Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT

A03W0202

CONTROLLED FLIGHT INTO TERRAIN

ALTA FLIGHTS (CHARTERS) INC.

CESSNA 414A C-GVZE

CALGARY, ALBERTA 49 nm SW

23 SEPTEMBER 2003

Canada

Aviation Investigation Report

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Summary

The Alta Flights Cessna 414A (registration C-GVZE, serial number 414A0219) departed Cranbrook, British Columbia, at approximately 1910 mountain daylight time (MDT) on a visual flight rules cargo flight to Calgary, Alberta. The aircraft disappeared from the Calgary area radar at 1936 MDT, at an indicated altitude of 9000 feet above sea level (asl) in the Highwood Range mountains, approximately 49 nautical miles southwest of Calgary. The aircraft wreckage was found on a mountain ridge at 8900 feet asl some 40 hours later. The flight was in controlled descent to Calgary when the impact occurred. There was a total break-up of the aircraft, and the pilot, the lone occupant, was fatally injured. There was a brief fire ball at the time of impact.

Ce rapport est également disponible en français.

Other Factual Information

The cargo flight from Calgary, Alberta, to Cranbrook, British Columbia, and return was usually conducted with a Piper Seneca, routinely flown under instrument flight rules (IFR) by a specific company pilot. Neither that aircraft nor that pilot was available on September 23, so a Cessna 414A, C-GVZE, was substituted, with the occurrence pilot scheduled as the crew. He had flown this route before and was familiar with the operation.

C-GVZE departed Calgary on the first cargo flight of the day at 0543 mountain daylight time[1] under IFR, arriving at Cranbrook at 0639. The pilot was then driven to a hotel in Cranbrook, where he checked in at about 0715. His activities during the day are unknown; however, a hotel desk clerk saw him return to the hotel from an outing in the late afternoon. Other than during the check-in, no hotel personnel spoke to him during the day.

At 1745, the pilot was picked up from the hotel and arrived at the airport at 1805. No fuel was added to the aircraft at Cranbrook. A centre-stored IFR flight plan was on file as ALZ706 for a Piper Seneca, which was the usual aircraft on the route. The pilot cancelled this flight plan by telephone with Kamloops Flight Information Centre (FIC) at 1807, and filed a visual flight rules (VFR) flight plan for C-GVZE. The estimated flight time was one hour at an altitude of 11 500 feet above sea level (asl). The pilot filed this flight plan from the airport flight service station (FSS) kiosk, where he checked the current weather and NOTAMs (Notices to Airmen). Confirmation of visual meteorological conditions on the route was made with the FSS operator by telephone. The aircraft departed Cranbrook at 1911, four minutes ahead of the scheduled departure time. The last recorded radio call was a blind transmission on the en route frequency to Kamloops FIC at 1917, stating that the flight was climbing through 7500 feet for 11 500 feet asl.

Air traffic control (ATC) radar began recording C-GVZE at 1931, when the aircraft was about 65 nautical miles (nm) from Calgary, west of the Continental Divide. The initial recorded altitude was 11 500 feet asl, and at 1933, a descent was begun out of 11 400 feet, which continued at a relatively stable rate of 828 feet per minute for the remainder of the flight. The descent started over the Continental Divide; it continued over the high mountain ranges east of the Divide and into the Highwood Range, east of the Highwood Valley.

The target disappeared from radar at 1936; the last recorded information showed the aircraft at 9000 feet asl and 240 knots ground speed. From initial radar contact until the beginning of the descent, the ground speed remained constant at about 195 knots in cruise and accelerated to an average of 225 knots during the descent (see Figure 1).

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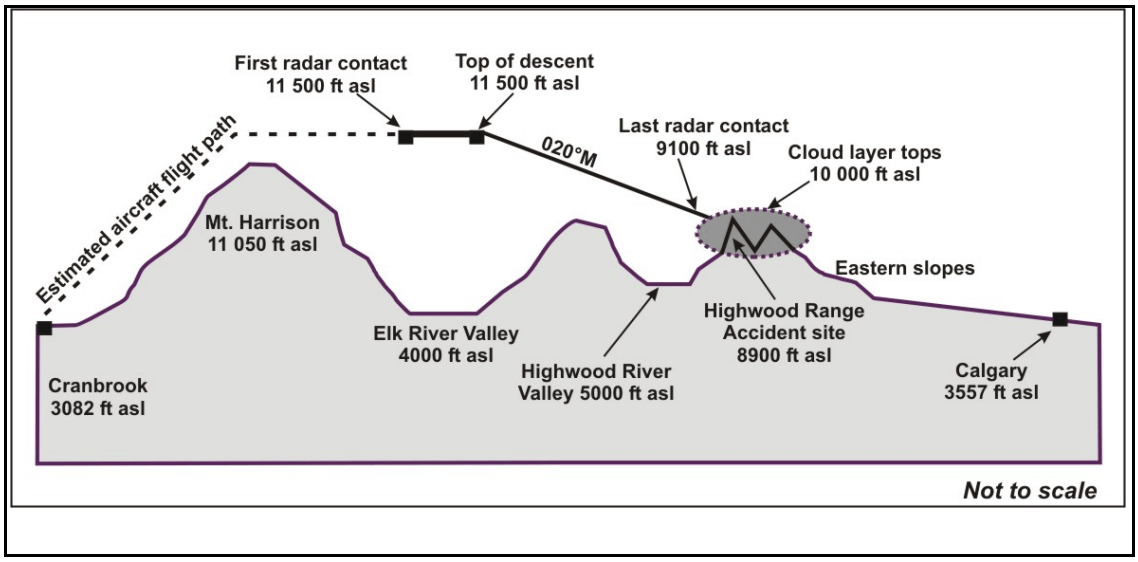
[1] All times are mountain daylight time (Coordinated Universal Time minus six hours) unless otherwise noted.



The weather reporting facilities closest to the accident site were two Alberta Forestry lookout towers. One was at Junction Mountain, approximately 7 nm to the northeast, and the other at Raspberry Mountain, 11 nm to the south. Both reported that, at the approximate time of the accident, all the nearby ridges were obscured by cloud cover, and there were light winds from the northeast.

The area forecast (GFA), issued at 1721 and valid from 1800 for the area west of the Continental Divide, predicted scattered cumulus and alto-cumulus cloud based at 8000 feet asl, with tops to 12 000 feet asl, and visibility more than six statute miles. The same forecast predicted moderate lee-side, mechanical turbulence from the surface to 12 000 feet asl. No pilot reports were filed regarding turbulence along the route. Light rime icing was predicted above the freezing level, which was near 10 000 feet asl at departure from Cranbrook and lowered to near 7500 feet near Calgary. East of the Continental Divide, in southern Alberta, the 1800 GFA called for broken cloud layers from 8000 feet to 16 000 feet asl, visibility of more than six statute miles, patchy light rain, and moderate lee-wave turbulence below 15 000 feet. The area west of the Continental Divide was under the influence of a weakening ridge of high pressure. A cold front moving southward passed through the route about six hours after the accident. At the accident site, sunset was at 1935, with twilight at 2008. This applied to ground level, and light levels were considered to be adequate for day VFR at the flight altitudes flown.

Satellite imagery of the area taken at 1800 and 1900 showed a narrow band of cloud cover in the occurrence area, spreading out in a fan shape to the southeast. Pilots overflying the area on their approach into Calgary reported cloud cover in the foothills area and no turbulence. Analysis of this band of cloud by Environment Canada indicated the tops of the cloud in the vicinity of the occurrence site were at about 10 000 feet asl, and the cloud bases were estimated to be at 8000 feet asl. This was confirmed by an independent contractor hired by the Cessna Aircraft Company. There was no observed snow or rain on the wreckage or the ground when the aircraft was found 40 hours after the accident.

The Cessna 414A aeroplane was manufactured in 1979 and imported into Canada in 1983. It had accumulated approximately 8377 hours in service. The aeroplane was equipped for IFR operations. It did not, however, have a global positioning system (GPS) receiver, ground proximity warning system (GPWS), or a radio altimeter installed, none of which was required by Transport Canada regulations.

Records indicate that the aeroplane was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had no known deficiencies before the first flight of the day. Aircraft weight at the time of the occurrence was estimated to be 5764 pounds, which was well under the maximum take-off weight limit of 7100 pounds, and the calculated centre of gravity was within limits at the time of the accident. There was sufficient fuel on board to complete the flight.

The accident site was on a bearing of 196° Magnetic (M) and 49 nm from the Calgary International Airport. Impact was at 8900 feet asl, about 50 feet below the top of a mountain ridge and on the west face. The slope of the face at point of impact was about 70°, and the overall slope of the west side was about 47°. Marks on the rock face suggest that the aircraft was in a wings-level attitude on a heading of about 035° M, which was nearly perpendicular to the ridge. A peak about 300 feet to the left of track was about 9100 feet asl.

The Highwood River Valley is a large, wide valley that lies on the west side of the Highwood Range, where the impact occurred. Beyond the Highwood Range, on the flight path toward Calgary, the terrain drops off into the eastern slopes of the foothills (see Figure 1).

The aircraft disintegrated on impact, with the majority of the wreckage going east over the ridge, coming to rest on inaccessible ledges and on the loose rock slopes at the base, down the mountainside as much as 1200 feet vertically and 1500 feet horizontally from the impact point. Wreckage on the west side included various small pieces of the aircraft. The propeller blades were field examined to the extent possible and indicated rotation at the time of impact. The engine cylinders and all other aircraft components that could be visually examined on site showed no evidence of any failure or malfunction. The extreme incline of the terrain precluded any closer examination of the remainder of the wreckage. To the extent that the wreckage could be examined, there were no indications found to suggest a malfunction of the aircraft or its systems prior to the impact sequence.

On the day of the occurrence, the pilot had nearly 11 hours of rest at Cranbrook, which was considered to be his daily rest period free from duty. He had been on duty for approximately two hours at the time of the occurrence.

Postmortem examination and toxicology screening of the pilot did not reveal any indication that incapacitation or physiological factors affected the pilot's performance. The accident was not considered survivable, and the brief fire ball that occurred at impact had no effect on survivability.

The pilot received a private licence on 03 August 1990, and a commercial licence on 07 June 1993. He then received a multi-engine rating and an instrument rating. Records indicate that he had accumulated 4375 total flight hours, of which 3925 were on multi-engine aeroplanes, and 1145 hours on turbine engine aeroplanes, with 2780 hours' experience on the Cessna 402/414 series aircraft. He had successfully completed his last pilot proficiency check (PPC) on the 414 type on 26 September 2002, with his next PPC due on 01 October 2003. The pilot's Category 1 medical was valid to 01 May 2004.

The pilot was involved in an aviation accident on 12 April 2000 (TSB report No. A00W0079), which resulted in serious injuries. During the investigation, it was shown that the pilot demonstrated deficiencies in several areas of decision making. In that accident, the pilot took off without the required amount of fuel, resulting in an engine failure due to fuel exhaustion. He also departed for the flight into known icing conditions with an aircraft that was not certified for flight in icing conditions, and he continued into deteriorating weather.

Alta Flights provides controlled flight into terrain (CFIT) avoidance training as part of its annual pilot ground-school curriculum. The pilot was a training pilot for the Cessna 400 series aircraft within the company, and had undergone recurrent ground school on the weekend prior to the accident.

The pilot had filed a VFR flight plan with NAV CANADA through the Kamloops FIC before his departure from Cranbrook. The flight plan was passed to the Edmonton FIC, which then assumed responsibility for flight following. At 2011, 30 minutes after scheduled arrival in Calgary, the Edmonton FIC began a communication search that included a verbal inquiry of the Calgary tower controllers. Calgary tower did not have a written record of arrival; however, one controller recalled the landing of an earlier Alta Flights aircraft, which was assumed to be C-GVZE. Based on this information, Edmonton FIC closed the flight plan at 2045. Neither Edmonton FIC nor Calgary tower personnel had a relatively quick and simple method of accessing computer records for arrival information. The Rescue Coordination Centre (RCC) took responsibility for the physical search at 2305, approximately 3.5 hours after the accident.

The Flight Safety Foundation defines a CFIT accident as "one in which an airworthy aircraft, under the control of the crew, is flown unintentionally into terrain, obstacles, or water with no prior awareness on the part of the crew of the impending collision." It is necessary that a pilot have a mental map of where the aircraft was, is, and where it is going.

A paper on CFIT in *Aviation, Space and Environmental Medicine*,[2] states, "A CFIT accident refers to any collision with land or water in which the pilot was in control of the aircraft, but lost situational awareness (i.e. was not aware of relationships regarding the plane's altitude, terrain, elevation, or latitude and longitude position of the aircraft)."

Situational awareness is defined by Transport Canada as "all the knowledge that is accessible and can be integrated into a coherent picture, when required, to assess and cope with a situation."

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[2] Timothy K. Thomas, M.D., Diana M. Bensyl, Ph.D., Jan C. Manwaring, M.P.H., George A. Conway, M.D., M.P.H. "Controlled Flight into Terrain Accidents Among Commuter and Air Taxi Operators in Alaska," in *Aviation, Space and Environmental Medicine*, Vol. 71, No. 11, November 2000.

Some of the factors that may contribute to CFIT are:

- mountainous terrain
- single-pilot operation
- VFR into instrument meteorological conditions (IMC)
- mis-identification of significant terrain along the route
- no terrain avoidance instrumentation
- company procedures
- descent procedures (e.g. altitude considerations, restrictions)

A Federal Aviation Administration (FAA) study found that, between 01 January 1990 and 31 December 1998, there were 126 fatal accidents in Alaska. A total of 89 (71 per cent) involved CFIT, and 69 involved VFR flight into IMC.

A Transportation Safety Board of Canada (TSB) report, *A Safety Study on VFR Flight Into Adverse Weather* (90-SP002), found that between 1976 and 1985, this type of accident accounted for only 6 per cent of the total aviation accidents but 23 per cent of fatalities. In a further study of investigations from 1985 to 1988, VFR flight into IMC resulted in 23 per cent of the fatal accidents and 22 per cent of the fatalities.

Another TSB report, *A Safety Study of Controlled Flight Into Terrain Accidents in Canadian Commercial Operations*, determined that, from the beginning of 1984 to the end of 1994, there were 70 commercial operation CFIT accidents. Of these, 35 claimed 106 lives and left 23 persons seriously injured. The intention of flying VFR accounted for 40 of these accidents, and 38 (95 per cent) resulted from flying in weather conditions below those required for VFR flight.

An effective last line of defence against CFIT accidents are GPWS and/or radio altimeters with altitude alert. None of the aircraft in the latter TSB study carried GPWS, and 64 (91 per cent) did not have useable radio altimeters. The FAA passed regulations on 17 March 1992 (FAR 135.153 and 135.154) requiring an approved GPWS on all turbine-powered aircraft with more than 10 seats, excluding any pilot seats, effective 20 April 1994. The International Civil Aviation Organization (ICAO) adopted Amendment No. 21 in Annex 6 on 08 March 1995. This amendment required all aircraft over 5700 kg, or authorized to carry more than nine passengers, to be equipped with a GPWS after 01 January 1999. The latter TSB report found that, if the then in-force U.S. regulations had been in effect in Canada, 20 per cent of the accident aircraft in that study would have been equipped with a GPWS and some of those accidents could have been avoided.

The FAA has implemented regulations requiring terrain awareness warning systems (TAWS) on all turbine-powered, U.S.-registered aircraft with six or more seats (excluding the pilot seats) for aircraft manufactured after 29 March 2002. For aircraft manufactured on or before 29 March 2002, the rules become effective 29 March 2005. The ICAO now requires that all international air carrier aircraft over 15 000 kg or having 30 or more seats be equipped with TAWS. In Europe, the Joint Aviation Authorities (JAA) have implemented regulations requiring that this same category of aircraft be upgraded from a GPWS system to Class A TAWS by 01 January 2005. Since October 2001, the JAA have also required all European-registered aircraft over 5670 kg, or having more than nine passenger seats, that do not have a GPWS, to be equipped with TAWS.

Canadian requirements for a GPWS include only commercial turbo-jet aeroplanes over 15 000 kg that are authorized to carry more than 10 passengers. Proposed changes to the *Canadian Aviation Regulations* will require the installation and use of a GPS-based, forward-looking TAWS in all aeroplanes manufactured after promulgation of the regulation that are configured for seating six or more persons (excluding any pilot seat). After promulgation plus two years, this regulation will apply to all similarly configured aeroplanes manufactured prior to promulgation. An altitude accuracy requirement will take effect once the rules have been in place for five years. These regulations are not yet in effect, and it could not be determined when promulgation would take place. The occurrence aircraft was flown with all six passenger seats in place and was not in a cargo configuration.

Analysis

The pilot departed from Cranbrook with VFR conditions, which lasted for the duration of the flight. It is not known why he chose to fly under VFR for the return to Calgary, when he had flown into Cranbrook under IFR.

The aircraft climbed and flew at a safe altitude above all obstacles through the route until it began its descent. The reason why the descent was started as early as it was could not be determined. Analysis of the weather data indicated that the Highwood Range mountains were capped with cloud, which obscured the mountains nearly to their bases. At the time of the accident, it was legally sunset, but there was adequate light to navigate visually. Given that there was cloud cover over the range where the impact occurred, it is possible that the pilot mistook the Highwood Valley for the lower altitude eastern slopes west of Calgary and started a descent over what he perceived to be relatively flat terrain.

The following indicators of controlled flight were derived from ATC radar return data and a site examination:

- a moderate rate of descent
- steady cruise speed
- impact at wings-level attitude
- heading at impact consistent with a track from Cranbrook to the Calgary VOR (very high frequency omni-directional range).

The following are the contributing factors to CFIT that were present in this occurrence:

- mountainous terrain
- single-pilot operation
- VFR into IMC
- mis-identification of significant terrain along the route
- no terrain avoidance instrumentation

In this occurrence, company procedures were not a contributing factor. The other factors were all either present or had to be considered by the pilot. To what extent they were considered or realized could not be determined. Based on all information gathered, it has been concluded that this was a CFIT occurrence.
Depending on the settings, a GPWS or TAWS may have given sufficient warning of the rising terrain ahead of the aircraft to have allowed the pilot to avoid the impact. The introduction of Canadian regulations requiring terrain avoidance instrumentation on all commercial aircraft configured with over six seats at an earlier date

than that proposed would probably have significantly increased the pilot's situational awareness and would have provided a last line of defence.

The premature closing of flight plans could have negative impacts on future aviation safety. The survival of injured persons on any aviation accident may depend on the timely notification and mobilization of search and rescue (SAR) agencies.

Findings as to Causes and Contributing Factors

1. The pilot lost situational awareness most likely believing he was over lower terrain.

2. The aircraft was very likely flown into cloud during a day VFR flight, which prevented the pilot from seeing and avoiding the terrain.

Findings as to Risk

1. The aircraft was not required by regulation to have terrain avoidance equipment installed, leaving the pilot with no last defence for determining the aircraft's position relative to the terrain. This is a risk for all aircraft operated in similar conditions.

Other Findings

1. The flight plan was prematurely closed by NAV CANADA, which caused the early stoppage of SAR activities and delayed the recommencement of those searches by two hours.

Safety Action Taken

Alta Flights has received approved amendments to its *Operations Manual* that require higher/further clearances from obstacles on all day and night VFR flights. It has also implemented additional training on clearances for VFR flights and CFIT awareness.

Since the occurrence, NAV CANADA has increased the ability of Calgary Tower and Edmonton FIC personnel to search computer records for positive information on aircraft arrival and departure, with options for search by registration or time frame. This increased ability will reduce reliance on memory. In addition, the Edmonton area control centre (ACC) shift managers and the Edmonton air traffic operations specialist, located in the Edmonton ACC, now have access to the same computer records for search capabilities. A similar system is being beta tested in two centres and will be considered for national deployment.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 14 July 2004.

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