different methods such as:
>
> a) Check of visual readings (tab, dip, drip, sight gauges) against fuel consumed indicator readings; or
>
> b) Having regard to previous readings, a check of electrical gauge or visual readings against fuel consumed indicator readings; or
>
> c) After refuelling, and having regard to previous readings, a check of electrical gauge or visual readings against the refuelling installation readings; or
>
> d) Where a series of flights is undertaken by the same pilot and refuelling is not carried out at intermediate stops, cross-checks may be made by checking the quantity gauge readings against computed fuel on board and/or fuel consumed indicator readings, provided the particular system is known to be reliable.

Additional information

Photographic information

The passenger who was located in the centre rear seat took a number of photographs during the flight. One of those photographs, which was taken when the helicopter was at 600 ft AGL on descent to the helipad, showed the fuel gauge reading about 9 USG (34 L). Another, which was taken about 30 seconds later at 300 AGL and just after the engine lost power, showed the helicopter's instrument panel, the powerlines, and the pilot's intended forced landing area (Figure 5). The instrument readings at that time are listed in Table 3.

9 Includes the time spent on the ground before takeoff and after landing.

10 Affected by the time spent on the ground and hovering during the total flight time.

Figure 5: Forward view from the rear seat at 300 ft during the autorotation

Table 3: Instrument readings at 300 ft

Time	15:51
Global Positioning System (GPS) heading	121 °M
GPS speed	43.6 kts
Airspeed	30 kts
Altitude	300 ft
Power turbine speed	47 %
Rotor RPM (Nr)	74 %
Engine torque	0 psi
Rate of descent	800 ft/min
Compressor turbine speed (N1)	26 %
Compressor turbine outlet temperature	220 °C
Fuel quantity	9 USG (34 L)

Autorotation requirements

According to the AFM, in order to complete a successful autorotation, the pilot was required to:

- maintain main rotor RPM at the high end of the operating range to provide maximum rotor energy to accomplish the emergency landing;
- adjust the collective pitch as required to maintain rotor RPM (Nr) from 90 to 107 %;
- reduce forward airspeed to the desired autorotation speed for existing conditions (50 to 60 knots);
- at low altitude, close throttle and flare to lose excessive speed;
- apply collective pitch as flare effect decreases to further reduce forward speed and cushion landing;
- upon ground contact, collective pitch should be reduced smoothly while maintaining the cyclic control in the neutral or centred position.

High main rotor RPM is essential during an autorotation so that there is sufficient energy in the main rotor to enable a pilot to arrest the descent and touchdown with minimal rate of descent.

Similar occurrences

There have been a number of fuel starvation occurrences involving Bell 206 helicopters throughout the world. Despite regulatory, operator and manufacturer action in an effort to prevent their recurrence, they continue to give cause for concern.

In 2006, the Irish Air Accident Investigation Unit published an accident report that found that the pilot relied solely on the fuel gauge for fuel quantity measurement.[11] Subsequently, the Irish Aviation Authority issued an aeronautical notice recommending that pilots of Bell 206 helicopters flight plan to a minimum indicated contents of 20 USG (75.7 L).

In 2002 and 2004, the ATSB released reports involving Bell 206B helicopters that experienced fuel starvation.[12,13] Both helicopters were involved in fire control operations and may have been affected by 'fuel sloshing', which occurs at low fuel quantities when turbulence or out-of-balance flight causes the fuel to move within the tank. If that movement is sufficiently pronounced, the fuel boost pump intake(s) may become uncovered.

The 2002 report involved a Bell 206B that entered turbulence and became out-of-balance,

---

11 http://www.aaiu.ie/AAIUviewitem.asp?id=12296&lang=ENG&loc=1280

12 http://www.atsb.gov.au/publications/investigation_reports/2001/aair/aair200104604.aspx

13 http://www.atsb.gov.au/publications/investigation_reports/2003/aair/aair200304105.aspx

which led to fuel sloshing and resulted in an engine failure. The ATSB recommended that the manufacturer should incorporate information in the AFM about the risk of uncovering the fuel pump inlets during out-of-balance flight with low fuel. The following response to that recommendation was received from the manufacturer on 30 September 2004.

> [The manufacturer] believes that maintaining trimmed flight is a requirement of basic airmanship in any helicopter and not appropriate for inclusion in specific model helicopter flight manual.

In 2007, the ATSB investigated an occurrence involving a turboprop commuter aircraft that lost power on one engine during an approach to land.[14] The investigation found that the operator's procedures for checking fuel quantity did not incorporate an independent crosscheck. Those procedures were subsequently changed by the operator. In addition, a safety issue titled *Regulatory guidance for fuel quantity measurement* was identified, which stated that:

> Regulatory guidance regarding the measurement of fuel quantity before flight lacked clarity and appropriate emphasis and it did not ensure that the fuel quantity measurement procedures used by operators included two independent methods.

In response to that safety issue, CASA stated that an amendment to CAAP 234 was being undertaken. At the time of writing, that amendment had not been implemented.

ANALYSIS

The pilot was appropriately qualified for the flight and was experienced in the conduct of scenic flights from the entertainment facility. The ambient conditions for the flight were not a factor and the on-site and technical examination of the helicopter and its systems found nothing that might have contributed to the development of the occurrence.

The following analysis examines a number of operational, technical, procedural and pilot performance factors during the final phase of the flight, and their contribution to the loss of engine power and subsequent landing.

Operator's fuel management

Despite the regulatory and other requirements to check the helicopter's fuel quantity by two independent means, the operator allowed the determination of fuel quantity by reference to the fuel gauge only. That meant that, if the helicopter's fuel gauge was inaccurate, the pilot could not be assured of exactly how much fuel was in the tank.

Because of the type of operations, the helicopter could not often be fully fuelled as a means to independently check the amount of fuel on board. Similarly, the fitment of the RANGE EXTENDER® precluded the use of a dipstick to check fuel tank quantity, and the pilot did not correctly interpret the available fuel-related data to identify any difference between the tank and gauge readings. The absence of any independent means of checking the helicopter's fuel quantity meant that the pilot was reliant on the accuracy of the fuel gauge.

The loss of power approaching the helipad, and witness reports of minimal fuel in or around the wreckage after the impact, suggested that low fuel was a factor. This, together with the successful operation of the engine after the accident supported that conclusion, and that the engine lost power because of fuel starvation. Any unusual attitudes or out-of-balanced flight during the approach to the helipad increased that risk.

Fuel measurement

The power loss occurred shortly after the fuel gauge indicated about 9 US gallons (34 L). Given the normal function of the boost pumps at test, and the helicopter's unusable fuel of 4 L, the fuel gauge may have been over reading at the time.

However, despite the almost 2 years since the last fuel gauge calibration, the insignificant gauge inaccuracy at that time and the successful conduct of the earlier flights that day to land with an estimated 34 L of indicated fuel remaining may suggest that gauge inaccuracy was not a factor. Of consideration, the previous Bell 206 fuel-related accidents that were examined as part of the investigation, in which fuel sloshing was a factor

14 http://www.atsb.gov.au/publications/investigation_reports/2007/aair/ao-2007-017.aspx

during flight with reduced fuel, could indicate an unintentional period of unbalanced flight during the initial stages of the approach to land. That could have uncovered the fuel boost pumps and starved the engine of fuel.

The manufacturer's optional low fuel warning light installation offered an additional means to check the fuel quantity that was independent from the fuel gauge. If fitted to JTI, and based on the pilot's fuel consumption rate of 100 L/h, that system would have alerted the pilot to the helicopter's low fuel state about 25 minutes prior to the power loss - that was, during the previous flight. The need in such cases to land as soon as practical would have required the pilot to reconsider the conduct of the scenic flights that day.

In-flight factors

In combination with his reliance on the fuel gauge, the pilot's previous experience with erroneous FUEL PUMP warning light illuminations in Bell 206B helicopters predisposed the conclusion that the illumination of the FUEL PUMP warning light was symptomatic of an electrical problem. The pilot's understanding that he had enough fuel on board lead him to troubleshoot the warning light, instead of landing as soon as practical in accordance with the Approved Flight Manual.

Autorotation management

In addition to deactivating the caution lights on the annunciator panel, pulling the CAUTION LT circuit breaker deactivated the low rotor RPM warning horn. Consequently, when the main rotor RPM decayed during the forced landing, the provision of an aural alert to the pilot was not possible.

Any power loss requires an immediate response from the pilot and at the time, the pilot's attention would have been focussed outside the cockpit to visually assess progress towards the chosen forced landing site. The absence of the low rotor RPM warning horn may have delayed the pilot's recognition of the power loss, and permitted a significant decay in the main rotor RPM before any reaction. This, in combination with the use of collective to avoid the powerline, reduced the energy in the main rotor that was available for the landing. The low airspeed and altitude at that time further degraded the helicopter's autorotative performance and a heavy landing resulted.

FINDINGS

Context

From the evidence available, the following findings are made with respect to the fuel starvation occurrence at Coomera, Queensland on 10 June 2009 involving Bell Helicopter Co Jetranger 206B, registered VH-JTI. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The operator did not have a procedure in place to ensure independent crosschecking of the helicopter's fuel quantity. *[Minor safety issue]*
- At takeoff, there was insufficient fuel on board the helicopter to ensure the safe completion of the flight.
- The pilot did not associate the illumination of the FUEL PUMP warning light with a possible low fuel state because of his previous experience where such illuminations were a consequence of electrical system faults.
- The combination of low altitude, airspeed and main rotor RPM meant that there was insufficient energy in the main rotor for the pilot to arrest the descent rate prior to landing.

Other safety factors

- The helicopter's fuel gauge may have been over reading.
- The pilot deactivated the caution lights on the annunciator panel, which also deactivated the low rotor RPM warning horn.
- The low fuel quantity approaching the helipad increased the risk that any unusual attitudes or out-of-balance flight may uncover the fuel boost pump(s).

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Helicopter operator

Fuel quantity crosscheck

Minor safety issue

The operator did not have a procedure in place to ensure independent crosschecking of the helicopter's fuel quantity.

Action taken by the helicopter operator

The operator no longer operates any aircraft in Australia.

SOURCES AND SUBMISSIONS

Sources of information

The sources of information during the investigation included:

- the pilot
- the passengers
- the helicopter's flight manual
- Civil Aviation Regulations
- Civil Aviation Advisory Publications.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the pilot, the Transportation Safety Board of Canada, the operator, the helicopter manufacturer and the Civil Aviation Safety Authority.

Submissions were received from the helicopter manufacturer and the pilot. The submissions were reviewed and, where considered appropriate, the text of the draft report was amended accordingly.