Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A03P0113

RISK OF COLLISION

BETWEEN
HELIJET INTERNATIONAL INCORPORATED
SIKORSKY S-76A (HELICOPTER) C-GHJL AND
HARBOUR AIR LTD.
de HAVILLAND DHC-3 C-FRNO
ACTIVE PASS, BRITISH COLUMBIA
22 MAY 2003

Canada

Aviation Investigation Report

Risk of Collision

Between
Helijet International Incorporated
Sikorsky S-76A (Helicopter) C-GHJL and
Harbour Air Ltd.
de Havilland DHC-3 C-FRNO
Active Pass, British Columbia
22 May 2003

Report Number A03P0113

Summary

A Helijet International Incorporated (Helijet) Sikorsky S-76A helicopter (registration C-GHJL) was on an IFR (instrument flight rules) med-evac flight from Victoria, British Columbia, to Vancouver Harbour. The crew was in communication with the Victoria terminal controller who, at approximately 1315 Pacific daylight time, cleared the helicopter to descend from 3000 to 2200 feet in the vicinity of Active Pass. Shortly thereafter, the controller alerted the crew that an opposite-direction radar target was one nautical mile (nm) ahead. It had been previously undetected by the controller. The crew immediately spotted an aircraft landing light directly ahead and took evasive action to the right.

The opposing traffic was a Harbour Air Ltd. (Harbour Air) de Havilland DHC-3 (Otter), registration C-FRNO, on a VFR (visual flight rules) flight from Vancouver Harbour to Victoria Harbour. The pilot had just established contact with the Victoria tower outer airport controller and, as he was levelling at 2500 feet above sea level (asl) approximately one nautical mile (nm) north of Active Pass, was cleared through the Victoria Airport control zone. Although the pilot was not advised of any conflicting traffic, he spotted the helicopter, C-GHJL, at his 12 o'clock position less than one nm, in an evasive manoeuver. The Otter did not take any evasive action. Radar data displayed both aircraft passing approximately two nm south of the Active Pass NDB (non-directional [radio] beacon) at 2700 feet with less than 600 feet lateral spacing.

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

The helicopter was operating within Class C airspace along a company area navigation (RNAV) route. This route is not published on aeronautical charts, but crosses a published southbound VFR route approximately two nm south of the Active Pass NDB. The helicopter had commenced descent when it was approximately three nm south of the Active Pass NDB, with the intention of cancelling IFR, when able, and following the low-level transit route to Vancouver Harbour. The helicopter did not have a landing light on for cruise flight because of the downward orientation of the light.

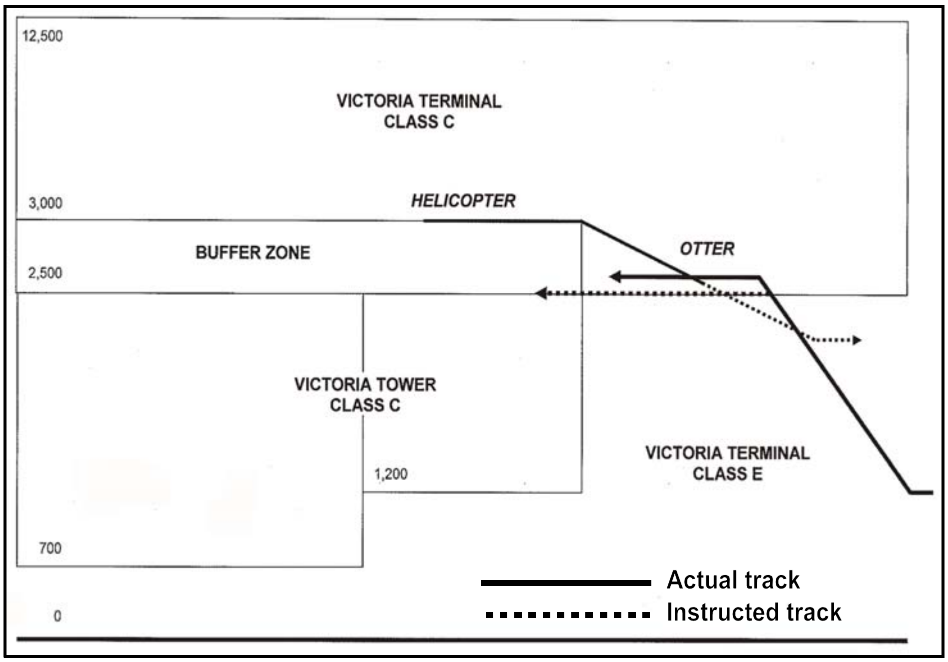

Figure 1. Diagram of airspace and aircraft tracks (based upon radar data)

Because of the reduced ceilings and visibilities around Vancouver, the Otter aircraft had remained at 700 feet above ground level (agl) within Class G airspace below the Vancouver tower outer control zone. The weather improved once the Otter was clear of this zone, which permitted the aircraft to climb to 2500 feet while proceeding within Class E airspace along a published, low-level transit route toward Active Pass. In accordance with VFR, the pilot was required by Canadian Aviation Regulations (CARs) 602.21 to maintain an altitude at least 500 feet below the cloud base and to maintain separation from other aircraft. Radar data show that the Otter climbed as high as 2800 feet and entered Victoria terminal airspace (Class C) while still outside the lateral boundary of Victoria tower airspace. (See Figure 1.) The Otter was flying with pulse lights on.

Weather

The 1300 Pacific daylight time[1] weather report for the Vancouver International Airport was as follows: a very light easterly breeze, four statute miles (sm) visibility in light rain and mist, scattered cloud at 500 feet agl, and a broken ceiling at 1600 feet agl. The 1300 weather

1 All times are Pacific daylight time (Coordinated Universal Time minus seven hours).

observation for the Victoria International Airport was as follows: a light southeasterly breeze, seven sm visibility in light rain and mist, several levels of cloud reported as few, and a broken ceiling at 6100 feet agl. There are no official reporting stations between Vancouver and Victoria. However, pilots using the route described the northbound visibility to be a grey, murky haze. The southbound visibility faced improving conditions; the Victoria Airport could be seen from Active Pass, approximately 13 nm away. The helicopter had just broken out of cloud, and at approximately 2800 feet asl, enough forward visibility was established for the crew to spot the landing light ahead of them.

Classification of Airspace

Canadian Domestic Airspace has seven classifications. The classification of airspace determines the operating rules, the level of air traffic control (ATC) service provided within the structure, and in some instances, communications and equipment requirements (Designated Airspace Handbook TPE 1820E). The Vancouver Terminal Control Area (TCA) covers most of the southern Straight of Georgia and is designated as Class E transition[2] airspace from 700 feet asl up to and including 2500 feet asl. Airspace is designated Class E when an operational need exists for controlled airspace, but it does not meet the requirements of Class A, B, C, or D.[3] Above 2500 feet lies Victoria terminal Class C airspace up to 12 500 feet. Both Vancouver and Victoria airports have an outer control zone designated as Class C airspace from 1200 feet asl up to and including 2500 feet asl to a range of 12 nm from the respective airport. There is approximately 10 nm of Class E airspace between these control zones. When operating under VFR in level cruising flight at or below 3000 feet agl, pilots are not required to maintain altitude appropriate for the direction of flight.[4]

Class E airspace is controlled airspace; however, ATC control applies only to IFR flights. VFR flight is permitted to operate within Class E airspace without any special requirements other than compliance with weather minimums applicable to controlled airspace. Class C airspace is controlled airspace within which VFR and IFR flights are permitted, but VFR flights require an ATC clearance to enter. Within Class C airspace, controllers are required to provide conflict resolution between IFR and VFR aircraft, and traffic information to VFR flights. It is left to the controller's judgement to determine when traffic may be a conflict.[5] Transponders are required within Class C airspace, but are not required within basic Class E airspace.

---

[2] Aeronautical Information Publication (AIP) RAC 2.7.5 Transition areas are established when it is considered advantageous or necessary to provide additional controlled airspace for the containment of IFR operations. Transition areas have defined dimensions, based at 700 feet AGL, unless otherwise specified, and extend upwards to the base of overlying controlled airspace.

[3] AIP RAC 2.8.5

[4] CARs 602.34

[5] NAV CANADA MANOPS 394.1, 394.2

Air Traffic Control

The Otter was equipped with an altitude encoding transponder, and the pilot was still using the code assigned by ATC on departure from Vancouver Harbour. However, radar service terminated when the Otter left the Vancouver Harbour control zone and proceeded en route within Class G or E airspace.

The present position symbol (PPS) displayed on both the Victoria terminal NARDS (NAV CANADA Auxiliary Radar Display System) monitor and the Victoria tower controllers' NARDS monitor, had an attached data tag that included at least the transponder code, aircraft altitude, flight number, and controller jurisdiction code. The NARDS monitor is the primary display for the Victoria tower outer control position. The NARDS monitor at the Victoria terminal position is a secondary display monitor. On the RSIT (Radar Situation Display) monitor, the Otter appeared as an unknown target (asterisk with a two digit altitude indicator) commonly referred to as a "splat."

When a non-radar identified flight makes initial contact, a controller will verbally confirm the transponder altitude readout and inform the crew when the flight is radar identified. The pilot was not informed that the flight was radar identified, but did receive a clearance to enter and transit through the Victoria tower Class C airspace at 2500 feet.

The helicopter and the Otter were not coordinated as traffic between the Victoria tower and Victoria terminal controller because, in accordance with an inter-unit agreement, it was not required to be. The agreement describes a 500-foot buffer zone within the Victoria terminal Class C airspace overlying the Victoria tower Class C airspace. It directs that, without coordination, the Victoria terminal controller may clear traffic over the Victoria tower Class C airspace at or above 3000 feet, and the Victoria tower controller may clear traffic to maintain 2500 feet or below within the tower's Class C airspace. If either controller wishes to clear an aircraft through the buffer zone between 2500 feet and 3000 feet, coordination would be required.

The Victoria terminal controller was responsible for five IFR aircraft (including one training flight), one VFR aircraft, and was planning for two pending IFR departures within the eight-minute period since assuming the control position. Staffing of the Vancouver West specialty consisted of four controllers plus one supervisor; two were on a break and one was filling a data position shared between the Victoria sector controller and the Abbotsford sector controller. At the time of the incident, the data person was busy in the Abbotsford sector and was unable to assist the Victoria terminal controller. The staffing level was consistent with the stated minimum staffing level for the specialty.

Approximately eight minutes after a controller shift change, the relieving Victoria terminal controller cleared the helicopter to descend to 2200 feet, the minimum en route altitude. The controller was executing a traffic sequencing plan for flights proceeding to Vancouver and issued the descent clearance to the helicopter to make the 3000-foot altitude available for the descent of another aircraft in accordance with the plan. Separation between IFR and VFR consists of preventing the PPSs from overlapping or providing at least 500 feet of vertical separation unless visual contact by at least one crew is established.[6] Radar scanning is the basic skill employed by controllers to ensure radar separation between aircraft. It was incumbent upon the controller to verify whether conflicting traffic existed before issuing a descent clearance to the IFR helicopter. Flight progress strips aid scanning by providing a physical organization and record-keeping list of aircraft for which the controller is responsible. The controller did not have a flight progress strip for the Otter because it was not operating on a flight plan that proposed entering the controller's airspace jurisdiction.

Aids to Visual Detection

The AIP, Section RAC (Rules of the Air and Air Traffic Services) 2.5.1, Use of Controlled Airspace by VFR Flights, states: "because of air traffic density at certain locations, the 'see and be seen' principle [see-and-avoid principle] of VFR separation cannot always provide positive separation." Further, Section AIR (Airmanship) 3.7, Vision, notes that good visual scanning practices are required for the see-and-avoid principle to be effective. Pilots need to identify conflicting traffic while there is still time to take avoiding action.

Research by the Australian Bureau of Air Safety Investigation concluded "the see-and-avoid principle in the absence of traffic alerts is subject to serious limitations" and that un-alerted see-and-avoid has a "limited place as a last resort means of traffic separation at low closing speeds."[7] Research conducted by the MIT Lincoln Laboratory during traffic alert and collision avoidance system (TCAS) flight testing showed a 50 per cent improvement in the visual target acquisition rate by pilots alerted to the presence of other aircraft, and a 40 per cent improvement in the median range of visual acquisition.[8] TSB Engineering Report LP 86/95 indicated that visual search effectiveness improves by an approximately eight-fold factor when TCAS equipment is used (that is, one second of search with the aid of a TCAS traffic advisory is as effective as eight seconds of un-alerted search).

Supporting Information

This occurrence is the fifth reported air proximity event recorded in the TSB database within the last 12 months involving an IFR versus VFR conflict within Class C and E airspace lying within the bounds of a line connecting Victoria, Bellingham, Abbotsford, Vancouver, and Nanaimo airports. There were a number of similarities between the four previous occurrences. In all four, there was a risk of collision, and the VFR aircraft was not radar identified nor was there any communication with it. In three cases no traffic information was passed by the controller. In two cases traffic was spotted by the IFR crew, but not in time to prevent a risk of collision.

---

[6] NAV CANADA MANOPS 394.1, 394.2

[7] Australia, Bureau of Air Safety Investigation, *Limitations of the See-and-Avoid Principle*, 1991.

[8] J.W. Andrews, "Modeling of Air-to-Air Visual Acquisition," *The Lincoln Laboratory Journal*, 2, 3, 1989, p. 478.

A risk management study conducted by Transport Canada in 2003 found that over two million passengers are transported each year (many by floatplane or helicopter) in the area over the southern Strait of Georgia between Vancouver, Victoria, and Nanaimo. Twenty four risk of collision scenarios were identified. One of the hazards identified was that IFR routes transit Class E airspace without traffic protection from general aviation aircraft. Risk-of-collision scenario #21 describes a VFR aircraft, climbing from Class E airspace to Class C airspace, conflicts with an IFR aircraft descending to Class G airspace while both are transiting the boundary of two TCAs. One recommendation of the study was a review of IFR routes in the Vancouver TCA to improve airspace protection for IFR flights transiting Class E airspace. An airspace study entitled *Airspace Review of the Vancouver, Lower Mainland and Victoria Areas* was initiated by NAV CANADA on 26 November 2003. The purpose of the study is to determine the optimum airspace configuration, routes, and procedures required for the area. The projected completion date is autumn 2005.

Analysis

General

Safety in aviation is based primarily on the concept of defences built into the system. In this investigation, discussion of defences in place to mitigate the risk of mid-air collisions include:

– the classification of airspace, and applicable operating rules and level of ATC service;
– visual scanning by flight crews;
– aides to visual detection, including two-way communication, TCAS, landing/pulse lights; and
– altitude separation.

Airspace

Within the Class E transition airspace between Vancouver and Victoria, any aircraft may operate under VFR up to and including 2500 feet without a transponder or any form of communication with an ATC unit or other aircraft. Since regulations governing altitude and direction of flight do not apply, many pilots choose to maintain 2500 feet regardless of direction. In this area there can be an airspeed differential of 200 knots between same-direction traffic and closing speeds of up to 500 knots between opposite-direction traffic. In spite of this mix of traffic, controlled IFR flights operating at speeds of up to 250 knots are routinely cleared into the same Class E airspace as uncontrolled, unidentified VFR radar targets without communication. Yet, radar traffic information and conflict resolution between IFR and VFR aircraft in Class E airspace are not considered to be high priorities. Air traffic controllers are not expected to ensure separation between IFR and VFR aircraft on Class E airspace, and radar traffic information will be provided only when the controllers' workload permits. This incident is representative of the recent history of IFR/VFR air proximity events and one of the 24 risk-of-collision scenarios identified in the TC risk management study. Continuation of these events demonstrate that an elevated level of risk of mid-air collision exists when IFR and uncontrolled VFR aircraft share this airspace under the current levels of air traffic services.

Air Traffic Control

Radar scanning of Class E airspace to detect conflicting VFR traffic is not supported by aides, such as flight data strips, and these targets may only display as a splat without associated data tags. Therefore, determination of conflicting traffic requires an additional effort delegated to the controller's memory. In this occurrence, the controller's attention was divided between numerous tasks related to his plan, which likely caused his radar-scanning technique to deteriorate. The VFR traffic was displayed on ATC radar; however, based on scanning alone, the Victoria terminal controller did not detect the Otter's presence before issuing a clearance to the IFR helicopter for descent into Class E airspace. Although not mandatory, traffic information was provided, but not in time to prevent a risk of collision between the helicopter and the Otter. In accordance with ATC MANOPS, controllers are not obliged to provide such service within Class E airspace when other matters take priority.

Aids to Visual Detection

The altitude deviation by the Otter contributed to the risk of collision; however, it was not causal to the air proximity conflict. When the helicopter received the descent clearance, the defence of altitude separation was removed and, since neither crew had been advised of the traffic, only the defence of un-alerted visual scanning remained. Traffic advisories, via radio communication (ATC or air-to-air), on-board technology such as TCAS, or landing lights greatly assist pilots in detecting conflicting traffic. Weather conditions may have contributed to the difficulty of visual detection, but reliance on the see-and-avoid principle of separation may not have been adequate to prevent a collision since neither flight crew detected the opposing traffic, in advance, on their own. Once alerted, the helicopter crew immediately spotted the Otter's landing light.

Transponders are required within Class C airspace, but are not required within basic Class E airspace. The safety advantage that might be gained with TCAS equipment installed in aircraft is thus limited within Class E airspace since TCAS systems operate on transponder signals. Since the Otter pilot intended to operate within Class C airspace, the transponder was turned on. Had either aircraft been equipped with TCAS, this incident likely would have been averted.

Findings as to Causes and Contributing Factors

1. The Victoria terminal controller did not detect the Otter's presence, possibly because his attention was divided between numerous tasks related to his plan, causing his radar-scanning technique to deteriorate.

2. Traffic advisories greatly assist pilots to spot conflicting traffic. However the Otter pilot was never advised of the helicopter traffic, and the helicopter crew was not advised of the Otter in a timely manner, impairing the pilots' abilities to detect the other aircraft.

Findings as to Risk

1. Over the southern Strait of Georgia, controlled IFR flights are routinely cleared into the same Class E airspace as uncontrolled, unidentified VFR radar targets. Yet, radar traffic information and conflict resolution between IFR and VFR aircraft in Class E airspace are not provided unless the controller's workload permits providing this additional service.

2. Weather conditions may have contributed to the difficulty of visual detection, but reliance on the see-and-avoid principle of separation may not have been adequate to prevent a collision since neither flight crew detected the opposing traffic in a timely manner on their own.

Other Findings

1. Both incident aircraft were equipped with transponders; however, neither aircraft was equipped with a traffic alert and collision avoidance system. A TCAS probably would have alerted both pilots to the conflict.

2. Because transponders are not required within basic Class E airspace, the safety advantage that might be gained with TCAS equipment installed in aircraft is limited.

3. The altitude deviation by the Otter contributed to the risk of collision; however, it was not causal to the air proximity conflict.

Safety Action

An airspace study entitled *Airspace Review of the Vancouver, Lower Mainland and Victoria Areas* was initiated by NAV CANADA on 26 November 2003. The purpose of the study is to determine the optimum airspace configuration, routes, and procedures required for the area. The projected completion date is autumn 2005. Both operators involved in this occurrence are active participants in this study.

Both operators and NAV CANADA are involved in frequent dialogue regarding traffic conflicts and the safety of their operations. Both operators believe that the number of conflicts has been reduced as a result.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 07 April 2005.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.

Appendix A – Vancouver VTA Chart