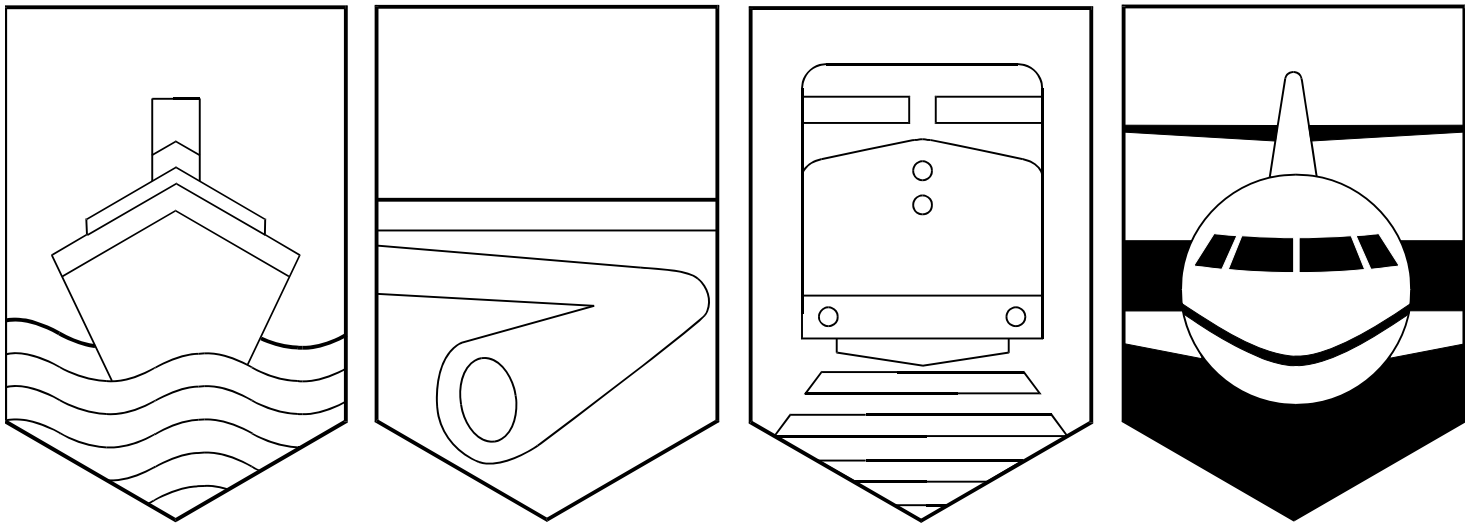
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



AVIATION OCCURRENCE REPORT

COLLISION WITH TERRAIN

PIPER PA-46-310P MALIBU C-GSEV
KILLARNEY AIRPORT, ONTARIO 4.4 nm NE
19 AUGUST 1994

REPORT NUMBER A94O0219

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

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Piper PA-46-310P Malibu C-GSEV
Killarney Airport, Ontario 4.4 nm NE
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Synopsis

The Piper Malibu, C-GSEV, was on a day instrument flight rules (IFR) flight from Windsor to Killarney, Ontario, with the pilot and five passengers on board. The pilot cancelled the IFR flight plan about five nautical miles (nm) south of the Killarney airport and the aircraft continued in a controlled descent below radar coverage. There was no further communication with the pilot after he cancelled the IFR flight plan. The aircraft was reported missing the following morning and the wreckage was located by search and rescue late that afternoon. The aircraft struck the side of a mountain, 4.4 nm northeast of the Killarney airport, at 1,321 feet above sea level (asl). The pilot and five passengers were fatally injured and the aircraft was destroyed.

The Board determined that the pilot was operating the aircraft in instrument meteorological conditions and uncontrolled airspace while below a safe terrain clearance altitude, and the aircraft struck a mountain.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 History of Flight

The flight was a private pleasure/travel flight for the purpose of transporting the pilot, his wife, and two other couples from Windsor to Killarney, Ontario, where they were to spend the weekend with friends. The flight had been planned in advance of the departure date.

The pilot commenced taxiing at 1058 eastern daylight saving time (EDT)[1], and was issued an instrument flight rules (IFR)[2] clearance to Killarney via the routing "Windsor, radar vectors Sarnia, direct Wiarton, direct Killarney, to maintain 3,000" feet asl. The pilot took off at 1105.

After take-off, the flight proceeded in a routine manner in accordance with the IFR clearance and was issued a final cruise altitude of 9,000 feet asl. The pilot reported level at 9,000 feet asl at 1125. At 1137, while the flight was 65 to 70 nm southwest of Wiarton, Ontario, the pilot was issued and acknowledged a clearance to fly direct to Killarney. At 1151, he requested and was issued a clearance to climb to 12,000 feet asl to get above a cloud layer, and reported level at 12,000 feet asl at 1155. The flight passed 20 nm to the west of Wiarton at 1203. At 1206, the pilot was given the Sudbury altimeter setting of 29.91[3] and was cleared to maintain 4,000 feet asl at his convenience. He acknowledged the clearance and commenced descent from 12,000 feet asl, 62 nm south of Killarney.

Shortly after issuing the descent clearance, the air traffic services (ATS) controller advised the pilot that the IFR flight plan could be cancelled with the controller on his frequency while still airborne or with the Sault Ste. Marie flight service station (FSS) on the ground by a toll-free telephone number. The ATS controller asked the flight crew of another aircraft on the same frequency to listen for an IFR cancellation from C-GSEV and to relay the cancellation to the controller. At 1221, the pilot of C-GSEV advised the ATS controller that he would be descending to 2,000 feet asl. The controller advised the pilot that the flight was in uncontrolled airspace and descent would be at the pilot's discretion. The pilot acknowledged the message, and this was the last direct controller/pilot communication (DCPC) between ATS and the aircraft. The last recorded radar position of the aircraft was at 1223:43, when it slowed to 180 knots ground speed and was descending out of 3,000 feet asl, 3 1/2 to 4 nm south of the Killarney airport. At about 1224, the flight crew from another aircraft on the frequency advised the ATS controller that C-GSEV had cancelled the IFR flight plan.

There was no further communication with the flight after the pilot cancelled the IFR flight plan. The aircraft was reported missing to officials of the pilot's company the following morning by friends and family of the passengers. Search and rescue authorities were notified at approximately 0930, and the wreckage was located by search and rescue late that afternoon.

The aircraft struck the rock face of a mountain at 1,321 feet asl in near level flight, on a northeast heading. The top of the mountain was 1,408 feet asl. The six occupants were fatally injured, and the aircraft was destroyed on impact. The accident occurred at about 1230 EDT during the hours of daylight, at latitude 46°02'N and longitude 081°26'W.

1.1.1 Pre-flight Preparation

At approximately 0720 on the day of the accident, personnel at the Windsor weather office received a request, over the telephone,

1 All times are EDT (Coordinated Universal Time [UTC] minus four hours) unless otherwise noted.

2 See Glossary for all abbreviations and acronyms.

3 Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

for weather information for the Killarney area. After discussing the weather conditions with the caller, copies of aerodrome forecasts, hourly observations, and area forecasts for locations closest to Killarney were faxed to the pilot's office.

At 0806, an IFR flight plan for the route Windsor direct Sarnia direct Wiarton direct Killarney at a requested altitude of 10,000 feet asl was filed by telephone with the London FSS. The alternate airport filed for the IFR flight was Sudbury, Ontario, and the proposed departure time from Windsor was 1100. Estimated time en route was one hour and 40 minutes.

The aircraft was last fuelled on 12 August 1994; 284 litres (75 US gallons) of 100 octane low lead (LL) fuel were placed in the aircraft fuel tanks. The flight plan indicated that the aircraft had fuel on board for three hours and 30 minutes flying time.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	1	5	-	6
Serious	-	-	-	-
Minor/None	-	-	-	-
Total	1	5	-	6

1.3 Damage to Aircraft

The aircraft was totally destroyed.

1.4 Other Damage

None.

1.5 Personnel Information

	Pilot-in-Command
Age	47
Pilot Licence	PPL - Aeroplane
Medical Expiry Date	01 October 1994
Total Flying Hours	1,322
Hours on Type	122
Hours Last 90 Days	39
Hours on Type Last 90 Days	26
Hours on Duty Prior to Occurrence	N/A
Hours off Duty Prior to Work Period	N/A

The pilot-in-command was at the controls and occupied the left front seat of the aircraft. He was certified and qualified for the IFR flight in accordance with existing regulations.

The pilot commenced flying training in November 1985 and was issued his private pilot licence in September 1986. His licence was endorsed for night flying in February 1987 and for multi-engine aircraft in April 1987. He passed the written examination for his instrument flight rating on 27 September 1993 and passed his initial instrument flight test on 21 July 1994. His pilot licence was endorsed on 21 July 1994 for instrument flight.

1.6 Aircraft Information

Manufacturer	Piper Aircraft Corporation
Type and Model	PA-46-310P Malibu
Year of Manufacture	1984
Serial Number	468408035
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	2,019 hr
Engine Type (number of)	Continental TSIO-520-BE (1)
Propeller/Rotor Type (number of)	Hartzell BHC-C2YF-1BF (1)
Maximum Allowable Take-off Weight	4,100 lb
Recommended Fuel Type(s)	100/100 LL Aviation gasoline
Fuel Type Used	100 LL

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The emergency locator transmitter (ELT) had been removed and sent to an overhaul shop for annual certification and had not been reinstalled in the aircraft.

The weight and centre of gravity (C of G) were within prescribed limits.

The aircraft was properly equipped for IFR flight. Navigational equipment included a Northstar M1 Loran C and King KNS-80 area navigation system.

The normal cruise climb speed is 125 knots indicated airspeed (KIAS) with the engine power set at 2,500 revolutions per minute and 35 inches of manifold pressure. The best rate-of-climb speed is 110 KIAS and the best angle-of-climb speed is 90 KIAS. Both the best rate of climb and best angle of climb are achieved with the aircraft landing gear and wing flaps retracted, and the engine at full power.

With the engine set to 75 per cent power, the fuel consumption is about 16 US gallons per hour (GPH). Full power or climb power settings would result in fuel consumption greater than 16 US GPH.

The calculated best rate of climb for the aircraft at maximum gross weight, with the meteorological conditions that existed at the time of the accident, was 1,125 feet per minute (fpm).

1.7 Meteorological Information

A warm front was the main feature affecting the weather in the Killarney area on the day of the accident. At 0800, the front was located on a line extending from just south of Sault Ste. Marie, to south of Killarney, to the Barrie, Ontario, area. By 1100, the front had moved north and was situated through the Killarney area. By 2000, it had stalled 100 miles north of Killarney.

There was significant weather associated with the front as it passed through the Killarney area around midday, generally producing low stratus cloud ceilings, rain showers, and fog.

Persons in and around the accident area on the day of the accident reported low overcast sky conditions with periods of drizzle and fog and, at times, periods of heavy rain. There were no reports of thunder or lightning and the winds were reported to be light. The top two-thirds of the mountain ranges were in cloud.

The pilot of another aircraft attempting to fly to the Killarney airport at about noon on the day of the accident was unable to maintain visual reference with the ground and diverted to the Wiarton airport.

The Killarney airport is located on the north shore of Georgian Bay, within the Sudbury region weather forecast area. The Sudbury region area forecast issued at 0730, 19 August 1994, and valid from 0800 until 2000, forecast local stratus ceilings 200 to 1,000 feet asl in precipitation, becoming more widespread throughout the period, with almost zero ceilings and visibilities near the Great Lakes and in upslope flow conditions.

There were no aerodrome forecast or aviation weather observations issued for the Killarney airport. The closest weather reporting stations where aerodrome forecasts and weather observations were available were Elliot Lake, 50 nm northwest; Sudbury, 48 nm northeast; and Gore Bay, 46 nm west.

The aerodrome forecast for Sudbury, issued at 0630, 19 August 1994, and valid for the period 0700 until 1900, was cloud 3,000 feet above ground level (agl) scattered, 8,000 feet agl overcast with visibility better than six statute miles; after 0800, cloud 3,000 feet agl overcast, visibility five statute miles in fog, occasional sky partially obscured, cloud 1,000 feet agl overcast, visibility one statute mile in light rain showers and fog with a risk after 1000 of visibility one statute mile in thunder showers and fog, with wind gusts to 25 knots.

The aerodrome forecast for Gore Bay issued at the same time and valid for the same period was cloud 2,500 feet agl overcast, visibility six statute miles in light rain, occasional cloud 800 feet agl overcast, visibility one statute mile in light rain showers and fog; after 0900, cloud 1,500 feet broken, visibility better than six statute miles, occasional cloud 300 feet agl

overcast, visibility three quarters of a statute mile in light rain showers and fog; after 1200, cloud 2,000 feet agl scattered, 6,000 feet agl broken, high broken cloud with visibility better than six statute miles, occasional cloud 1,500 feet agl broken, visibility three statute miles in light rain showers and fog.

Ceiling and visibility observations taken near the time of the accident were as follows:

Sudbury	1200 - cloud 1,500 feet agl scattered, 4,000 feet agl overcast, visibility six statute miles in light rain showers.
	1250 - cloud 200 feet agl overcast, visibility two statute miles in light rain showers and fog.
	1300 - cloud 200 feet agl overcast, visibility two statute miles in light rain showers and fog.
Elliot Lake	1200 - sky obscured 100 feet agl, visibility one eighth of a statute mile in fog.
	1300 - sky partially obscured, cloud 300 feet agl overcast, visibility one and one-quarter statute miles in fog.

The Gore Bay automatic weather observation station (AWOS) did not report a cloud base at 1200, but reported a visibility of two statute miles, and at 1250, reported cloud 500 feet agl and visibility three and one-half miles.

The current weather information for the reporting locations around Killarney would have been available to the pilot, while en route, from either the Toronto area ATS controller or an FSS. There was no record or evidence that the pilot obtained any updated or current weather information while he was en route and prior to commencing the descent into Killarney.

1.8 Aids to Navigation

The airport is not served by any IFR navigational or approach aids.

It was not determined what navigation aids the pilot was using to fly IFR direct to Killarney. The navigation ground stations and aids required to navigate by Loran C and area navigation were all reported serviceable throughout the flight period.

The Sudbury instrument landing system (ILS) for runway 22 was unserviceable on 19 August 1994. A notice to airmen (NOTAM) had been issued stating that the facility was unserviceable until 23 August 1994.

1.9 Communications

There were no reported unserviceabilities or difficulties with the communication equipment associated with the flight. The loss of DCPC radio communication with the Toronto Area Control Centre (ACC) was anticipated when the aircraft descended in the Killarney area, and communications were relayed without difficulty by another aircraft by pre-arrangement.

There was no report of any communication between the aircraft and the Killarney unicom station.

1.10 Aerodrome Information

The Killarney airport is an unattended public-licensed airport located on the north shore of Georgian Bay, at latitude 45°58'N, longitude 081°29'W. There is a single asphalt runway 3,500 feet long by 90 feet wide, oriented

060/240 degrees magnetic (°M). The elevation of the airport is 608 feet asl.

Aircraft landing at the Killarney airport on an IFR flight must have visual reference with the ground in order to carry out an approach and landing in accordance with visual flight rules (VFR).

The airport is located in uncontrolled airspace.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder or cockpit voice recorder, nor was either required by regulation.

1.12 Wreckage and Impact Information

1.12.1 Accident Area

The accident occurred on the south side of the South La Cloche mountain range. The terrain elevation along the Georgian Bay shore line is between 600 and 650 feet asl and rises abruptly to 1,400 feet asl, with spot elevations above 1,700 feet asl, about three to four miles inland. Witnesses hiking in the area heard the aircraft fly overhead and heard the impact. The witnesses reported that the aircraft sounded normal, with no change in the engine sound, right up until impact.

1.12.2 Accident Site

The aircraft struck a rock-covered surface with about a 30-degree incline, at 1,321 feet asl, on a northeast magnetic heading, in a wings-level attitude, about 4.4 nm northeast of the Killarney airport.

The major portion of the wreckage was in a small area and formed a short wreckage trail. The leading edges of the wings displayed accordion crushing and the ground scar marks clearly indicated a wings-level attitude at impact.

A portion of the fuselage with the complete empennage failed on impact and was thrown forward of the main wreckage. The aircraft exploded on impact and an intense fire followed, causing extensive post-crash fire damage to the aircraft cockpit/cabin and wings. The impact forces and post-crash fire rendered the cockpit and cabin area of the fuselage unrecognizable. Cockpit switch and control positions could not be determined due to the severity of destruction.

All three landing gear were found in the retracted position. The trailing edge flap position could not be determined. The engine was located at the initial impact point. Breakup of the engine on impact precluded any further teardown or engine investigation. The propeller broke free of the crankshaft on impact and the blades were fragmented. Damage to the propeller blades was consistent with power being developed at impact.

All flight control surfaces and essential airframe components of the aircraft were located and accounted for at the accident site.

The elevator trim system is a cable-operated screwjack mechanism. The elevator trim position at impact could not be determined because the cable may have moved the screwjack at impact. The elevator trim was found in a nose-up trim position.

The accident site was located along a direct line between the Killarney airport and the Sudbury airport.

1.12.3 Cockpit Instrument Examination

The cockpit area was destroyed; however, some instruments were recovered and sent to the TSB Engineering Branch for examination. Both airspeed indicators were indicating approximately 115 knots ± 10 knots at the time of impact, and the vertical speed indicator pointer impact mark was captured at the 100 fpm up graduation. The encoding altimeter baroscale was set at 29.91 and the altimeter was indicating 1,480 feet ± 25 feet. A second altimeter baroscale was set at 29.86 but no indicated altitude information was determined.

The vacuum-driven directional gyro and horizontal situation indicator were extensively

damaged and did not reveal any aircraft heading, roll, or pitch attitude information. The vacuum-driven rotors from both instruments revealed damage consistent with high rotational energy at impact.

The engine manifold pressure and fuel flow indicator were a combined instrument. No reliable manifold pressure indication was determined. The fuel flow indicator was indicating 20 to 25 US GPH at impact.

1.13 Medical Information

The pilot's last aviation medical examination was on 20 September 1993, and the pilot was assessed as fit and category 3. Glasses or contacts lenses were to be worn while flying.

The post-mortem examinations of the pilot and passengers revealed that they were fatally injured on impact.

There was no evidence that incapacitation or physiological factors affected the pilot's performance.

1.14 Fire

Ground scar marks and burn patterns on the trees indicated that there was a fire ball on impact, after which an intense fuel-fed fire continued to burn, consuming the cockpit/cabin section of the aircraft fuselage and a major portion of the wings.

There was no fire-fighting equipment involved with the occurrence.

1.15 Additional Information

1.15.1 Uncontrolled (Class G) Airspace

Air traffic control has neither the authority nor responsibility of exercising control over aircraft operating in accordance with IFR in uncontrolled airspace. IFR flight is permitted in uncontrolled airspace provided the pilot holds a valid instrument rating and the aircraft is equipped to fly in instrument meteorological conditions (IMC). When operating IFR in uncontrolled airspace, the pilot should monitor frequency 126.7 megahertz (MHz) and broadcast his intentions prior to changing altitude or commencing an approach.

Weather minima for VFR flight in uncontrolled airspace, above 700 feet agl, require that the aircraft be not less than 500 feet vertically and 2,000 feet horizontally from cloud, and that the flight visibility be not less than one mile. Flight at or below 700 feet agl requires that the aircraft be clear of cloud, and the flight visibility be not less than one mile.

1.15.2 Minimum IFR Altitudes

Air Regulations require that, except when taking off or landing, aircraft flying in accordance with IFR fly at least 1,000 feet above the highest obstacle within a horizontal radius of 5 nm of the aircraft.

It is the pilot's responsibility to determine the highest obstacles in the area of flight from applicable aeronautical navigation charts, before operating IFR in uncontrolled airspace. The minimum IFR altitude within a 5 nm radius of the Killarney airport is 2,456 feet asl.

2.0 Analysis

2.1 Introduction

There was no evidence found to indicate that the aircraft was not airworthy or that the pilot was experiencing any difficulty controlling it. The recorded radar data at the Toronto ACC clearly indicate that the pilot was able to accurately navigate to, and determine when he arrived in, the area of his intended destination. The data shows the aircraft in a controlled descent and the ground speed decreasing as the pilot slowed the aircraft a short distance south of the Killarney airport, his intended destination. The following analysis, therefore, concentrates on the probable flight profile after the aircraft descended below radar coverage in the Killarney airport area.

2.2 Descent Profile

The aircraft main (encoding) altimeter baroscale was correctly set (29.91) to the current Sudbury altimeter setting. Radar data shows the aircraft at about 3,000 feet asl, 5 nm south of the Killarney airport, at the time the pilot cancelled IFR. He likely had visual contact with the ground or water at the time he cancelled IFR and commenced flying VFR. As he descended towards the airport, he probably was unable to maintain VFR flight because of the low cloud, fog, and drizzle conditions as reported by persons in the Killarney area at the time of the accident. It could not be determined what altitude the pilot descended to below radar coverage.

The accident site location and the aircraft heading at the time the aircraft struck the mountain support the conclusion that the pilot did not encounter suitable weather conditions to carry out a landing at Killarney and elected to proceed to Sudbury, his filed alternate airport. It is likely he was using Loran C for navigation and was able to determine from the Loran C when he had passed over the Killarney airport, even if he did not have visual reference with the ground. He then likely selected the waypoint for Sudbury on the Loran C, turned the aircraft to the appropriate heading indicated on the Loran C, and began to climb on course towards Sudbury.

Analysis of the airspeed indicators, the vertical speed indicator, and the fuel flow indicator readings support the conclusion that the aircraft was climbing when it collided with the mountain. The indicated airspeed (115 knots ± 10 knots) was within the manufacturer's best rate-of-climb or cruise-climb speed for the aircraft. The vertical speed indicator (100 feet up) was indicating a shallow climb. The fuel flow indication (20 to 25 US GPH) was more than the fuel flow indications at maximum cruise power settings, suggesting that engine power was set above maximum cruise power, likely at a climb power setting.

2.3 Controlled Flight into Terrain

Witnesses on the ground reported low cloud with fog and drizzle in the accident area and reported hearing an aircraft engine sound, but none observed any aircraft. They also reported that the mountain tops were in cloud. The wings-level attitude of the aircraft at impact and analysis of the aircraft instruments suggest that this was a controlled flight into terrain, likely while the aircraft was flying in cloud in a shallow climb.

2.4 Survival Aspects

The aircraft was not reported missing until 21 hours after the accident. It was not equipped with an ELT. After the pilot cancelled IFR with no further communication with ATS, the controller assumed the aircraft had landed at Killarney. There was no evidence that the pilot contacted the Killarney airport unicom frequency after cancelling IFR, and, as a result, no one at Killarney was expecting the aircraft to arrive at the airport. Friends expecting the pilot at Killarney were unable to determine that the aircraft had in fact left Windsor en route to Killarney until the morning after the accident, and it was their enquiries that initiated the search for the

aircraft through officials at a company owned by the pilot.

2.5 Terrain Clearance Altitude

The aircraft struck the mountain while the pilot was flying in cloud below a safe terrain clearance altitude. It could not be explained why the pilot was operating the aircraft in cloud more than 1,000 feet below the safe IFR altitude for the Killarney area. It is possible that, when he cancelled IFR, he had visual contact with the ground or water and continued descent towards the airport, but that he entered cloud while flying below a safe IFR altitude in the vicinity of, but prior to gaining visual reference with, the airport. Once past the airport, it appears that he set course for Sudbury, which resulted in the aircraft heading towards higher terrain. It is not known where, or from what altitude, the pilot began to climb en route to Sudbury.

It could not be determined why the aircraft appeared to be in a shallow climb while heading towards higher terrain when it collided with the mountain. It appears that the pilot was climbing the aircraft in a cruise climb configuration when a best-rate or best-angle configuration would have resulted in the aircraft gaining altitude in a shorter distance travelled over the ground. It is also possible that, because of cockpit workload, he was inattentive to altitude and did not maintain a good rate of climb in order to gain altitude as rapidly as possible, or that he was not aware he was flying towards higher terrain.

3.0 Conclusions

3.1 Findings

1. The Killarney airport, located in uncontrolled (class G) airspace, does not have an IFR approach.

2. The pilot cancelled his IFR flight plan just short of his destination without further communication.

3. The weather conditions at the Killarney airport likely did not allow the pilot to maintain VFR flight in order to carry out a landing.

4. The pilot likely diverted to his alternate airport.

5. The pilot was operating the aircraft in cloud below the surrounding terrain elevation.

6. The aircraft was intact and under control in a shallow climb when it struck the mountain.

7. The aircraft ELT had been removed for recertification and was not re-installed in the aircraft, nor was it required by regulation.

8. The aircraft was not reported missing until 21 hours after the accident.

9. The aircraft weight and centre of gravity were within limits.

10. The pilot was certified and qualified for the flight in accordance with existing regulations.

11. Based on the autopsy, toxicology, and medical records, there was no evidence to indicate that the pilot's performance was degraded by physiological factors.

3.2 Causes

The pilot was operating the aircraft in instrument meteorological conditions and uncontrolled airspace while below a safe terrain clearance altitude, and the aircraft struck a mountain.

4.0 Safety Action

The Board has no aviation safety recommendations to issue at this time.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 13 July 1995.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Laboratory Report was completed:

LP 136/94 - Cockpit Instruments.

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

Appendix B - Glossary

ACC	Area Control Centre
agl	above ground level
asl	above sea level
ATS	Air Traffic Services
AWOS	automatic weather observation station
C of G	centre of gravity
DCPC	direct controller pilot communication
EDT	eastern daylight saving time
ELT	emergency locator transmitter
fpm	feet per minute
FSS	Flight Service Station
GPH	gallons per hour
hr	hour(s)
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
KIAS	knots indicated airspeed
lb	pound(s)
LL	low lead
MHz	megahertz
nm	nautical miles
NOTAM	Notice to Airmen
PPL	Private Pilot Licence
TSB	Transportation Safety Board
UNICOM	a private advisory station located at an uncontrolled aerodrome
US	United States
VFR	visual flight rules
°	degrees
°M	degrees of the magnetic compass
'	minutes

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