Australian Government
Australian Transport Safety Bureau

Tail rotor strike and collision with terrain involving a Bell B206L1, VH-NBR

14 km north-east of Kubin Airport, Queensland on 22 April 2020

ATSB Transport Safety Report
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Addendum

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Safety summary

What happened

On 22 April 2020, a Bell 206L1-C30P helicopter, registered VH-NBR, was being operated by Nautilus Aviation on a passenger charter flight from Kubin Airport, Queensland, to Banks Peak, on Moa Island. On board were the pilot and two passengers.

While manoeuvring at the helicopter landing site (HLS), the helicopter's tail rotor contacted trees. The helicopter then rotated rapidly to the right, collided with terrain, and was destroyed. The passengers were seriously injured, and the pilot sustained a minor injury.

What the ATSB found

The ATSB found that the design and maintenance schedule of the HLS made it susceptible to overgrowth. Vegetation had overgrown the site, obscuring the edges and surface of the helipad. The helipad was elevated above the ground, which made positioning of the helicopter on the helipad vital for the safe conduct of a landing.

It was also found that the pilot's use of a flight helmet very likely reduced the severity of the pilot's injuries.

What has been done as a result

The operator amended its helicopter landing site template to include a grading system for site assessment by the chief pilot/deputy chief pilot prior to tasking pilots. It also developed a risk assessment template for landing at non-surveyed sites. In addition, the operator sent an alert to all the operator's pilots to reinforce the go-around procedure as stated in its operations manual, and this procedure was performed on all remote area check flights. All cross-hired aircraft were migrated to the operator's flight following system, which allowed the ability to track these aircraft in real time while on task.

The Department of Home Affairs, as owner of the HLS, conducted a formal risk assessment of Banks Peak and other higher-risk HLSs throughout the Torres Strait. It also ceased flying operations to landing sites deemed to have unacceptable risks until sufficient control measures had been implemented. In addition, it is developing a detailed HLS brief for aircraft operators and is considering the most appropriate mechanisms for systematic engagement with other users of the sites.

Safety message

The design and ongoing maintenance of helicopter landing sites and helipads in a tropical environment is an important function. The frequency of the maintenance schedule must be sufficient to account for the rapid plant growth to enable safe use of the site.

Helicopter landing site owners are encouraged to add touchdown/positioning markings to their facilities. Pilots can choose natural features in lieu of human-made markers where markers are absent. Additionally, if a landing cannot be conducted as planned, pilots should reject the landing and re-evaluate their options from a safe position.

The wearing of helmets is an important safety consideration when performing utility aerial work. The survivability in the event of an accident is greatly increased, as highlighted by this accident.

The investigation

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 22 April 2020, at about 0756 Eastern Standard Time,[1] a Bell 206L1-C30P LongRanger helicopter, registered VH-NBR and operated by Nautilus Aviation, departed Kubin Airport, Queensland. The passenger charter flight was transporting workers and equipment to a communications tower on Banks Peak, a mountain on the north-east side of Moa Island in the Torres Strait. On board were a pilot, and two passengers seated in the rear seats.

Overhead Banks Peak, the pilot conducted an aerial reconnaissance circuit of the helicopter landing site (HLS). The pilot then approached the site from the north, for landing. Closer to the ground, the pilot had difficulty locating the helipad. Grass had grown across the helipad and its edges (Figure 1).

Figure 1: Helipad as viewed during aerial reconnaissance circuit

Source: Passenger photo, annotated by the ATSB

At 0808, the pilot manoeuvred over the top of the helipad and using rotor downwash to push the grass and reveal the edges of the helipad. During this process, the tail rotor contacted trees 9 m from the helipad on the eastern side. A video taken by one of the passengers showed that, as the helicopter was turning to the right, a buzzing sound was heard, followed by a crack. Immediately

[1] Eastern Standard Time: Coordinated Universal Time (UTC) +10 hours.

after this sound, the helicopter spun rapidly to the right before rolling left. The helicopter collided with terrain and was destroyed (Figure 2).

Figure 2: VH-NBR accident site showing overgrown helipad

Source: Operator, annotated by the ATSB

The two passengers were restrained by lap belts. The passenger video showed that, during the sequence, the left rear door opened. The spinning and rolling forced the rear left passenger's legs out of the door and the passenger's legs were trapped under the helicopter, resulting in serious injuries. The right rear passenger sustained a serious injury to one hand.

The main rotor blades contacted and destroyed the forward fuselage structure. During the accident sequence, the pilot's helmet impacted the aircraft's structure, resulting in a loss of consciousness for a brief period. The pilot was restrained by a four-point safety harness, including a lap belt and shoulder harness.

The pilot and passengers were subsequently evacuated for medical attention.

Context

Pilot information

The pilot held a valid Commercial Pilot Licence (Helicopter), and a current Class 1 Aviation Medical Certificate. The pilot was also a qualified helicopter flight instructor and had previously flown in Papua New Guinea, as well as conducting a number of years of remote flying in Australia. At the time of the accident, they had a total of 6,807.4 hours of which 3,836.4 hours was on the Bell 206. The pilot completed their last helicopter flight proficiency check in September 2019. Their most recent ridge and pinnacle training was carried out in June 2019.

The pilot had flown to Banks Peak a number of times prior to the helipad construction. In 2016, they conducted 29 trips to the site during construction of the concrete helipad, slinging materials in for the work. They had not flown to Banks Peak since the construction work.

Aircraft information

The Bell 206 LongRanger is a seven seat, single engine helicopter used in passenger and utility roles. It is primarily all metal construction with a two-blade main and tail rotor system.

The helicopter involved in this accident, serial number 45232, was manufactured in 1979 and had 8,166.4 hours total time in service. The day before the accident, a periodic (100 hourly) inspection was performed on Horn Island. This was a standard inspection with no additional work carried out, and there were no rectifications that would have contributed to the accident.

Due to the regulatory requirements in place at the time of the helicopter's manufacture, the seatbelts fitted to the rear passenger seats consisted of lap belts only. Civil Aviation Safety Regulation (CASR) 90.115 (*Occupant restraints–helicopters*) required all helicopters manufactured after September 1992 to have seatbelts with upper torso restraints fitted to all passenger seats.

Banks Peak helicopter landing site

The helicopter landing site (HLS) was located on Banks Peak on the north-east side of Moa Island, Queensland. It was about 1,220 ft above sea level, confined within a steep-sloping, irregularly-shaped cleared area, and about 30 m by 35 m in size. The up-slope area to the west of the HLS contained small structures and two communication towers. The closest guy wire anchor point was 8 m to the west of the helipad.

The helipad was constructed in 2016. The final approach and take off area[2] (FATO) was about 21 m. The touchdown and lift-off area (TLOF) was a 4 m square. It was constructed as a box, consisting of a concrete border about 500 mm wide with a compacted gravel centre. The raised helipad meant precise positioning was required. Covering the sloping ground surrounding the helipad were numerous large rocks.

Prior to construction of this helipad, maintenance workers would utilise another helipad, downhill of Banks Peak, about 270 m west of the towers. The Banks Peak site was accessed for annual tower maintenance and the biannual site maintenance.

Helicopter landing site guidance

Civil Aviation Regulation (CAR) 92 (*Use of aerodromes*) stated that an aircraft shall not land at or take off from any place unless it was:

> …suitable for use as an aerodrome for the purposes of the landing and taking-off … having regard to all the circumstances of the proposed landing or take-off.

Civil Aviation Advisory Publication (CAAP) 92-2(2) (*Guidelines for the establishment of on-shore Helicopter Landing Sites (HLS)*) provided detailed guidelines for the establishment and use of a HLS. The CAAP provided guidance for the design of basic and secondary HLSs:

> BASIC HLS – a place that may be used as an aerodrome for infrequent, opportunity and short term operations, other than Regular Public Transport (RPT), by day under helicopter Visual Meteorological Conditions (VMC).
>
> SECONDARY HLS – a place suitable for use as an aerodrome for helicopter operations by day or night that does not conform fully to the standards for a heliport set out in Volume II of Annex 14 to the Chicago Convention

Due to the terrain and construction of the Banks Peak HLS, it was consistent with the stated requirements for a basic HLS.

A secondary HLS had a higher level of requirements, which incorporated the use of touchdown/positioning markings (TD/PM). CAAP 92-2 (2) described the TD/PM requirement as:

> …essential where it is necessary for a helicopter to touchdown or be accurately placed in a specific position…. A TD/PM provides the visual cues that permit a helicopter to be placed in a specific position and, when necessary, orientated such that, when the pilot's seat is above the marking, the

[2] Final approach and take-off area (FATO): an area of land or water over which the final phase of the approach to a hover or landing is completed and from which the take-off manoeuvre is commenced

undercarriage will be inside the load-bearing area and all parts of the helicopter will be clear of any obstacles by a safe margin.

There were no markings at the Banks Peak HLS to indicate the landing point to assist a pilot to line up for landing.

Without markings, a well-accepted and taught technique for confined areas is to use lead-in features. These features are commonly particular trees or rocks positioned around the selected landing site. The pilot can reference their position from these markers to ensure the helicopter is in the correct place. The helicopter operator's HLS register for Banks Peak stated that pilots should conduct the approach into the prevailing wind (either towards the south-east or towards the north-west). There were no markers for lead-in features annotated on the register.

On this occasion, the pilot reported aiming for the centre of the grassed area and then the helipad. They did not use any lead-in features.

Site maintenance

The Department of Home Affairs was responsible for the management of the Banks Peak HLS. The HLS and the area surrounding the structures had a flexible biannual preventative maintenance schedule. As part of this schedule, clearing of vegetation around the site and structures was conducted. The last maintenance, 4 months prior to the occurrence, was performed in December 2019. This included the use of chainsaws for trimming of small trees and branches from the HLS and its surrounds and utilising brush cutters and weed killer to control grass growth.

On the day of the accident, long grass obscured the helipad. Although the outline was apparent to the pilot during the aerial reconnaissance circuit of the site, when the helicopter was closer to the ground the pilot reported that the helipad became difficult to see. In the months following the December maintenance, there had been about 1,000 mm of rain recorded at nearby Horn Island.

Tail rotor strike

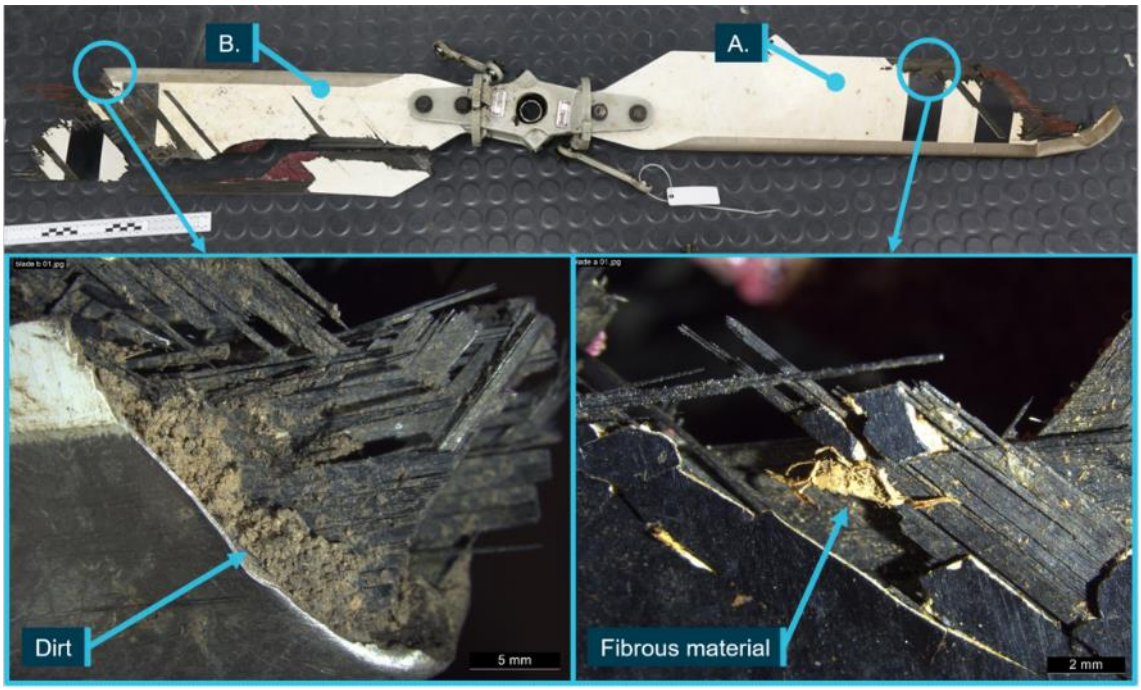
The tail rotor blades fitted to VH-NBR were manufactured by Van Horn Aviation and installed under a supplemental type certificate.[3] The blade construction was a carbon fibre skin over a foam core. They were a direct replacement for the original manufacturer's blades and were the same length, with a lighter weight.

Several branches of up to 45 mm thick were struck by the tail rotor, leading to fracturing of both blades about two-thirds of the way along their respective span. This led to bending of the leading edge protection and splintering of the carbon fibre skins.

A detailed examination of the tail rotor blades was conducted by the ATSB. This examination found that blade A (Figure 3) had sustained bending about the leading edge strip, opposite to the direction of its rotation. That damage was consistent with an impact under power. It also had numerous deposits of woody fibrous material throughout the inner structure. The leading edge of blade B showed the surfaces were contaminated with a quantity of dirt throughout the fractured sections and internal structure. This was most likely due to ground contact during the accident sequence.

[3] Supplemental Type Certificate, STC: Authorizes alteration to aircraft, engine or other item operating under approved type certificate.

Figure 3: Tail rotor damage showing fibrous material and dirt within the blade structure



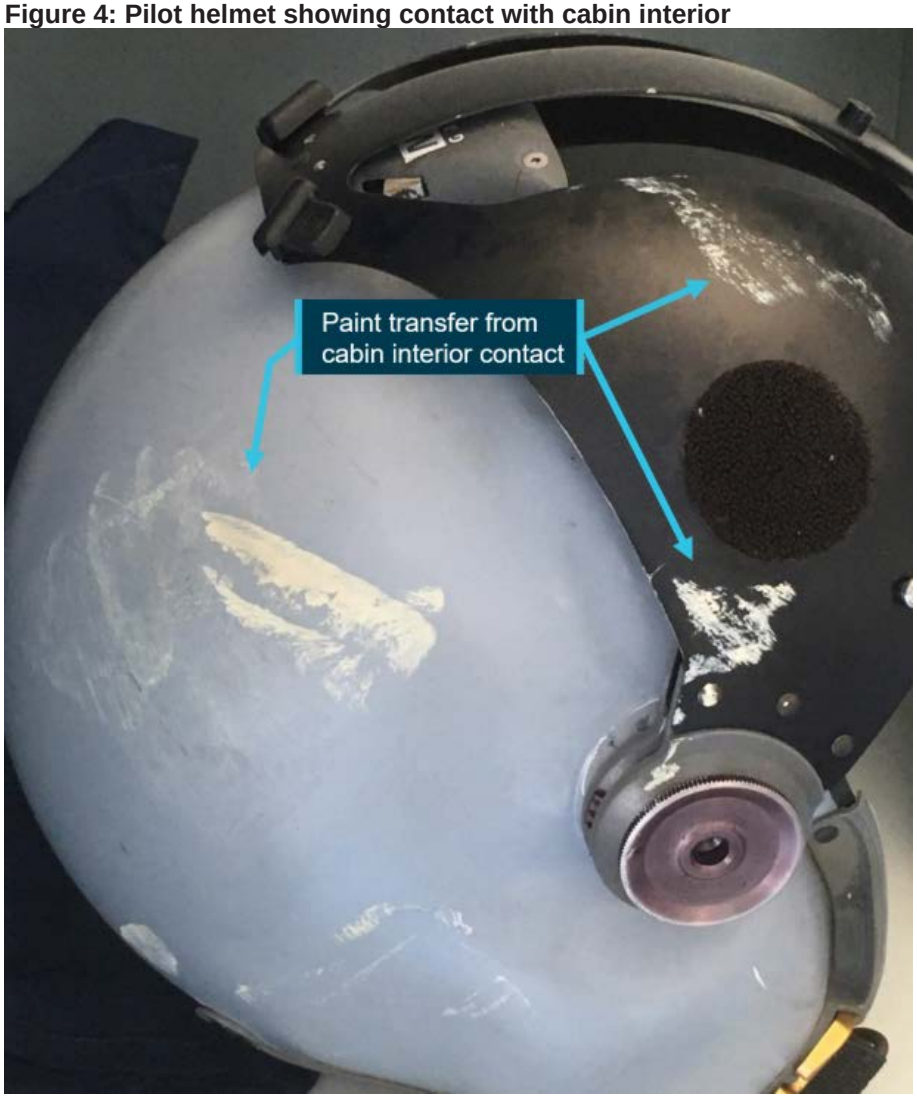
Source: ATSB

Flight helmet

The pilot was wearing a helmet at the time of the accident, which was approved for helicopter operations. The helmet was damaged from impact with the aircraft structure, and a 25 mm split was noted in the helmet outer shell. Paint transfer on the pilot's helmet was of a colour matching the interior paint of the cabin (Figure 4).

Passengers reported that the pilot was initially unconscious post-impact, but regained consciousness after a short time, and the pilot then freed themselves of their harness and exited the wreckage.

Figure 4: Pilot helmet showing contact with cabin interior



Source: Operator, annotated by the ATSB

Safety analysis

Helicopter landing site design and maintenance

Due to the helicopter landing site's sloping ground, a level small 4 m square helipad was elevated above the ground, which meant precise positioning was required to prevent helicopter rollover on landing. Although a precise landing was required, there was no touchdown/positioning marking (TD/PM) at the site to assist with positioning. The application of TD/PM provides the pilot with a visual reference to align the helicopter with the correct landing position and ensures the helicopter will be clear of any obstacles.

The compacted gravel centre of the helipad provided a surface for grass to grow over the helipad. The extended time and significant rainfall since the last maintenance, 4 months earlier, allowed that grass to grow to a length that obscured the whole helipad from view of the pilot during the approach. The obscured pad increased the complexity of the operation and increased the workload on the pilot during a critical phase of flight.

The high rainfall and tropical environment of Moa Island generated a high rate of vegetation growth. The rate of scheduled maintenance conducted at the helicopter landing site was too low to prevent the helipad becoming overgrown, effectively camouflaging the helipad during the approach.

Manoeuvring at the helipad

As already noted, there were no TD/PM markings at the site, and the pilot stated that they could not see the helipad. While manoeuvring the helicopter in the confined area, the pilot was most likely directing a reasonable amount of their attention towards identifying the helipad, and the anticipated touchdown point.

A small change in position at the front of the helicopter can be associated with a large change at the tail end. Unless changes are being observed while taking place, there is a good chance that small changes in a visual scene will not be identified (Wickens and McCarley 2008). This likely led to a difference between the pilot's understanding of the helicopter's position in space, and the helicopter's actual position, leading to a tail rotor strike.

Tail rotor damage

The passenger video recording had distinct audio of a buzzing sound and then a crack, immediately prior to the loss of control. ATSB examination of the tail rotor showed no evidence of pre-existing damage. The damage on both blades was consistent with impact under power.

A detailed examination identified numerous deposits of woody fibrous material throughout the inner structure. The video evidence and the presence of the fibrous material indicated that it was likely the blade had impacted a tree or branch, immediately prior to the loss of control.

Flight helmet and restraints

The pilot was wearing an approved flight helmet. During the accident sequence, the helmet was struck by the internal structure after the structure was impacted by the main rotor system. This resulted in minor damage to the helmet, and the pilot was unconscious for a short period of time. It is very likely that had the pilot not worn the helmet, the severity of their injuries would have significantly increased.

A substantial amount of research has consistently shown that seatbelts in small aircraft that include an upper torso restraint (UTR) significantly reduce the risk of injury compared to lap belts only. This helicopter was not fitted with UTRs in the rear seats, nor were they required at the time the helicopter was manufactured.

With the rapid rotation of the helicopter, the flailing of the passengers' limbs led to the rear left passenger's arms and legs being thrown to the left out the open door and the rear right passenger's hand to be injured on damaged aircraft structure. There was insufficient evidence in this case to conclude that UTRs would have reduced the severity of the passenger injuries. Nevertheless, the ATSB has previously issued a safety advisory notice to encourage all owners and operators of small aircraft to fit UTRs of all passenger seats to minimise injury risk.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the collision with terrain involving a Bell 206L1-C30P, VH-NBR, at Banks Peak, Moa Island, Queensland on 22 April 2020.

Contributing factors

- The helipad maintenance schedule was not sufficient to prevent the gravel helipad from being overgrown. This enabled vegetation to grow out from the centre of the helipad, obscuring its edges and making its borders difficult to identify during landing.
- While the pilot was manoeuvring in the confined area, the tail rotor contacted a tree. This led to a tail rotor failure, resulting in rapid rotation and collision with terrain.

Other findings

- The helmet worn by the pilot very likely prevented a more serious head injury.

Safety actions

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out to reduce the risk associated with this type of occurrences in the future.

Safety action taken by Nautilus Aviation

Following the accident, the operator reported that it had taken or was taking the following safety actions:

- amended its helicopter landing site template to include a grading system for site assessment by the chief pilot/deputy chief pilot prior to tasking pilots
- developed a risk assessment template for landing at non-surveyed sites
- sent an alert to all company pilots to reinforce the go-around procedure as stated in the operations manual and ensured this procedure was performed on all remote area check flights
- migrated all its cross-hired aircraft to the operator's flight following system, which allowed the ability to track these aircraft in real time while on task.

Safety action taken by the Department of Home Affairs

The helicopter landing site owner reported that it had taken or was taking the following safety actions:

- conducted a formal risk assessment of the helicopter landing site (HLS) at Banks Peak and other higher-risk sites in the Torres Strait.
- engaged an independent specialist to appraise the higher risk HLSs used by the department
- ceased flying operations to HLSs with unacceptable risks until sufficient control measures had been implemented
- identified vegetation growth as a significant risk factor for helicopter landings at Banks Peak, with a regular maintenance regime in place to manage ongoing clearance operations
- developing a detailed HLS brief for aircraft operators, which will include photos and relevant local risk factors
- considering the most appropriate mechanisms for systematic engagement with other site users, including how relevant information may be shared amongst stakeholders.

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot and passengers of the accident flight
- Nautilus Aviation
- Telstra and the organisation conducting maintenance on the communication towers
- Department of Home Affairs (organisation responsible for the maintenance of the HLS)
- Queensland Police Service
- video footage of the accident flight and other photographs taken on the day of the accident.

References

Wickens CD & McCarley JS, 2008, *Applied Attention Theory*, CRC Press, Boca Raton.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section 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 following directly involved parties:

- the pilot
- Nautilus Aviation
- the Department of Home Affairs
- the Civil Aviation Safety Authority.

A submission (with safety action only) was received from the Department of Home Affairs. The submission was reviewed and, where considered appropriate, the text of the report was amended accordingly.

General details

Occurrence details

Date and time:	22 April 2020 – 0808 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	14 km north of Kubin Island Airport, Moa Island, Queensland	
	Latitude: 10° 8.824' S	Longitude: 142° 19.308' E

Aircraft details

Manufacturer and model:	Bell Helicopter Textron 206L1-C30P	
Registration:	VH-NBR	
Operator:	Nautilus Aviation	
Serial number:	45232	
Type of operation:	Charter	
Activity:	Commercial air transport – Non-scheduled – Passenger transport charters	
Departure:	Kubin Airport	
Destination:	Banks Peak Helicopter Landing Site	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – 1 (minor)	Passengers – 2 (2 serious)
Aircraft damage:	Destroyed	