Australian Government
Australian Transport Safety Bureau

Loss of control involving a Bell 206B, VH-SMI

7 km NE of Horn Island, Queensland, 31 July 2013

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2013-121
Final – 26 May 2014

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

Publishing information

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Addendum

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Loss of control involving a Bell 206B, VH-SMI

What happened

On 31 July 2013, at about 1045 Eastern Standard Time, a Bell 206B helicopter, registered VH-SMI, departed Horn Island, Queensland for an aerial filming flight about 5 NM to the north-east, at the Tuesday Islets (Figure 1). On board the helicopter were the pilot, camera operator and director.

The purpose of the flight was to film a 20 metre vessel travelling back and forth along a channel in between the Islets. A digital camera system was mounted under the nose of the helicopter and controlled remotely by the camera operator from within the cabin. The pilot also had a view finder positioned in the cockpit so that he could monitor the camera view.

Figure 1: Approximate path of vessel and VH-SMI

Source: Google earth

After having completed four passes over the vessel, above 500 ft above sea level, the pilot positioned the helicopter for the next pass. Maintaining 200 ft, and with an airspeed of about 55 kt, the helicopter approached the vessel from behind and to the left (Figure 2). The vessel was travelling into wind.

As the helicopter flew abeam the vessel, the pilot initiated a climb and selected about 95% engine torque and then commenced a right turn, to pass in front (Figure 3). The helicopter passed in front of the vessel at about 300-400 ft. At that time, the pilot was monitoring the view finder to ensure that the helicopter's skids did not impede the film shot. The pilot reported that the wind direction was then 280° relative to the helicopter.

Figure 2: Approaching

Source: Camera operator

Figure 3: Passing in front

Source: Camera operator

Figure 4: Prior to LTE

Source: Camera operator

After having completed the film shot (Figure 4), when at about 450 ft, the helicopter entered an uncommanded yaw right by about 25-30° and started to experience a loss of tail rotor effectiveness (LTE). In response, the pilot attempted to manoeuvre the helicopter into wind by applying forward and left cyclic.[1] The pilot reported that the helicopter rotation stopped, but shortly after, it began to yaw right again. The pilot believed that he was not going to be able to recover from the situation.

The pilot lowered the collective[2] and applied forward cyclic in an attempt to place the helicopter into a crosswind situation, with the intent of then turning into wind once the airspeed had increased. At that time, they were at about 400-450 ft, with an airspeed of 20 kt.

However, the helicopter did not respond to the pilot's actions and it rapidly yawed right and began to descend. The pilot had expected the helicopter to respond as it had been performing well and they only had a 20 kt wind.

When at about 200 ft, the pilot attempted to arrest the descent, but the helicopter did not respond and continued to yaw.

When below 100 ft, with neutral cyclic applied, the pilot determined that he was unable to recover and he prepared for a forced landing onto the water. The pilot raised the collective and activated the emergency flotation system, and the helicopter landed on the water.

During the landing, the left rear float was damaged and deflated. Consequently, the helicopter sat left rear skid low on the water. The main rotor blades and mast became separated, the tail rotor assembly sustained damage, and the oil reservoir fractured (Figure 5).

The occupants exited the helicopter and received nil injuries.[3] Shortly after, the vessel arrived and provided assistance.

Camera footage

A review of the camera footage indicated that, when the helicopter was in a downwind position, the helicopter yawed 270° to the right. The helicopter stopped yawing momentarily for several seconds before rapidly yawing to the right again. The helicopter rotated about four to five times before landing on the water.

[1] A primary helicopter flight control that is similar to an aircraft control column. Cyclic input tilts the main rotor disc varying the attitude of the helicopter and hence the lateral direction.

[2] A primary helicopter flight control that simultaneously affects the pitch of all blades of a lifting rotor. Collective input is the main control for vertical velocity.

[3] All occupants were wearing lifejackets, but they were not inflated.

Figure 5: VH-SMI

Source: Camera operator

Pilot comments

The pilot provided the following comments:

- During the climb, with a high power setting selected, the helicopter's forward airspeed reduced. At that time, the pilot was focusing on the view finder and did not observe the airspeed decline.
- The helicopter may not have responded to his actions as he may not have lowered the collective quickly enough.
- Throughout the event, he believed that the helicopter would recover from the situation.
- The Bell 206 was more susceptible to LTE than some other helicopter types.
- Additional training on identifying and responding to an LTE event would be beneficial.

Meteorological information

Bureau of Meteorology weather observations at Horn Island indicated that, at about 1130, the wind was from the east-south-east at 18 kt gusting to 23 kt.

Loss of tail rotor effectiveness (LTE)

The United Stated (US) Federal Aviation Administration (FAA) Advisory Circular 90-95 defined LTE as a critical low-speed aerodynamic flight characteristic, not related to a mechanical failure. It can result in an uncommanded rapid yaw rate that does not subside on its own accord, and if not corrected, can result in a loss of control. LTE may occur in all single main rotor helicopters at airspeeds less than 30 kt.

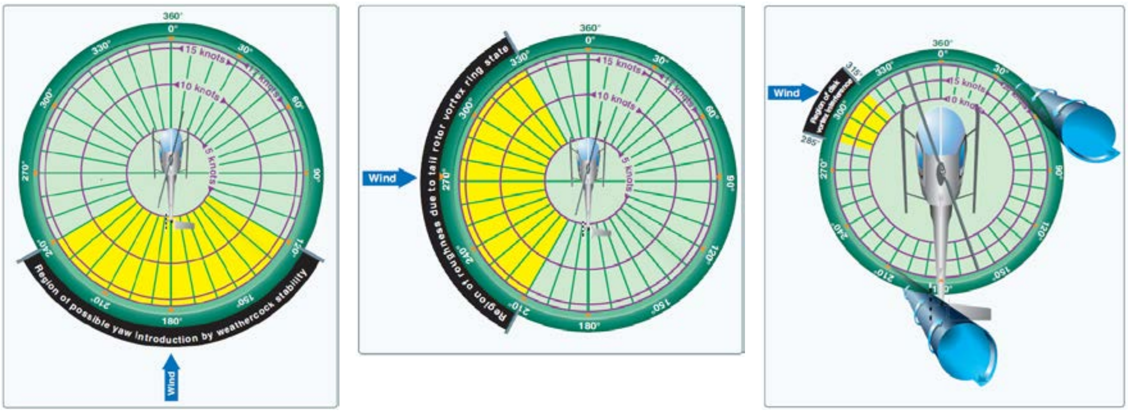
Any manoeuvre that required the pilot to operate in a high-power, low-airspeed situation with a left crosswind or tailwind, created an environment conducive to LTE. The susceptibility for LTE was also greater in right turns for US designed helicopters such as the Bell 206B, particularly during low airspeed flight where the pilot may not be able to stop the yaw. Flight and wind tunnel tests had identified four relative wind azimuth regions and aircraft characteristics that could, singularly or in combination, result in LTE (Bell Helicopter Information Letter 206-84-41) (Figure 6).

- *Weathercock stability (120° to 240°):* the helicopter will attempt to weathercock its nose into the relative wind. The helicopter will then make an uncommanded turn to the right or left, depending on the wind direction.
- *Tail rotor vortex ring state (210° to 330°):* the vortex ring state will cause tail rotor thurst variations, which result in yaw rates.

- *Main rotor disc vortex interference (285° to 315°):* main rotor vortex passes the tail rotor, reducing the tail rotor angle of attack. This causes a reduction in thrust and a right yaw acceleration will commence.
- *Loss of translational lift (all azimuths):* results in increased power demand and additional anti-torque requirements. If this occurs during a right turn, the turn will be accelerated as power is increased unless corrective action is taken.

Figure 6: Relative wind azimuth regions

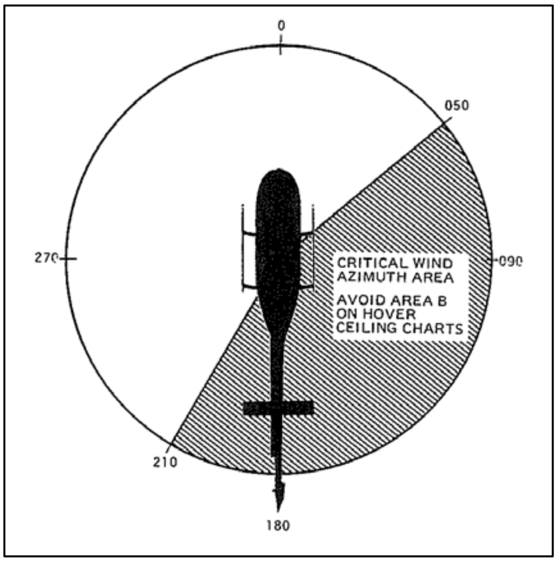
Weathercock stability *Tail rotor vortex ring state* *Main rotor disk vortex interference*



Source: Federal Aviation Administration

The Bell Information Letter also emphasised that the helicopter could be operated in all of the above conditions if suitable attention was given to controlling the helicopter. However, if the pilot's attention was diverted and a right yaw rate commenced, the rate may increase unless appropriate corrective action was taken. It further noted that the above did not replace the critical relative wind azimuth chart located in the helicopter's flight manual (Figure 7).

Figure 7: Critical relative wind azimuth area



Source: Bell Helicopter Company

If LTE occurs, the recommended recovery technique detailed in the Bell Information Letter was to:

- Simultanously apply full left anti-torque pedal and forward cyclic to increase airspeed.
- As a recovery is achieved, adjust the controls for normal forward flight.

Caution: Lowering the collective will aid in arresting the yaw rate, but may increase the rate of descent.

- If helicopter rotation cannot be stopped and ground contact is imminent, an autorotation (forced landing) may be required. Maintain full left anti-torque pedal until the rotation stops, then adjust to maintain heading.

An ATSB investigation (200003293)[4] into an LTE accident involving a Bell 206B, registered VH-TMR, on 6 August 2000, also highlighted that:

> There is greater susceptibility for LTE on United States designed helicopters in right turns and more so in right turns overwater. This is especially true during flight at low airspeeds when the pilot is looking out the right window (not viewing the instrument panel) and is unaware of the airspeed dropping to a low value. The turn is commonly done with reference to the ground where the pilot attempts to keep a constant groundspeed by referencing ground cues. Flying overwater, the pilot does not have the visual cues available as when flying overland.

Safety action

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. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Helicopter operator

As a result of this occurrence, the helicopter operator has advised the ATSB that all company pilots will be required to demonstrate their ability to recover from an LTE event during regular flight checks with the Chief Pilot.

Safety message

Certain operations, such as low speed aerial filming/photography flights, lend themselves to being more at risk to LTE than others; where visual cues can be misleading, and pilot attention to airspeed, height and orientation to local wind conditions is critically important. If a helicopter was placed in conditions conducive to LTE, it is crucial that pilots not only recognise the onset of LTE, but respond immediately and appropriately before the situation develops.

Furthermore, the FAA recognised that, while the design of main and tail rotor blades and the tail boom assembly can affect the characteristics and susceptibility of a helicopter to LTE, it will not nullify the event completely. Consequently, pilots should be aware of the specific characteristics of each helicopter type flown and the particular requirements for operating in different flight conditions.

The following provide additional information on LTE:

- ATSB investigation AO-2013-016: www.atsb.gov.au/publications/investigation_reports/2013/aair/ao-2013-016.aspx
- Bell Information Letter 206-84-41: http://218.6.160.231/dl/Bell206_2012_10/Data/docs/206/IL/206-IL-84-41.pdf
- Bell Operations Safety Notice 206-83-10: http://218.6.160.231/dl/Bell206_2012_10/Data/docs/206/OSN/206-OSN-83-10.pdf
- FAA Advisory Circular 90-95: http://www.faa.gov/documentLibrary/media/Advisory_Circular/ac90-95.pdf
- FAA Helicopter Flying Handbook: www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/

[4] www.atsb.gov.au/publications/investigation_reports/2000/aair/aair200003293.aspx

General details

Occurrence details

Date and time:	31 July 2013 – 1130 EST	
Occurrence category:	Accident	
Primary occurrence type:	Loss of control	
Location:	7 km NE of Horn Island, Queensland	
	Latitude: 10° 32.90' S	Longitude: 142° 20.73' E

Helicopter details

Manufacturer and model:	Bell Helicopter Company 206B	
Registration:	VH-SMI	
Serial number:	4271	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Destroyed	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB 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; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

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

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

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, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.