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

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A22P0019

COLLISION WITH TERRAIN

Kootenay Valley Helicopters Ltd.
Airbus Helicopters AS350 B3, C-GWTQ
Nelson, British Columbia, 35 NM N
16 March 2022

History of the flight

On 16 March 2022, the Kootenay Valley Helicopters Ltd. Airbus Helicopters AS350 B3 helicopter (registration C-GWTQ, serial number 7482), contracted by the British Columbia Ministry of Transportation and Infrastructure (MOTI), was conducting avalanche control operations north of Nelson Aerodrome (CZNL), British Columbia (BC), with the pilot and 2 avalanche technicians on board.

The occurrence flight was the second avalanche control flight of the day. The flight was in the London Ridge avalanche area, approximately 35 nautical miles (NM) north of CZNL, and consisted of dropping strategically placed explosive charges (12.5 kg bags of ammonium nitrate and fuel oil [ANFO] compound) and igniters onto the slope from a height of approximately 20 feet.

The occurrence aircraft took off from the staging area near New Denver, BC, at 1315[1] under visual flight rules (VFR). The crew were the same as on the first flight, but the avalanche technicians exchanged roles and positions: the one who had fulfilled the duties of bombardier (or blaster of

[1] All times are Pacific Daylight Time (Coordinated Universal Time minus 7 hours).

record) on the previous flight was the blasting assistant, and the former blasting assistant took on the role of bombardier and planned to deploy 15 explosive charges.

En route to London Ridge, the sky was overcast with scattered clouds at and below the ridgeline with calm to light winds from the southwest. The helicopter was being operated at an altitude of about 7000 feet above sea level (ASL), approximately 100 feet below the ridgeline. The pilot and technicians coordinated the placement of the charges and documented whether they detonated and triggered controlled releases of snowpack. The bombardier was seated on the right side of the rear bench wearing a high-visibility fall-arrest/restraint harness. His role was to deploy charges out of the right-side pocket door.[2] He coordinated the placement of the helicopter with the pilot to achieve the best effect from the explosive charge. The role of the blasting assistant, who occupied the left front seat, was to document the operation.

The bombardier requested an adjustment to the initial target for the second explosive charge to be deployed, and the pilot climbed the helicopter up the slope, nearer to the ridge and close to the base of the clouds. The trees in the new location were more sparse and covered with more snow. The pilot assessed the new location and estimated that, as previously anticipated, his exit strategy to turn left and then fly downhill would be appropriate.

As the helicopter progressed along the mountainside near the upper treeline, the pilot positioned and stabilized it in a hover to allow the explosive charge to be deployed. Just as the pilot lost reference with the ground and flight visibility[3] was reduced, the bombardier deployed the second explosive charge. At this time, the main rotor downwash and prolonged hover over a layer of loose snow created whiteout conditions.[4]

The pilot, with reduced visibility, turned the helicopter to the left. During this manoeuvre the tail rotor contacted either a tree or the surface of the slope; this caused the helicopter to shudder. The high-frequency vibration rapidly worsened and the pilot performed a forced landing. At approximately 1331, the helicopter landed hard on its skids and tipped onto its right (the pilot's) side (Figure 1). The main rotor and blades were fractured and the tail boom was partially severed. The helicopter came to rest about 3 to 5 m downslope of the second explosive charge deployed; the charge detonated approximately 2.5 minutes later, but did not trigger a release of the snowpack.

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[2] The "pocket door" is a small hinged door aft of the pilot's door that is removed for avalanche control missions.

[3] Flight visibility refers to the average range of visibility forward of the cockpit of an aircraft in flight at any given time.

[4] As described in Transport Canada's *Snow Landing and Take-off Techniques for Helicopters*, "[t]hroughout the course of winter operations, helicopters face a significant hazard associated with takeoffs, landings and hovering when the ground is covered with fresh or light snow. The rotor down wash can produce a flurry of re-circulating snow, reducing local visibility and causing whiteout conditions." (Source: Transport Canada, TP 2228E-35, *Snow Landing and Take-off Techniques for Helicopters* [January 2008, revised 28 June 2018], at tc.canada.ca/en/aviation/publications/take-fivefor-safety-tp-2228/snow-landing-take-techniques-helicopters-tp-2228e-35 [last accessed on 27 September 2022]).

Snow entered the cabin through the gap where the pocket door had been removed and through several windows that had broken or popped out. The 3 occupants were initially disoriented and shaken, but were not injured. The bombardier was face down in the snow, still secured in the aircraft by his harness, with bags of unprimed ANFO on and around him. The blasting assistant was still belted in the front passenger seat and was disoriented due to being on his side. The pilot secured the electrical and fuel systems, and he, along with the blasting assistant, egressed from the helicopter.

Figure 1. The occurrence aircraft, rolled over on its right side (Source: British Columbia Ministry of Transportation and Infrastructure)

The bombardier required some assistance to release his harness because his own knife was not easily accessible. He also experienced difficulty releasing his lap belt because the latch mechanism had been taped over.[5] With the assistance of the other crew members, he was released and egressed from the aircraft. The required survival equipment[6] was on board the helicopter; however, because the helicopter was lying on its right side, the cargo door could not be opened and the crew could not access this equipment.

The pilot was able to remove the emergency locator transmitter (ELT) from its housing, attach the remote antenna, and turn it on manually to ensure that it was activated. The signal was received by the Canadian Mission Control Centre and relayed to the Joint Rescue Coordination Centre (JRCC) in Victoria, BC.

The technicians had a portable radio on board, but it was not readily available after the impact. It had been left on top of the instrument panel glareshield and was displaced during the accident sequence. After approximately a 15-minute search through the snow, it was found. The operator was contacted and informed of the accident, and transportation off the mountain was coordinated.

The JRCC then contacted the operator. It was determined that search and rescue resources were not required because a local helicopter operator could rescue the crew. The local helicopter arrived at the accident site at approximately 1430.

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[5] This adopted practice of the technicians was a precautionary method to prevent what they anticipated could be an inadvertent release of the latch if it were caught in a piece of equipment.

[6] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 602.61.

Pilot information

The pilot had a valid commercial pilot licence – helicopter for VFR flight and had completed a pilot proficiency check valid until 01 June 2022. He had accumulated about 11 000 total flight hours, mostly on the occurrence helicopter type. He had many years of experience flying avalanche control missions, and had previously flown similar missions in the same area. The pilot was certified for the transportation of dangerous goods by air. The occurrence flight was the third avalanche control mission in which he worked with these technicians.

Avalanche control operations

The BC MOTI's Avalanche and Weather Programs unit has a published manual, *Explosive Use Operational Plan*,[7] that specifies that the Ministry artificially triggers avalanches to reduce the threat of naturally triggered avalanches along provincial highways. As the manual states,

> [p]redicting where and when avalanches could occur requires a thorough understanding of the interaction between weather, terrain, and the mountain snowpack. […] The decision to conduct explosive control is based on a complex analysis of current and future weather and snowpack conditions, and the effect these conditions may have on the avalanche hazard.[8]

Annual training had been conducted and procedures had been reviewed before the occurrence (during pre-season training in the fall of 2021). Both technicians had over 20 years of experience in avalanche control and were certified for the transportation of dangerous goods by air. Both also had current blasting certification with a helicopter deployment endorsement.

The blasting procedure requires that the deployment of the bag(s) be performed from an ideal height above the ground or slope because the bags could disappear from view under the helicopter, requiring the helicopter to break off the operation to track them and document whether or not they detonate.

The MOTI avalanche control personnel are provided with helicopter familiarization training, which is primarily focused on safety in and around helicopters. Training includes instruction on shutting off fuel and electrical systems and on access and operation of ELTs.

Weather information

The accident occurred in an area known for weather conditions associated with mountainous terrain. Flying conditions can be harsh, and abrupt variations in weather are not uncommon.[9]

The closest aviation weather reporting station is Revelstoke Aerodrome (CYRV), BC, located 65 NM northwest of the accident site.

The reported weather at 1323 was as follows:

- variable winds at 2 knots

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[7] British Columbia Ministry of Transportation and Infrastructure, Avalanche and Weather Programs, *Explosive Use Operational Plan* (2021).

[8] Ibid., p. 7.

[9] NAV CANADA, *The Weather of British Columbia: Graphic Area Forecast 31* (2001), p. iii.

- visibility 9 statute miles (SM)
- few clouds at 5500 feet
- overcast ceiling at 9300 feet
- temperature 3 °C
- dew point 2 °C
- altimeter setting 30.18 inches of mercury (inHg)

According to the graphic area forecast for the region, which was valid at 1100, the weather was forecast as follows:

- broken cumulus clouds, based at 6000 feet ASL with tops at 12 000 feet ASL
- visibility more than 6 SM
- occasional towering cumulus clouds, topped at 14 000 feet, with associated:
  - visibility from 2 SM to more than 6 SM in light snow showers, or light rain and snow showers, and mist
  - local ceilings 1500 above ground level (AGL)

Safety action taken

Following the accident, Kootenay Valley Helicopters Ltd. implemented a policy of in-flight briefing, which was reviewed with all pilots: before starting the approach to a blasting site, the crew must hold a briefing to discuss the suitability of the avalanche start zone, current weather conditions, and the adequacy of visual reference for approach, deployment of the charge, and departure from the blasting site. If, during the approach phase, a new site is selected, the approach is discontinued. A thorough assessment of the new location is subsequently conducted and briefed, and a new approach is initiated.

In compliance with WorkSafeBC requirements, the BC MOTI completed an internal investigation of its avalanche control operations.[10] The MOTI examined in depth several aspects of the operations and arrived at several findings and recommendations pertaining to the work activity, work conditions, execution, materials and equipment, communications, training, safe-work procedures, emergency procedures, personal protective equipment (PPE), and other factors such as post-occurrence worker assistance, and general coordination and planning.

Safety messages

The deterioration of weather conditions or whiteout generated by the helicopter during flight can lead to disorientation and controlled flight into terrain. Pilots must continuously exercise vigilance to reduce and mitigate the risks associated with changing weather, especially in the mountains.

In an otherwise survivable accident, egress from the aircraft wreckage can be complicated by disorientation and the need to release restraint systems. Aircraft occupants are reminded to use restraint systems as intended so that they can be easily released when required. Following egress, ready access to alerting equipment can facilitate the prompt rescue of the occupants.

[10] British Columbia Ministry of Transportation and Infrastructure, Avalanche Program Incident Investigation: Helicopter Crash—March 16, 2022 (27 April 2022).

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 19 October 2022. It was officially released on 02 November 2022.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

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Citation

Transportation Safety Board of Canada, *Air Transportation Safety Investigation Report* A22P0019 (released 02 November 2022).

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Air transportation safety investigation report A22P0019

Cat. No. TU3-10/22-0019E-PDF
ISBN: 978-0-660-45987-5

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