Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06P0190

LOSS OF CONTROL – TRANSMISSION PYLON SUPPORT SPINDLE FRACTURE

QUANTUM HELICOPTERS LTD.
BELL 206B (HELICOPTER) C-GSLV
ALICE ARM, BRITISH COLUMBIA
19 SEPTEMBER 2006

Canada

Aviation Investigation Report

Loss of Control – Transmission Pylon Support Spindle Fracture

Quantum Helicopters Ltd.
Bell 206B (Helicopter) C-GSLV
Alice Arm, British Columbia
19 September 2006

Report Number A06P0190

Summary

At about 0710 Pacific daylight time, a Bell 206B helicopter (registration C-GSLV, serial number 4199), with one pilot and two passengers on board, departed from a service landing area about 0.5 nautical miles (nm) from the village of Alice Arm, British Columbia. The flight was conducted under visual meteorological conditions. This was the first flight of the day and the pilot was conducting a crew change at a resource exploration drill site about 6 nm to the north. The flight departed on a northeast heading across the tidal estuary in front of the village and crashed in the estuary 0.5 nm from the departure point. It was low tide at the time. The helicopter was destroyed and all three persons were fatally injured. There were indications of a small post-impact fire that self-extinguished. There were no eyewitnesses.

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

The daily routine for the helicopter operation consisted of two trips to the drill site in the morning and two trips in the evening to accomplish crew changes. During the day, the helicopter delivered barrels of diesel fuel to the drill site and carried sling-load boxes of core samples and empty barrels from the drill site. Due to the short trip lengths, the helicopter was not normally carrying full fuel. At the time of the accident, the wind was calm with clear skies and a thin shallow layer of ground fog. The ground fog had dissipated by 0720 Pacific daylight time[1] when first responders arrived at the accident site. Members of the Royal Canadian Mounted Police (RCMP) and the coroner arrived before anything was moved from the accident site. The pilot and passengers were removed from the aircraft and then another helicopter dragged the wreckage higher up the shore to prevent it from being submerged by the rising tidal waters. As the tide continued to rise, the wreckage was separated and transported back to the departure point. TSB investigators arrived at the site later on the day of the accident and conducted an initial examination of the wreckage.

Weight and Balance

Both passengers were seated in the rear seats. Because actual figures are not known, the weight and balance condition for the helicopter was estimated for various conditions of passenger weights, seating configuration and fuel loads. The helicopter would have been within the maximum certificated take-off weight limit using estimated passenger weights and a full fuel load. With both passengers in the rear seat, the helicopter would have been within both the longitudinal and lateral centre of gravity for all weight scenarios.

Flight Crew

The pilot held a valid Canadian commercial pilot licence – helicopter. The medical certificate imposed a restriction requiring glasses to be available. A pilot proficiency check was carried out on a Bell 206B helicopter on 03 July 2006 and was valid until 01 August 2008. He had a total of 9100 flight hours with 7200 hours on helicopters. A review of the pilot's flight and duty time records for the period leading up to the accident did not reveal any deviation from Transport Canada (TC) regulations nor suggest that fatigue would have been a factor. A post-mortem examination did not find any indications of incapacitation or pre-existing medical condition that could have contributed to the circumstances of this accident.

Survivability

The helicopter struck the ground in a steep descent and a nose-down, left-side-low attitude. The large impact forces compromised the living space of the aircraft and the accident was not survivable.

---

[1] All times are Pacific daylight time (Coordinated Universal Time minus seven hours).

Site Examination

Ground scars indicated that the helicopter struck the level ground and bounced about one aircraft length in the direction of travel. The airframe belly broke laterally at the locations of both skid gear cross tubes. Additionally, there was a diagonal belly fracture from the aft door post of the left-hand rear door forward to the vicinity of the pilot foot pedals. The upper cabin roof structure, including the load beam, broke beneath the main transmission.

The helicopter had been re-fuelled at a fuel cache of barrels located across the inlet from the helicopter service landing area. Samples were taken from the fuel barrel, filters, and the pump, as well as from the helicopter; visual examination did not detect any water or particle contamination.

No fire was reported; however, soot deposits, indicative of a small fuel-fed post-impact fire, were observed on the exterior engine cowling below the right-hand exhaust collector stack and on the last stage power turbine blades. A fire at this location would indicate the presence of fuel and continuity of the flame in the engine combustion chamber.

The main rotor blades exhibited extensive damage consistent with a rapid deceleration. Both blades had been severed at the end of the doublers, about four feet from the root ends. One had been thrown an estimated 150 feet from the crash site and the other remained with the balance of the wreckage. The blade at the wreckage site exhibited impressions directly on the leading edge and on the top side of the blade made by stones in the silt. The blade that was thrown from the wreckage site was uniformly bent in the coning direction throughout its length. The leading edge did not exhibit impact damage of any significance.

Aircraft Examination

Engine

The engine teardown examination revealed foreign-object damage (mud) ingestion as far as the fifth stage compressor disk. There was evidence of rotational contact throughout the compressor, particularly between the centrifugal impeller vanes and the diffuser scroll, which is consistent with a forward impact. All bearings were intact and lubricated. Operation of the input freewheel unit was confirmed. The examination did not reveal any damage indicative of a pre-impact mechanical failure within the engine.

Flight Controls

The helicopter was not equipped with dual controls and was being flown from the right-hand seat. The collective grip was found in the normal, full throttle position. The collective and cyclic flight control systems were closely examined for possible failure modes, but all damages were attributed to impact forces. The collective control tubes from the centre hydraulic servo to the transmission-mounted bell crank and then to the swash plate assembly remained intact. Both cyclic control tubes between the swash plate assembly and the bell cranks mounted on the fuselage remained intact and attached.

Continuity of the anti-torque control system was established from the pilot pedals to the tail rotor hub assembly. One break in the tail rotor driveshaft was caused by a reverse torsion twist a few inches forward of the tail rotor gearbox, which implies that the driving end of the shaft stopped first and that the tail rotor still had enough energy to twist the driveshaft. There was no leading edge damage to either tail rotor blade, although one was bent chord-wise near the root end.

Hydraulic Servo Actuators

All three hydraulic servo actuators, the hydraulic reservoir, and the hydraulic pump were removed for examination and testing. When subjected to an "as received" bench test, the right-hand cyclic servo, the centre collective servo, and the pump operated as expected. The left-hand cyclic servo exhibited a displaced spherical bearing at its lug attachment indicative of a side impact. This servo did not develop any actuator movement at hydraulic pressures up to 280 pounds per square inch (psi); whereas, it should move at pressures above 105 psi (600 psi is the normal operating pressure). The test was therefore discontinued in favour of disassembly. During disassembly, signs of normal wear were evident, but nothing notable was found. In summary, nothing about this servo appeared likely to be a causal element. It was re-assembled and subjected to the full range of post-overhaul test procedures along with the other two servos. The left-hand cyclic servo then functioned normally in all respects except for internal leakage rates, which were similar to the other two servos. It could not be determined why it did not operate on the test bench initially.

Hydraulic Oil

Samples of hydraulic oil from all three servos as well as small amounts of debris collected in the filters were analyzed by an independent laboratory. The analysis concluded that some samples contained particulate and water contamination and that the samples were generally dirty. One sample contained steel particles indicative of abnormal wear. It is likely that this sample was contaminated when the piston rod assembly steel bolt attachment was separated from the servo housing during the examination. While contamination of the hydraulic oil could be problematic, it was not shown to be the case.

Main Transmission

The transmission, part number 206-040-002-027, serial number B50803, was the original transmission installed on the helicopter. It has a service life of 4500 hours time before overhaul. It was removed in 2004 for overhaul with 4499.0 hours since new and was re-installed with 0 hours since overhaul. The overhaul included replacement of both transmission pylon support spindles (part number 206-031-554-003) with repaired units. Maintenance records indicated that the transmission was last removed and re-installed for a 1500-hour inspection in August 2006 (six weeks before the accident) with a time since overhaul of 1477.5 hours. The left-hand pylon support spherical bearing was replaced at the 1500-hour inspection. Otherwise, nothing unusual was identified. A diagram of the main transmission assembly is attached at Appendix A.

The rotor mast was bent below the rotor head static stops, but did not exhibit any torsion deformation and the rotor mast could be turned from the transmission input quill. The transmission remained attached to the airframe structure by the left-hand pylon support spindle and pylon link assembly, as well as miscellaneous hoses and all three flight control tubes. The reinforcing plate surrounding the pylon stop[2] beneath the transmission was damaged on the top surface, but the pylon stop itself received only minor damage. The drag pin was separated from the transmission where the attachment hardware was sheared. The top left side of the adjacent isolation mount exhibited rotational contact damage made by both flanges of the forward coupling of the main driveshaft. The transmission casing was intact, but the attached right-hand pylon support spindle was found broken at the root end of the journal section; the journal section, radius washers, retention nut, and cotter pin were not recovered.

The transmission was disassembled and inspected. Nothing abnormal was observed that might indicate a vibration-induced stress or wear on the spindles. Information provided by Bell Helicopter Textron Inc. (BHTI) indicates that there are no vibration specifications for the transmission and that any loads on the spindles produced by transmission vibrations would be negligible.

The main driveshaft forward coupling case was broken and the inner spherical gear teeth were chipped and ground away at the fore and aft top corners, which indicate that the shaft was rotating while misaligned. There were no signs that the shaft was flailing; therefore, it was not broken while it was rotating. There were no signs of slippage or overheating; therefore, the shaft was not misaligned for very long.

Pylon Support Spherical Bearing

Neither the right-hand pylon support spherical bearing, which connects the spindle to the support link attached to the fuselage, nor the support link exhibited any significant impact damage. This is contrary to the significant damage that would be expected to the spherical bearing and the pylon support link had the spindle fractured due to impact forces. The left-hand pylon support spherical bearing, which had been replaced at the last 1500-hour transmission inspection, did not exhibit visual signs of wear. The right-hand pylon support spherical bearing exhibited some looseness indicative of wear. Measurement indicated axial play of 0.024 inches where 0.010 inches is the maximum specified. Anecdotal evidence indicates that the life expectancy of spherical bearings varies from hundreds to thousands of flight hours.

The Federal Aviation Administration (FAA) Service Difficulty Reporting (SDR) database contains a small number of records of worn pylon support spherical bearings, but none provided meaningful details. Maintenance records provided by the operator did not record that the right-hand spherical bearing had been replaced at any time or what the condition of it was at the last inspection. The inspection of spherical bearings and bushings of transmission pylon support links is a required item in a 100-hour maintenance inspection. The last 100-hour

---

2 The pylon stop is a rectangular hole in a plate on top of the fuselage. The drag pin, on the bottom of the transmission, sits within this hole and makes marks on the edges of it if excessive movement of the transmission occurs.

inspection was completed on 28 August 2006 at 6074.0 hours of total time on the airframe (TTAF) and recorded that there were no defects that required correction. The helicopter had 6165.7 hours of TTAF when the accident occurred. BHTI states the following:

> If the bearing is worn enough, the worst case scenario would be for the ball to come out of the bearing outer race, but there is a large washer under the spindle nut to prevent this. However, the lateral displacement would affect the pylon tilt and the control couplings which would increase the pilot workload significantly.

There were no records of pilot complaints about flight characteristics of the helicopter, and it is not likely that this aircraft is the first occurrence of a spherical bearing worn beyond specified limits. The Bell 206B series helicopter has been flying for more than 40 years and no records of failures in the journal section of unmodified spindles for Bell 206B helicopters in civilian use were identified during the investigation.

Examination of Pylon Support Spindles

A collection of four parts exhibited fracture surfaces of possible interest: one main rotor pitch change rod, the collective pitch link, the left-hand cyclic yoke, and the right-hand main transmission pylon support spindle. These components were sent to the TSB Engineering Laboratory for metallurgical examination. With the exception of the spindle, all fracture surfaces were found to be consistent with overload. The examination of the spindle identified crack arrest markings on the fracture surface of the journal section consistent with a progressive fatigue failure mode. The fatigue was visually estimated to have progressed through more than 90 per cent of the cross-sectional area before the final overload event resulted in complete failure. Photo 1 shows an exemplar spindle and Photo 2 shows the fractured right-hand spindle from the occurrence aircraft.

Photo 1. Exemplar pylon support spindle

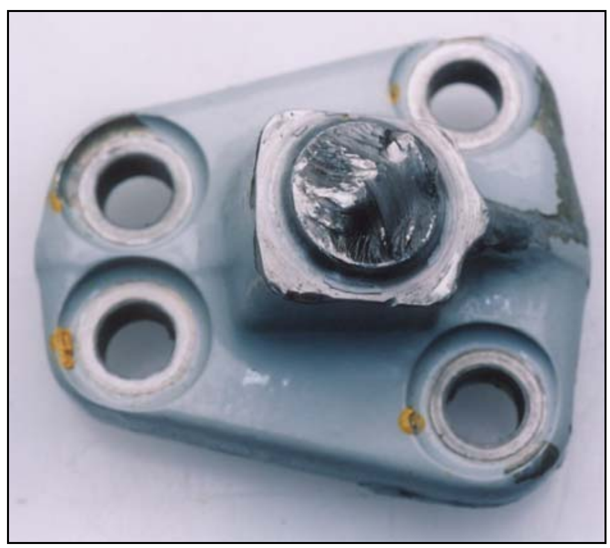

Photo 2. Fractured right-hand pylon support spindle

Both spindles were identified as part number 206-031-554-003. Serial number B12-14395 was the fractured right-hand spindle and B22515 was the intact left-hand spindle. The history of the spindles was not known in the early phase of examination; therefore, only a representative with metallurgical expertise from BHTI was invited to attend the examination at the TSB Engineering Laboratory facilities. Scanning electron microscope examination of the right-hand spindle confirmed fatigue as the primary mode of failure and vibratory loading as secondary. A second distinctive feature of the fracture surface was the presence of a thin annular ring, of a more crystalline appearance, around the full circumference of the journal. Such a feature would be consistent with a layer of plated material, indicating that a repair had been made. Coincident with the crack location was the presence of a subsurface radius produced by a grinding operation.

Examination of the left-hand spindle from the subject transmission also identified the commencement of cracks, limited to the plating layer, in the same region of the subsurface radius. This suggests that a stress concentration feature introduced by the repair was responsible for cracking at this particular location.

Cadorath Aerospace Inc. is a TC–approved repair facility and held a Repair Design Certificate (RDC) specific to the dimensional restoration repair of BHTI Bell 206B pylon support spindles. About 10 per cent of the spindles repaired by Cadorath Aerospace Inc. were received from service by the TSB Engineering Laboratory for examination; none showed signs of similar cracking. The metallurgical analysis identified three issues regarding the repair that could have had detrimental effects on the fatigue properties of the material: the dimension of the subsurface radius produced by grinding, the absence of shot peening prior to chromium plating, and plating of a critically loaded radius.

The spindles do not have a life limitation and are maintained as an "on-condition"[3] item. The transmission was overhauled by Aero-Smith Heli Service in 2004, when it was determined that both original spindle (serial numbers B22515 and B22558) journals were worn and did not meet the dimensional specifications. The removed pair plus one more (serial number B12-14395) were sent to Cadorath Aerospace Inc. for repair. When the three repaired spindles were returned, two (serial numbers B22515 and B12-14395) were retrieved from inventory and installed on the subject transmission. Information obtained indicates that the right-hand spindle (serial number B12-14395) had in excess of 13 000 hours of air time. The Cadorath Aerospace Inc. repair process included two successful non-destructive test (NDT) inspections performed at different stages of the repair process. The TSB Engineering Laboratory examination did not find any evidence of pre-existing cracking in the substrate material of either spindle, which supports the NDT results.

Incorrect installation of the inner (chamfered) radius washer on the spindle journal was examined as a possible source of stress on the journal. Placing the chamfered washer backwards would result in outward displacement of the spherical bearing and, consequently, increase the

---

[3] This term has its roots in the discipline of Reliability-Centered Maintenance (RCM), which focuses on achieving the inherent safety and reliability capabilities of equipment and can be defined as "Scheduled inspections to detect potential failures." Reference: Service Difficulty Reports, *Feedback*, Issue 1/2007.

risk of the non-chamfered side of the washer damaging the blend radius at the intersection of the journal and shoulder of the spindle when the retention nut is tightened to allow insertion of the cotter pin on the outside of the nut. The TSB Engineering Laboratory was requested to specifically examine the journal stub of the fractured spindle for indications that this washer may have been installed backwards; no such indications were found.

Pylon Support Spindle Repairs

Canada is the design certificate holder for the Bell 206B series helicopter. TC is the authority to approve the manufacture or repair of aircraft and aircraft parts in Canada. Therefore, TC also holds the authority to approve repair procedures.[4] This can be done by authorizing Design Approval Representatives (DARs) to act on behalf of TC. The process and approval requirements of a repair procedure (granting of an RDC) are contained in Part V, Airworthiness, of the *Canadian Aviation Regulations* (CARs). Part V, Subpart 13, Approval of Modification and Repair Designs, Subsection 513.11 (1) of the CARs states, in part, the following:

> The Minister shall [. . .] issue [. . .] a repair design certificate for each design change to an aeronautical product if
>
> *(b)* the type design of the aeronautical product with the design change incorporated provides a level of safety at least equivalent to the level provided by the basis of certification that applied before the design change was incorporated.

Cadorath Aerospace Inc. is a TC–approved repair facility and held an RDC specific to the dimensional restoration repair of BHTI Bell 206B pylon support spindles granted in 1998 by a DAR.

Several engineers were involved in the design and approval of the subject repair procedure. A review of supporting documentation indicates that one page of an obsolete Bell Helicopter Company drawing of the pylon support spindle was referenced for the repair design (the manufacturer does not normally release this proprietary information). The drawing contained a stamp labelled "Critical Part." The design implication of this classification was recognized in the supporting documentation, and it was stated that the repair did not compromise the strength and the critical characteristics of the journal and that the original design data properties of the spindle were not changed by the repair.

The documentation reviewed did not indicate how the level of integrity appropriate to a critical part was ensured. The definition of a critical part applicable to normal category rotorcraft was not introduced in the United States *Federal Aviation Regulations* (Section 27.602) until 1999 and in CARs (Section 527.602) until 2003. The current definition of a critical part is found in Subsection 527.602(a) of the CARs: "A part, the failure of which could have a catastrophic effect upon the rotorcraft, and for which critical characteristics have been identified which, in turn, must be controlled to ensure the required level of integrity."

---

4 *Aeronautics Act*, Section 4.9, Part V, Section 13 of the CARs.

Loads carried by a structural part are described as static or dynamic in nature. The difference between these types of loads plays a pivotal role in the original design of a part as well as subsequent repair procedures.[5] When discussing the role of the pylon support spindles, some engineers assessed the spindle as carrying static loads, while others assessed it as carrying dynamic loads. The supporting documentation for the repair identified the spindle as a static component. The manufacturer indicates that the spindles carry both types of loads. Reference documentation regarding plating procedures is contradictory. For example, Defense Standard 03-31/1, Section 9, stipulates that chromium plating must stop short of stressed fillet radii, whereas Federal Specification QQ-C-320B, Section 3.2.7, stipulates that plating shall cover all surfaces including roots of threads, corners and recesses.

The BHTI Component Repair and Overhaul Manual imposes limitations on the maximum wear and the damage and repair depth[6] for specific areas of spindles. The manual states that the limits set forth are the maximum acceptable, and parts exceeding these limits shall be scrapped.[7] For the spindle journal and associated fillet radius, mechanical or corrosion damage of up to 0.020 inches deep on the diameter is allowed following repair. The maximum area allowed for the full-depth repair is restricted to 10 per cent of the surface area in question, per repair. It is not stated how many such repairs may be made. The Cadorath Aerospace Inc. repair probably resulted in the full-depth repair in excess of 90 per cent of the surface area of the journal.[8]

In 1999, BHTI issued Operational Safety Notice (OSN) 206-99-35 Revision A as a result of a Bell 206B accident in Indonesia where a dimensional restoration repair was identified as a contributing factor to the failure of a spindle. An OSN provides safety-related information and does not mandate any action; however, the OSN indicated that BHTI does not approve of dimensional restoration of pylon support spindles by plating.

The OSN issued in 1999 prompted TC to make inquiries regarding approved spindle repair procedures for the two approved repair facilities in Canada. One facility voluntarily discontinued to offer this repair as a result of the OSN. The other, Cadorath Aerospace Inc., indicated that it intended to continue to offer the repair service, but was not actively pursuing this line of work. TC closed the file without formally reviewing or cancelling the repair certificate for either repair facility. Cadorath Aerospace Inc., in accordance with its RDC, repaired 43 spindles in total.

---

5 Federal Specification QQ-C-320B, Section 3.3.

6 BHTI Component Repair and Overhaul Manual, Volume 3, Chapter 63, Main Rotor Drive System (Transmission Top Case), Paragraph 6 states that the spindles should be inspected for damage and refers to Figure 63-20, which describes specifications for damage and repairs. Figure 63-21 specifies the minimum and maximum diameter limits for the spindle journal area.

7 Chapter 63, Main Rotor Drive System (Transmission Top Case), Paragraph 63-27, Inspection 2.b, Note.

8 TSB Engineering Laboratory report LP 010/2007.

Investigation Techniques

The remaining left-hand pylon support spindle and flight control linkages were still attached between the transmission and the airframe. The condition of the wreckage suggested that, if the pylon support spindle broke in flight, the helicopter did not immediately self-destruct. To test this hypothesis, a demonstration was conducted at a local aviation training college in Richmond, British Columbia, using an actual Bell 206B static display. The right-hand pylon support spindle was removed from the pylon support link and the helicopter was hoisted off the floor by the rotor head. Although the demonstration did not account for actual weights in the helicopter, aerodynamic loads or hydraulic power assist in the flight controls, it did confirm the following:

- The misaligned main driveshaft was free to rotate and was moveable longitudinally against the internal centring springs in both directions.

- The location of the main driveshaft forward coupling was in close proximity to the isolation mount.

- The pylon drag pin could be clear of the pylon stop.

- The flight control linkages carried some of the weight of the helicopter.

When the helicopter was suspended, the whole control assembly beneath the pilot seat tilted forward. The cyclic control stick appeared to have room to move aft, but it was already in the full aft position in the ball joint beneath the floor. It could be moved forward, which pulled the transmission in the downward direction (or the fuselage in the nose-up direction), but the swash plate remained firmly in the full, nose-down position, which rendered the flight controls completely ineffective about the lateral (pitch) axis. Left and right cyclic control appeared somewhat restricted, but functioned to some extent. The collective may have been more stiff than normal, but appeared functional. The hydraulic servos were not observed to reach full travel at any time, but the controls may not have been tested to full travel for fear of damage to the static display.

Analysis

Examination of the ground scars and photographs taken before the wreckage was moved revealed a wreckage distribution pattern associated with a condition of high deceleration forces and a steep angle of descent to the level ground, which is consistent with a loss of control. Weather, pilot incapacitation, and engine failure were assessed as unlikely contributors; the investigation focussed on flight control malfunction/failure.

The observations made during testing with the Bell 206B static display demonstrated that damage around the main transmission was consistent with the misalignment of the pylon assembly in flight. Although the main driveshaft and the pylon assembly were misaligned, the main rotor and tail rotor were still being driven by the engine until the time of impact.

The right-hand pylon support spindle was found fractured at the root end of the journal section, yet the spherical bearing supporting the spindle did not display impact-related damage. This indicates that the right-hand pylon support spindle was not in the spherical bearing at the time of impact. A fatigue fracture is not consistent with an impact force. The dimensional restoration repair of the spindle journal introduced a stress concentration feature at the location of the subsurface radius, which was responsible for the formation of the fatigue crack and subsequent failure of the right-hand pylon support spindle.

Testing with the Bell 206B static aircraft also demonstrated that the cyclic and collective control linkages could partially support the fuselage from the swash plate assembly, and this condition would render the helicopter uncontrollable in flight, regardless of pilot inputs. It is likely that the time between the spindle failure and ground impact could be measured in seconds. If the helicopter had flown for any longer, any uncontrolled gyrations that may have occurred would likely have resulted in the helicopter breaking apart in flight. Since the accident site was compact, it is more likely that the helicopter was at a low altitude and collided with the ground before time allowed it to break up in flight.

While it is beyond the scope of this investigation to determine the adequacy or appropriateness of engineering practices, the differing assessment, by different individuals, of whether the spindles were exposed to dynamic loads or static loads introduced risk. The design process for the repair of a critical part was approved, likely without the benefit of all original design data. It could not be shown that tests, stress analyses or other techniques were used in lieu of these data to ensure that the repaired part maintained the strength and other properties assumed in the original design. As the authority to approve repairs, TC must ensure that it, or its delegates, can demonstrate that approved repairs of critical parts do not compromise the required level of integrity.

The following TSB Engineering Laboratory report was completed:

LP 010/2007 — Main Transmission Spindle Fracture

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. The dimensional restoration repair of the spindle journal introduced a stress concentration feature at the location of the subsurface radius, which was responsible for the formation of the fatigue crack and subsequent failure of the right-hand pylon support spindle.

2. Failure of the right-hand pylon support spindle in flight caused the helicopter to become uncontrollable and collide with the level ground.

Findings as to Risk

1. It is likely that the pylon support spindle repair process was designed without the benefit of all original design data. It could not be shown that tests, stress analyses or other techniques were used to ensure that the repair maintained the strength and other properties assumed in the original design data.

2. There is a risk that repair designs for parts identified as critical parts may have been approved before the definition of critical parts, applicable to normal category rotorcraft, was adopted by Transport Canada. Such repair schemes may not ensure that critical parts maintain the critical characteristics on which certification is based.

3. Transport Canada made inquiries regarding approved spindle repair procedures following the release of Bell Helicopter Textron Inc. Operational Safety Notice 206-99-35 Revision A, but closed the file without formally reviewing or cancelling the two approved repair certificates, thus allowing the repair to continue in its original form.

Safety Action Taken

On 06 February 2007, the TSB issued Occurrence Bulletin OB-A06P0190-1 addressed to Transport Canada (TC). The Occurrence Bulletin provided a factual description of the failure mode of the pylon support spindle.

On 27 February 2007, TC issued Airworthiness Directive (AD) CF-2007-02, which mandated removal of all Bell 206B pylon support spindles that had been repaired by Cadorath Aerospace Inc. and mandated that maintenance records be annotated accordingly.

On 09 March 2007, Bell Helicopter Textron Inc. (BHTI) issued Operational Safety Notice (OSN) 206-99-35 Revision B. This document is a revision of the previous version (Revision A) and reinforces BHTI's opposition to dimensional restoration repairs of Bell 206B pylon support spindles.

On 23 August 2007, AD CF-2007-02 was superseded and CF-2007-02R1 was issued by TC. The revision included serial numbers of pylon support spindles, which incorporated a similar repair performed by H-S Tool & Parts Inc.

TC is in the process of withdrawing both of the identified Repair Design Certificates and Repair Authority for the Bell 206 pylon support spindles, issued by a TC delegate, to Cadorath Aerospace Inc. and H-S Tool & Parts Inc.

On 06 November 2007, AD 2007- 22-01 issued by the United States Federal Aviation Administration became effective. This AD reflected the concerns and part serial numbers stated in AD 2007-02R1 issued by TC and required that all affected spindles be removed from service within 16 hours of time in service.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 November 2007.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – Main Transmission Assembly