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

TRANSPORTATION SAFETY

REFLEXIONS

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TCAS Comes Through

Canada

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The Regionnair Raytheon Beech 1900D that crashed on approach to Sept-Îles airport in August 2002.

An All Too Familiar Scenario

The need for additional regulatory restrictions for instrument approaches in poor weather has been discussed in Canada for several years, because of the number of accidents that occur during the approach and landing phase. From 1994 to 2001, the Transportation Safety Board of Canada (TSB) has investigated 24 such accidents where low visibilities and/or ceilings likely contributed to the accident. These accidents resulted in 34 fatalities and 28 serious injuries, not counting the loss of property and damage to the environment.

In March 2002, in its final report of the investigation into the crash of a Beech 1900D on 12 August 1999 in Sept-Îles, Quebec (one of the above mentioned 24 occurrences), the Board made two safety recommendations relating to low visibility and low ceiling approaches.

In the August 1999 accident, a Regionnair Inc. Raytheon Beech 1900D, was on a scheduled multi-leg flight, with the final segment from Port-Menier to Sept-Îles, Quebec. There were two pilots and two passengers on board. The aircraft had departed Port-Menier at 2334 eastern daylight time (EDT). The aircraft crashed approximately 23 minutes later, while on approach to the Sept-Îles airport, one nautical mile short of the runway, in reported weather conditions of 200-foot ceiling and one-quarter statute mile visibility.
— TSB Report No. A99Q0151

Both pilots were flying for two companies. The captain had 7065 total flying hours; 606 hours were on aircraft type, of which 198 were within the last 90 days. His total flying hours for the last 30 and 90 days on all types were 127 and 337 hours, respectively. The first officer had 2600 total flying hours, 179 hours on type; 128 hours of these were in the last 90 days. His total flying hours for the last 30 and 90 days on all types were 181 and 368 hours, respectively. The captain had been on duty for 16 hours and the first officer

18 hours on the day of the occurrence. Over the previous 30 days, the first officer had only one day of rest and had worked an average of 14 hours a day, including 6 hours a day flying. The first officer was probably suffering from chronic fatigue. Further, the 30-day and the 90-day duty times of both crew members exceeded the legal maxima identified by Transport Canada (TC). The Regionnair operations manager did not effectively supervise the flight and duty times of company pilots, and TC was not aware that the company's pilots were exceeding the flight and duty times.

The flight was pilot self-dispatched and departed under instrument flight rules (IFR) in controlled airspace. The captain had earlier advised the Flight Service Station (FSS) personnel that he would come in for a detailed weather briefing. He instead called the FSS and asked for the actual local conditions. A copy of the relevant weather data sheets and notices to airmen were later obtained by the captain from the Canadian Regional Airline dispatch office before engine start. The captain did not discuss the weather forecast or the conditions at any of the intended landing points with the first officer.

The first officer was at the controls of the aircraft for the duration of occurrence segment of the flight and was sitting in the right-hand seat. After departure from Port-Menier, the crew received a weather report from the FSS, which reported the latest conditions at Sept-Îles Airport as ceiling 200 feet above ground level (AGL) and visibility 1/4 statute mile (sm) in fog.

In view of the reported weather conditions, the crew knew that an NDB approach to Runway 31 would not provide them with the required ceiling and visibility conditions to land. Runway 31 is not served by an RVR, so no regulations were in place to prevent an approach to that runway, regardless of the ceiling and visibility conditions; therefore, the crew decided to conduct a user-defined GPS approach to an altitude lower than the minimum established for the NDB approach. It was decided to aim for 300 feet AGL at 3 nm and 100 feet AGL at 1 nm, followed by a shallow descent until the approach lights were seen. There is no published GPS approach for Runway 31 at Sept-Îles Airport.

The descent into the aerodrome was started late, and the aircraft was high and fast during the approach phase to the NDB. From an altitude of 10 000 feet at 9 nm from the NDB, the rate of descent generally exceeded 3000 feet per minute (fpm). The aircraft crossed the beacon at 600 feet ASL. For the last 30 seconds of flight and from approximately 3 nm from the threshold, the aircraft descended steadily at approximately 850 fpm, at 140 to 150 knots indicated airspeed, with full flaps extended. The captain coached the first officer throughout the descent and called out altitudes and distances. The ground-proximity warning system (GPWS) minimums activation sounded, consistent with the decision-height (DH) selection of 100 feet, to which the captain responded with directions to continue a slow descent. The last call was at 30 feet, 1.2 seconds before

The decision to descend below the approach minimum is troubling because aviation regulations… are made to ensure the safety of persons, property, and the environment.

impact. The aircraft struck trees in a near-level attitude, in an area of rising terrain.

The decision to descend below the approach minimum is troubling because aviation regulations, which were taken so lightly in this occurrence, are made to ensure the safety of persons, property, and the environment. Reportedly, the practice of conducting user-defined GPS approaches and limits was common within this and other companies, at least until a previous Regionnair accident at Saint-Augustin on 04 January 1999. After that accident, Regionnair's president gave specific verbal instructions to all his aircrew to respect all descent minima. The crew involved in the Sept-Îles occurrence did not work for the company when the briefing was given. They were not briefed on this point when they were hired in the spring of 1999 and might have felt that the practice of descending below MDAs/DHs was acceptable.

Post Crash

A post-crash fire destroyed the wings, the engines, and the right midside of the fuselage. The captain was fatally injured; the first officer was seriously injured. The first officer was wearing his three-point lap belt and his shoulder harness. The captain was only wearing his lap belt. The two passengers received minor injuries, and walked away from the aircraft towards the sound of traffic on a nearby highway.

The emergency locator transmitter (ELT) activated on impact. The signal was heard by the FSS specialist for four to five seconds, then stopped. The antenna was sheared off during the impact sequence. It is likely that the ELT transmitting range was affected when the antenna was destroyed.

Sept-Îles Airport does not have an emergency response service (ERS) unit based at the airfield, although an ERS vehicle is located permanently at the airfield. The FSS alerted the ERS about a missing aircraft, and by 0015, ERS personnel, comprising local police and medical personnel in ambulances, were at the airport. The ground search was conducted in darkness and near zero visibility in fog. The two passengers were found at approximately 0100. The location of the aircraft was immediately passed to ERS personnel, who arrived at the scene shortly thereafter.

Regulatory Oversight and Company Management

As mentioned, approximately seven months prior to the Sept-Îles accident, on 04 January 1999, Regionnair experienced a controlled-flight-into-terrain accident while the crew was conducting a non-precision approach in reduced visibility at Saint-Augustin (TSB Report No. A99Q0005). As a result of a regulatory inspection on 19 and 20 January 1999, TC revoked the pilot-in-command's right to serve as chief pilot and revoked the president's right to serve as operations manager. TC felt that the pilot-in-command had not exercised good supervision over the procedures used by the crew members, and that the operations manager had not ensured the safety of air operations or exercised control over operations and the aircraft-operating standards used. TC restored the company president's right to serve as operations manager after he submitted a corrective action plan. Regionnair management verbally briefed its pilots on the requirement to adhere to established ceiling and visibility criteria during approaches in instrument meteorological conditions; however, a written directive to this effect was not produced for the flightcrews' circulation file, nor was the standard operating-procedures manual amended. In addition, TC was asked to deliver a cockpit resource management (CRM) course to company pilots. TC delivered the training in March, August, and December 1999; however, the occurrence pilots did not receive this training because neither was employed by Regionnair at the time of the March course – and the August course was four days after the accident.

On 13 August 1999, Transport Canada (TC) conducted a post-occurrence audit of Regionnair Inc. The findings of this inspection, primarily regarding training shortcomings and the lack of qualified management personnel, resulted in the suspension of the company's air-operator certificate effective that date. The company's response to the identified shortcomings resulted in the reinstatement of the air-operator certificate on 18 August 1999, providing that all aircrew undertake a TC CRM course and that the company replace the operations manager, put in place a flight-safety program, and promptly correct any flight-safety deficiencies uncovered by the regulatory audit. Regionnair appointed a new director of flight operations and established a safety program, with a new safety officer. Both persons met the TC requirements for the positions.

Until these regulations are promulgated, there will continue to be inadequate defenses against the risks associated with pilots descending below the decision-height/minimum-descent altitude.

Low Visibility and Low Ceiling Approaches

In September 1999, TC initiated action to implement new approach-ban regulations based on visibility. These regulations were to reduce the likelihood of accidents during instrument approaches in low-visibility conditions; however, timely implementation was delayed because of some resistance.

Until these regulations are promulgated, there will continue to be inadequate defenses against the risks associated with pilots descending below the decision-height/minimum-descent altitude (DH/MDA) in an attempt to land in visibility conditions that are unsafe. Consequently, controlled-flight-into-terrain accidents on approach have continued to occur and will likely continue to occur. The Board therefore recommended that:

The Department of Transport expedite the approach ban regulations prohibiting pilots from conducting approaches in visibility conditions that are not adequate for the approach to be conducted safely.
— TSB Recommendation A02-01

In response to Recommendation A02-01, TC indicated that it had prepared 16 Notices of Proposed Amendments (NPAs) concerning approach-ban regulations. The NPAs were under review by the Department of Justice and it was expected that the final product would be published in the June 2002 version of the *Canada Gazette*.

Most pilots adhere to regulations, rules, and standard operating procedures because it is good airmanship to do so. Education directed at pilots and others in the air industry attempts to instill safety cultures that will result in safer flight. TC actively promotes good airmanship and attempts to educate people about safe practices and the risks in disregarding safe practices; however, and for whatever reason – operational pressures, pride, commitment to the job – some pilots continue to conduct approaches in weather conditions where there is little chance of completing a safe landing. Unfortunately, many of these approaches result in accidents, injuries, and deaths directly attributable to the weather conditions and the pilots' decisions. Airmanship and education are evidently not effective in curtailing accidents of this type.

The proposed approach ban addresses the visibility issue to a large extent but does not address the ceiling issue. In recent years, the Board has investigated a number of accidents where the visibility was reasonable, but the ceiling was below the limits stated in *Canada Air Pilot* for the particular approach flown. Although regulations exist to prohibit pilots from descending below the applicable DH/MDA descent altitude for their approach, these regulations are not enforceable; therefore, the Board recommended that:

The Department of Transport take immediate action to implement regulations restricting pilots from conducting approaches where the ceiling does not provide an adequate safety margin for the approach or landing.
— TSB Recommendation A02-02

TC concurred with the Board's assessment of the extent that educational programs have contributed to an acceptable safety culture in aviation operations and agreed that including a ceiling limit in the approach ban merits consideration. TC also indicated that it is aware of the difficulty in creating a practical and enforceable regulation based on the known limitations of the available weather observations and the associated implications of defining what ceiling and sky conditions could be used to constitute an adequate safety margin. TC stated it would bring Recommendation A02-02 to the Canadian Aviation Regulation Advisory Council for further consultation and discussion.

Other Initiatives

In the three TC crew resource-management courses given specifically for Regionnair in March, August, and December 1999, 24 pilots were trained and qualified. An additional course was offered to all pilots on 15 January 2000.

TC issued special aviation notices and aeronautical information circulars and made entries in *Aeronautical Information Publication* concerning global positioning-system (GPS) use. TC also published a number of articles in the *Aviation Safety Letter* and *Aviation Safety Vortex* newsletters, addressing the operating limitations and safe use of GPS. Nav Canada is working with TC and the US Federal Aviation Administration to gradually introduce full use of GPS for all phases of flight in Canada.

TC is drafting a commercial- and business-aviation advisory circular (CBAAC) to emphasize to operators the importance of maintaining records of pilot flight-duty hours and flight hours. The CBAAC will emphasize the importance and various parties' responsibilities regarding the recording of duty and flight hours of pilots who fly for more than one operator.

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The approach-ban issue has been debated since September 1999; a proposed June 2002 implementation date passed. So what's next in curbing the all too familiar scenarios of approach and landing accidents in poor weather?

Wreckage of a Bell 214B helicopter near Kaslo, British Columbia, in July 1999.

Unsuccessful Autorotation Following Fuel Starvation

Emergency procedures following a power loss in a Bell 214B helicopter require timely and correct pilot response. If the emergency procedures are not implemented correctly and quickly, rotor rpm can rapidly decay to a point where it cannot be regained regardless of pilot response, making a successful autorotation impossible.

This information is contained in the TSB's final report on its investigation into the fatal crash of a Bell 214B near Kaslo, British Columbia, on 04 July 1999. — TSB Report No. A99P0075

The East West Helicopters Ltd. helicopter had departed a staging area near Kaslo at about 0645 Pacific daylight time on a local visual-flight-rules flight. The pilot and three crew members were on board. The pilot had indicated that he was doing a power check and that the conditions were too foggy for heli-logging. The helicopter was observed flying uneventfully in the area for about 10 minutes before the engine noise suddenly stopped. The helicopter, about 400 feet above ground level at the time, descended, made a 180-degree left turn, and landed heavily in a shallow, rapidly flowing river. The helicopter broke apart on impact and came to rest on the rocks in the middle of the river. Three of the occupants were fatally injured on impact; the pilot succumbed to his injuries about 45 minutes later. The aircraft was destroyed. There was no fire.

The night before the accident, an aircraft maintenance engineer (AME) and an apprentice AME had worked on the helicopter until midnight. It is not known what maintenance may have been performed at that time. The aircraft journey log could not be located following the accident; it may have been aboard the helicopter at the time of the accident. The technical logs were recovered but did not contain information for the last month of the aircraft's operation. The airframe technical log entries indicated that a surging problem with the engine had been reoccurring for about a year.

A detailed inspection of the wreckage revealed that all component breakage and damage in the flight controls, drive train, and main-rotor gearbox were overload in nature and were attributable to the impact forces of the accident. It was determined that the helicopter engine lost power in flight (engine flame-out) because of fuel starvation.

The Bell 214B helicopter is equipped with five fuel cells, interconnected to feed into the two forward fuel cells. Each forward cell contains an electrically driven boost pump which supplies fuel to the engine. A fuel-cell interconnect line runs between the left and right forward fuel cells, normally ensuring that the fuel level in the two forward cells remains

When the right boost pump is inoperative, the fuel-quantity gauge indicates more fuel than is actually on board.

equal. The light-bulb analysis during the investigation showed that the low-fuel light and the right boost-pump annunciator light might have been illuminated at the time of the crash. The fuel-level sensor is in the left forward cell; therefore, the low-fuel light would indicate that the left forward cell was virtually empty. Assuming the right boost pump became inoperative, the fuel from the left forward cell was consumed at a faster rate than the fuel could transfer from the right forward cell to the left forward cell. The fuel in the left forward cell eventually fell to an unusable level, and the engine stopped.

When the right boost pump is inoperative, the fuel-quantity gauge indicates more fuel than is actually on board. The actual amount of usable fuel would be difficult to determine in flight; moreover, because the helicopter was taken on a maintenance test flight, rather than the usual heli-logging flight, it is possible that the helicopter was not refuelled before the flight or that it was refuelled with less fuel than normal.

The pilot did not have a current pilot-proficiency check and had not received any recurrent training on the Bell 214B. Because no mechanical malfunction was found and because procedures

A portion of the helicopter's tail assembly.

following a power loss in the Bell 214B require timely and correct pilot response, it is possible that the pilot's lack of recent training on Bell 214B emergency procedures contributed to the unsuccessful autorotation.

The investigation determined that a Transport Canada (TC) audit of East West Helicopters Ltd. had not been conducted in the three years preceding the accident. Following the accident, TC audited the company on 14 July 1999, and found the flight-crew training program was lacking in several areas. The TC audit also concluded that the company suffered from a lack of operational control because of the significant workload placed on its operations manager. TC has subsequently indicated that the company corrected all of the items noted in the audit and has been put on a one-year audit cycle.

Safety Issue with Flight Manuals

The fuel-quantity indicating system in the Bell 214B (and Bell 205, which has a similar system) does not directly measure the amount of fuel in the left forward cell. Therefore, unless the fuel level in both forward cells is equal, the gauge will indicate an incorrect amount of fuel remaining. For the same reason, the fuel low-level warning system, which does not directly measure the fuel in the right forward cell, can read incorrectly. Either of these indications could lead a pilot to believe that there is more fuel than is actually available and to continue flight operations until fuel exhaustion. The flight manuals for these aircraft do not contain information explaining that the fuel-quantity indicating system may provide incorrect information.

Considering that boost-pump failures are common in Bell 214B and Bell 205 helicopters, and that there is insufficient information readily available to pilots operating these helicopters to reasonably expect that they would take appropriate action in the event of a boost-pump malfunction, the Board recommended, for the consideration of Bell Helicopter Textron and the Minister of Transport, that:

The Bell 214B and Bell 205 flight manuals be modified to provide information regarding the inaccuracy of fuel quantity indications, thereby allowing pilots to make informed decisions in the event of a loss of fuel boost pump pressure.
— TSB Recommendation A01-05, issued Oct 2001

TC agreed with the need to modify the Bell 214B and Bell 205 flight manuals and requested that the U.S. Federal Aviation Administration, the regulatory authority responsible for the design standards for the helicopters, review the fuel-system design and revise the flight manuals and the emergency procedures. TC also indicated that an advisory would be issued to operators of Bell 214 and Bell 205 helicopters in Canada.

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The list of players in this occurrence covers a wide spectrum: regulator(s), manufacturer, operator, flight crew and servicing personnel. Where does prevention of similar occurrences start?

A typical air traffic controller workstation.

TCAS Comes Through

As long as there is the possibility of human error in the execution of air traffic control procedures, the lack of automated ground-based conflict detection and alerting systems, combined with the lack of regulations requiring all transport aircraft to be equipped with traffic-alert and collision-avoidance systems (TCAS), will continue to put air travellers at risk.

The following loss-of-separation (LOS) occurrences are but two examples where TCAS has again proven its worth in aviation safety.

LOS #1—Sporadic Use of Checklists

Two Lufthansa German Airlines Airbus A340 aircraft were on nearly reciprocal tracks at flight level 370. The pilot of the eastbound aircraft (DLH411) advised the Gander air traffic controller that he had received TCAS traffic alert. The controller instructed DLH411 to turn left 20 degrees and instructed the westbound aircraft (DLH420) to descend to flight level 360. After following the controller's instruction, the pilot of DLH411 advised he was climbing the aircraft in response to a TCAS resolution advisory. DLH420 received a resolution advisory to descend. — TSB Report No. A00H0002

DLH420 was en route from Frankfurt to Boston through Canadian domestic airspace. At approximately 1750 Atlantic daylight time (ADT), on exiting oceanic airspace at flight level (FL) 360, DLH420 contacted the Gander Area Control Centre (ACC) domestic high (east) sector controller and was cleared to FL370, since FL360 would not be available for the domestic portion of the flight. However, DLH420 would not be able to remain at FL370 after about 1900, because, at that time, FL370 reverts to being an eastbound altitude to meet the

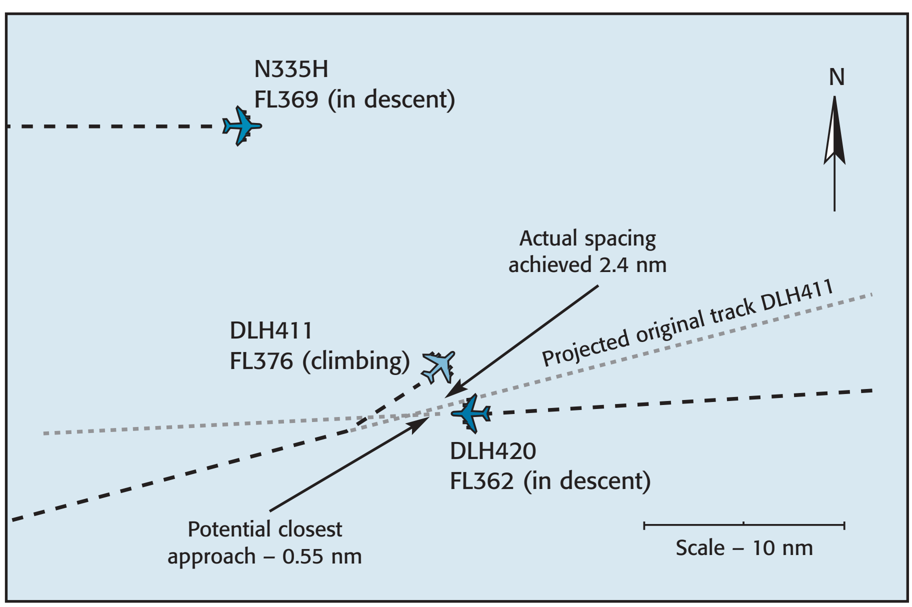
Since information concerning a potential conflict was not passed, the second controller did not see any requirement to immediately complete a detailed check of the flight progress strips.

demands of the intercontinental oceanic flow. As such, and based on the pilot's information that the flight would be able to climb to FL390 in approximately one hour, the controller entered information on the flight-progress strip to indicate that DLH420 was at FL370 and would have to be cleared to FL390 at 1850. Control of DLH420 was handed over to the domestic high (west) controller at about 1830.

DLH411 was on a flight from Newark to Munich, and its route through Canadian domestic airspace would cross the track of DLH420 approximately 95 nm north of Sydney, Nova Scotia. Moncton ACC initiated a radar handoff of DLH411 with the Gander domestic high (west) controller at about 1840, as the flight was approaching the Moncton/Gander boundary and stated that DLH411 was at FL370. DLH411 established radio contact with the Gander domestic high (west) controller, confirmed level at FL370, and requested FL380 or maximum FL390. After a brief conversation to clarify the request, DLH411 was told that the request for the higher altitude was under consideration. At this point, the Gander controller indicated to the supervisor that he required immediate relief. After a short handover briefing to a second controller, he left the operations room at approximately 1845. During the handover briefing, neither controller referred to the handover checklist. The general traffic situation was covered; however, the fact that DLH420 was to be cleared from FL370 to FL390 at 1850 was not mentioned. Since information concerning a potential conflict was not passed, the second controller did not see any requirement to immediately complete a detailed check of the flight progress strips. This resulted in the second controller having reduced situational awareness. Procedural defences were in place to help the controllers gather correct and current information and so develop accurate mental models of the air traffic situation; however, neither controller used the defences consistently in this occurrence. The first controller did not highlight strips for the two aircraft to indicate a potential conflict, the strip for DLH411 was not cocked to indicate an uncompleted action, nor was the altitude marked to indicate that DLH411 was flying at an altitude not in accordance with the current structure for the airspace.

At 1850:43, the pilot of DLH411 advised the second controller that he had received a TCAS alert of another aircraft 20 miles ahead at the same altitude. The second controller responded with instructions first to turn left now, then to turn left 20 degrees. The pilot acknowledged the instructions. Immediately afterward, the second controller instructed DLH420 to descend to FL360 to provide additional separation between the two aircraft.

At 1851:39, the pilot of DLH411 advised the controller that he had commenced a climb as a result of a TCAS advisory. Shortly thereafter, he acquired the other



Point of closest approach.

Gander Area Control Centre (ACC) has now included a mandatory requirement for controllers to complete the briefing checklist when assuming responsibility for a sector.

aircraft visually. DLH420 levelled at FL360 and DLH411 reached FL376 as the aircraft passed abeam. There was 2.4-nm lateral spacing between the two aircraft as they passed and a vertical spacing of 1400 feet at the point of closest approach. Extrapolation of the original flight tracks indicates that the aircraft would have come within 0.5 nm horizontally had they not taken evasive action. The minimum required radar separation in this airspace was 5 nm laterally or 1000 ft vertically.

In its final report on the investigation into this loss of separation, the Board found that there are no written requirements mandating controllers to use available handover checklists during transfer of position briefings. As a result, checklists are used only sporadically, which can lead to information being missed during the many times that handovers take place in the course of a day. Moreover, there is no standard method by which controllers depict direction of flight on the radar indicator module; this can lead to information being overlooked or misinterpreted. Gander Area Control Centre (ACC) has now included a mandatory requirement for controllers to complete the briefing checklist when assuming responsibility for a sector. This action was initiated on 15 August 2000, and the *Gander Unit Operations Manual* was updated on 22 March 2001. In April 2001, the TSB forwarded an Aviation *Safety Information Letter* to Nav Canada to encourage consideration of a method, applicable to all Air Traffic Services units across the country, to reduce the risks associated with memory-dependent transfer of position-responsibility briefings and to ensure that critical information will not be forgotten.

The radar processing system in use at Gander ACC has since been equipped with an automated conflict alerting system that provides warning that a loss of separation is about to occur or has occurred and thereby gives the controller time to act.

LOS #2—Ad Hoc Procedures

The airspace in the vicinity of the Montreal International Airport at Dorval, Quebec, is divided both horizontally and vertically in order to assign control responsibilities to sector controllers. The airspace up to and including 5000 feet is in the jurisdiction of the departure controller; the airspace at 6000 feet and above, is in the jurisdiction of the terminal south controller.

On 27 May 2000, an Air Canada Boeing 767 took off from Runway 28 at Dorval and, while climbing through 3000 feet, was cleared by the departure controller to maintain 17000 feet. As the aircraft reached 5200 feet, the pilot stopped the climb because of a traffic alert and collision avoidance system (TCAS) traffic advisory showing another aircraft directly ahead. The pilot advised the departure controller of the traffic and was immediately cleared to maintain 5000 feet and to turn left to a heading of 260 degrees.

The other aircraft was a Skyservice Cessna Citation inbound to Dorval from Mexico, in descent to 6000 feet under the control of the terminal south controller. At the same time that the departure controller was issuing climb clearance to the Boeing 767 to maintain 17000 feet, the terminal south controller advised the pilot of the Citation that there was traffic at his one o'clock position, four miles, westbound, a Boeing 767 that was climbing to 5000 feet. The controller assumed the Boeing 767 was going to level off at 5000 feet in accordance with terminal procedures. The pilot of the Citation replied that he was under instrument meteorological conditions (IMC) and he did not see the 767. The Citation was not equipped with TCAS, nor was it required to be. The aircraft passed with 1400 feet of vertical spacing and approximately 0.25 mile of horizontal spacing. — Report No. A00H0003

As with most, if not all, ad hoc procedures, this one lacked defences, particularly against normally expected levels of human error, such as forgetfulness and loss of situational awareness.

The departure controller was aware that the inbound Citation was in descent on arrival, he was aware of the vertical division of responsibility within the airspace, and he was aware that it was his responsibility to provide separation between aircraft under his control and other aircraft; however, when he issued the initial climb clearance to the Boeing 767, he did not recall and consider the inbound aircraft, which led to the loss of separation. Since no information was conveyed to the terminal south controller about the departure controller's intentions, no action was taken by the terminal south controller to assure separation.

It is common practice in Montreal to expedite departures by issuing, without coordination, climb clearance through the airspace of the terminal controller and to monitor the departure to assure separation. In this occurrence, the desire to expedite the departure by issuing immediate climb clearance, the lack of coordination between two controllers responsible for two aircraft within the same airspace, not monitoring the climb of the Boeing 767 with sufficient vigilance, and not recalling the presence of the inbound aircraft led to a loss of separation where the safety of the aircraft was not assured.

Procedures Lacked Defences

As with most, if not all, ad hoc procedures, this one lacked defences, particularly against normally expected levels of human error, such as forgetfulness and loss of situational awareness.

In August 2000, the TSB forwarded an Aviation Safety Advisory to Nav Canada, highlighting the risks associated with using ad hoc control practices or altering assigned airspace responsibilities in lieu of using established control procedures that have built-in separation assurance.

Nav Canada issued an *Air Traffic Services Safety Bulletin*, effective 26 October 2000, pointing out risks associated with such action and the importance of taking steps to mitigate any increased risk, should deviation from established procedures become necessary. These bulletins are mandatory briefing items.

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In these occurrences, only TCAS provided a warning in time for action to be taken to prevent potential accidents; however, reliance on TCAS as the sole automated defence against human error does not provide protection for all passenger-carrying aircraft, because TCAS is not mandatory for all passenger-carrying aircraft in Canadian-controlled airspace.

Heater ribbon failure and contaminated insulation blankets contributed to a fire in an Air Canada aircraft cargo hold such as this.

Cargo Bay In-flight Fire – Interim Recommendations

On 14 November 2002, the Transportation Safety Board of Canada (TSB) released two safety recommendations resulting from an ongoing investigation into an in-flight fire that occurred on 13 May 2002, aboard an Air Canada 767-300 aircraft. The TSB makes safety recommendations prior to the completion of an investigation when it identifies a significant safety issue.

The recommendations draw attention to the fire risks associated with water-line heater ribbon installation failures and with contaminated insulation materials and debris collecting in aircraft spaces. Heater ribbon failure was a contributing factor to the ignition of a fire in the cargo hold of the Air Canada aircraft. Contaminated insulation blankets and debris, collected on the floor of the cargo hold, helped to propagate the fire.

The aircraft, with eight crew members and 177 passengers on board, was on final approach at Toronto, Lester B. Pearson International Airport, from Vancouver when the flight crew received an aft cargo bay fire warning. The flight crew followed checklist procedures, activated the cargo bay fire extinguishers and declared an emergency. Although the fire indication went out approximately 50 seconds after activation of the fire extinguishers, a slight smell of smoke continued to be noticed by the cabin crew and flight crew. The flight landed and stopped on the runway to allow a preliminary examination of the aircraft by airport firefighters. The emergency situation was subsequently secured and passengers were deplaned using portable stairs. — TSB Report No. A02O0123

Widespread use of heater ribbons on transport-category aircraft exposes the traveling public to the risks associated with heater-ribbon fires.

Water-line Ribbon-heater Fires

To date, the investigation has determined that a heater ribbon, used to prevent the potable water line from freezing, failed and exhibited signs of overheating and arcing. The heater ribbon, which was spiral-wrapped around the water line, burned through both the protective tape used to hold the heater ribbon in place and the foam thermal insulation material wrapped on top of the protective tape, igniting the non-metalized covering (Mylar®) of the thermal acoustic-insulation blanket mounted on the vertical web of the floor beam. The fire then spread to the insulation blanket covering on the bottom of the pressurized hull and ignited debris in the non-fully enclosed floor area of the aft cargo compartment. The fire became self-propagating, burning its way forward, inboard and outboard, spreading approximately 46 centimetres (18 inches) up the right-side wall of the aircraft before it was extinguished by halon from the fire extinguishing system. Heat from the fire was intense enough to burn holes through the aluminum web of a floor beam and significantly distort the top cap (chord) of the beam structure.

Although the exact failure mechanism of the heater ribbon on the occurrence aircraft is still under investigation, examination of other failed heater ribbons suggests that an internal short or arcing event between two of the elements occurred.

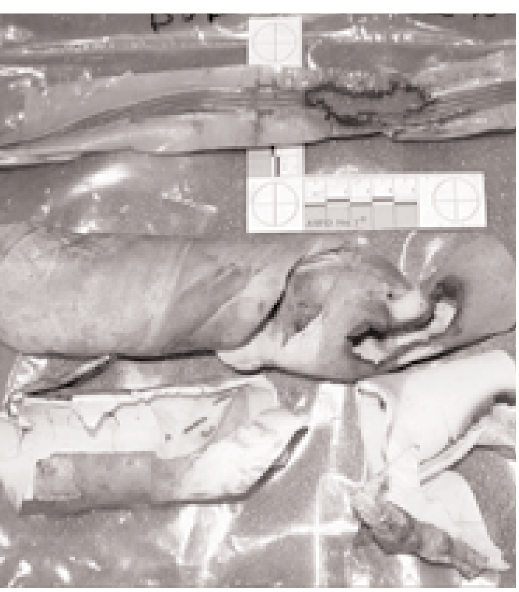
Air Canada took immediate action to reduce the risk of heater-ribbon fires: an inspection of specified areas of the 767 aircraft fleet was conducted and defective heater ribbons in these areas were removed or deactivated; the 767 service check (96-hour maximum interval) was amended to include a requirement to remove all debris found below the floor level of both the forward and aft cargo compartments; and the zonal general visual inspection was enhanced to ensure inspection of ribbon heaters during the scheduled 24-month *M* checks.

Fire damage caused by a faulty water-line ribbon heater. Note the heat-induced distortion to the beam structure.

Boeing released an *Alert Service Bulletin* (ASB) on 28 May 2002 to provide instructions and corrective action necessary to avoid a possible fire in the forward and aft cargo areas. The bulletin called for operators to take actions with respect to visually accessible potable water and drain lines located under the cargo floor in the forward and aft cargo areas. On 07 June 2002, the Federal Aviation Administration (FAA) issued an *Airworthiness Directive* (AD), which reflected Boeing's ASB. The AD indicated that action associated with the AD is considered interim action until final action is identified, at which time the FAA may consider further rules.

While action taken in accordance with the ASB and the AD should reduce the risk of fires associated with heater ribbons, they do not adequately defend against risk in a number of other areas. On 15 July 2002, Transport Canada (TC) sent a letter to the FAA, expressing concern regarding the AD. The letter states that heater tapes are used in numerous other areas of the aircraft and is concerned that the AD does not address those areas. In addition, the one-time inspection and replacement of defective heater tapes (with new parts that are the same), called for by the AD, will not eliminate the known ignition source because replacement heater tapes could fail in the same manner. While TC expressed this concern, they had not yet taken any independent action.

Widespread use of heater ribbons on transport-category aircraft exposes the traveling public to the risks associated with heater ribbon fires. Recent actions taken to reduce these risks were not comprehensive and did not address the risk in the long term. Consequently, there remain inadequate defences against heater ribbon installations starting fires; therefore, the Board recommended that:



Contaminated thermal-insulation blankets such as these pose considerable fire hazards.

The Department of Transport take action to reduce the short term risk and eliminate the long term risk, of heater ribbon installation failures starting fires, and coordinate and encourage a similar response from other appropriate regulatory authorities.
— TSB Recommendation A02-04

Contaminated Thermal Acoustic-insulation Blankets

During inspection of the occurrence aircraft and other 767 aircraft, TSB found contaminated insulation blankets and debris in all cargo compartments with open floors. Also, a considerable amount of blanket contamination, in the form of dust, dirt and lint, was found under and behind panels in areas that are not readily accessible without the removal of panels. Subsequent to the occurrence, Air Canada examined the open forward and aft cargo areas of its 767 aircraft. A general clean-up of debris found in these areas was carried out; however, this action did not address the contaminated blankets.

Contaminated thermal acoustic insulation blankets have fuelled aircraft fires on other occasions. A Lan Chile Airlines aircraft (Miami, Florida; B767-375ER; 28 January 2002) had a fire in the forward (lower) cargo compartment, which was fuelled by contaminated insulation blankets. These insulation blankets showed significant signs of contamination and wear. A Delta Airlines aircraft (Goose Bay, Labrador; Lockheed L1011; 17 March 1991) had a fire under the cabin floor area on the aft left side of the aircraft. A factor contributing to the severity of the fire was the large accumulation of dust and lint on aircraft components, including insulation blankets in the area. As evidenced by the occurrence involving Swissair 111 (02 September 1998), a self-propagating fire on board a transport-category aircraft can have catastrophic results.

During its investigation of the Swissair 111 accident (A98H0003), the TSB issued interim safety recommendations concerning flammability test criteria (A99-07 and A99-08), and material-flammability standards (A01-02 to A01-04). These recommendations, however, did not specifically address fire hazards associated with contaminated insulation materials, dust, lint, or debris.

Actions taken to reduce the risk of self-propagating fires due to contaminated thermal acoustic insulation materials and debris on transport-category aircraft were not comprehensive and did not adequately address risks in the long term; therefore, the Board recommended that:

The Department of Transport take action to reduce the short term risk and eliminate the long-term risk of contaminated insulation materials and debris propagating fires, and coordinate and encourage a similar response from other appropriate regulatory authorities.
— TSB Recommendation A02-05

The Fairchild/Swearingen Metroliner II that broke apart over runway 24 at Mirabel on 18 June 1998.

Update: In-flight Fire Accident at Montreal

During its investigation of a fatal accident on 18 June 1998 at Mirabel/Montréal International Airport, Quebec, involving a Fairchild/Swearingen Metroliner II operated by Propair Inc., the Transportation Safety Board of Canada (TSB) identified a number of safety deficiencies and made five interim recommendations in October 1998. These recommendations dealt with wheel wells and wings overheating, brake overheat detection and wheel well vulnerability, and hydraulic fluid mixing. (Issue 22 of Air *REFLEXIONS*, fall 1998, contains an article highlighting these safety issues and recommendations.)

For the most part, these recommendations were implemented. The actions taken included:

- Flight manual changes relating to *Wheel Well and Wing Overheat Light On*;
- Airworthiness Directives (ADs) to reduce overheated brakes during take-off ;
- ADs for protection of hydraulic and fuel lines in wheel wells; and
- Notifications, ads and manual changes concerning the usage/mixing of hydraulic fluids.

However, the regulator considered one recommendation – dealing with the installation of a brake temperature system to provide timely overheat information to the crew – as too costly to implement.

Completed Investigation

The final report on the investigation into this accident states that the Metro II (SA226-TC) had taken off from Dorval/Montréal International Airport, Quebec, around 0701 eastern daylight time. On board were nine passengers and two pilots. The captain was the company chief pilot and had 4200 flying hours on aircraft type; the first officer had been recently hired by Propair and had 93 hours on aircraft type (all within the last 90 days).

During the ground acceleration phase of take-off, the aircraft was pulling to the left of the runway centreline, and the right rudder was required to maintain take-off alignment. During the investigation, the take-off roll was estimated to be about twice as long as that calculated for the conditions, and the time to rotation was determined to be about six seconds longer than the calculated time of 21 seconds. Neither the aircraft's pull to the left nor the length of the take-off roll were strong enough cues to elicit a reject response from the crew.

About 12 minutes after take-off, at an altitude of 12 500 feet above sea level (asl), the crew advised air traffic control (ATC) that they had a hydraulic problem and requested clearance to return to Dorval. Shortly afterward came the first perceived indication that engine trouble was developing, and the left wing overheat light illuminated about 40 seconds later. Within 30 seconds, without any apparent checklist activity, the light went out. Just past 0718, the left engine appeared to be on fire, and it was shut down. Less than one minute later, the captain took the controls.

The flight controls were not responding normally: abnormal right aileron pressure was required to keep the aircraft on heading. Around 0719, at 8600 feet asl, the crew advised ATC that the left engine had been shut down because it was on fire. Around 0720, the crew decided to proceed to Mirabel Airport. At 0723, ATC was advised by the crew that the engine fire was out. On final for Runway 24 at Mirabel, the crew advised ATC that the left engine was again on fire. The landing gear was extended on short final, and when the aircraft was over the runway, the left wing broke upwards. The fuselage pivoted more than 90 per cent to the left around the longitudinal axis of the aircraft and struck the ground. All 11 occupants were fatally injured. — TSB Report No. A98Q0087

The crew did not realize that the pull to the left and an extended take-off run were due to the left brakes dragging, which led to overheating of the brake components. They retracted the landing gear immediately after take-off; thus, the overheated brake and wheel assembly was retracted into the enclosed wheel well, where the heat was dissipated to the tire and the surrounding structures, eventually causing a fire. The aircraft was not equipped with a means to alert the crew of overheated brakes. When the aircraft was certified, brake overheat detection systems were not required; they still are not required for this class of aircraft. The left wing overheat light came on approximately one minute after the indication of hydraulic failure. The light's continuous illumination indicated overheating in the wheel well or the air conditioning duct; however, before the crew initiated the checklist procedures, the light went out. The light very likely went out because the fire in the wheel well destroyed the warning system electrical circuit. The TSB found that dragging of the left brakes was most probably caused by an unidentified pressure-locking factor upstream of the brakes on take-off. The dragging caused overheating and leakage, probably at one of the piston seals that retain the brake's hydraulic fluid. When hydraulic fluid leaked onto the hot brake components, the fluid caught fire and initiated an intense fire in the left nacelle, leading to failure of both hydraulic systems and eventual rupture of the adjacent main fuel line. The left wing was weakened by the wing/engine fire and failed just short of the landing, rendering the aircraft uncontrollable.

Further Action Needed

The TSB did extensive research and found that, since 1983, landing gear failures, tire failures, flat tires, wheel fires and loss of control on ground were frequent for SA226s and SA227s; 65 of these occurrences involved circumstances similar to this accident and had the potential to result in tragic events.

Although the 1998 recommendations have resulted in important progress, flight crews are still not provided with an unambiguous alert of dragging brakes.

TSB research since 1983 has revealled that SA226s and SA227s suffer frequent landing gear and tire failures, wheel fires and loss of control on ground.

Although the 1998 recommendations have resulted in important progress, flight crews are still not provided with an unambiguous alert of dragging brakes. Until crews have accurate information about this problem, the risk of fire will remain high and could result in crashes, fatalities, injuries and property damage.

The Board believes that a brake system pressure warning indicator is absolutely necessary to ensure safety. The Board recommended, therefore, that:

Transport Canada, the United States Federal Aviation Administration, and Fairchild explore options for SA226 and SA227 aircraft to be equipped with a brake-pressure warning indicator for each main wheel brake system.
— TSB Recommendation A02-03, issued May 2002

As background to its reply to this recommendation, TC stated that, while the U.S. Federal Aviation Administration (FAA) had not implemented the previous 1998 interim recommendation regarding brake overheat detection, the FAA had initiated another course of action, which was to reduce the probability of overheated brakes during aircraft take-off. TC also believes that the most effective safety actions can be achieved by providing safety barriers to preclude the occurrence of brake overheating rather than a system to detect brake overheat conditions.

Given the TSB position that flight crews should be provided with an unambiguous warning of a dragging brake condition, and considering the brake system manufacturer's opinion that the cockpit brake pressure indicator is feasible, TC has requested the FAA to contact the aircraft manufacturer and brake vendor to investigate the feasibility of installing a brake pressure warning indication system in the Fairchild SA226 and SA227 airplanes.

Aviation Occurrence Statistics

	2002	2001	2000	1997–2001 Average
Canadian-Registered Aircraft Accidents[1]	**273**	**295**	**320**	**340**
Aeroplanes Involved[2]	209	243	258	280
Airliners	6	5	9	8
Commuter Aircraft	6	8	4	10
Air Taxi	40	37	45	74
Aerial Work	12	18	19	17
Corporate	2	4	5	7
State	4	3	1	2
Private/Other[3]	139	168	175	162
Helicopters Involved	56	46	53	52
Other Aircraft Involved[4]	10	9	12	1313
Hours Flown (thousands)[5]	**3,730**	**3,865**	**3,968**	**3,858**
Accident Rate (per 100 000 hours)	**7.3**	**7.6**	**8.1**	**8.8**
Fatal Accidents	**28**	**33**	**38**	**34**
Aeroplanes Involved	20	25	26	26
Airliners	0	0	1	0
Commuter Aircraft	0	1	1	1
Air Taxi	4	5	3	6
Aerial Work	1	1	2	1
Corporate	0	1	0	1
State	2	0	1	0
Private/Other	13	17	18	16
Helicopters Involved	6	6	11	7
Other Aircraft Involved	3	3	1	2
Fatalities	**47**	**62**	**65**	**71**
Serious Injuries	**42**	**37**	**53**	**50**
Canadian-Registered Ultralight Aircraft Accidents	**36**	**35**	**38**	**40**
Fatal Accidents	9	6	5	7
Fatalities	12	8	9	11
Serious Injuries	4	8	10	8
Foreign-Registered Aircraft Accidents in Canada	**14**	**29**	**19**	**21**
Fatal Accidents	1	8	7	6
Fatalities	2	10	17	56
Serious Injuries	1	5	2	3
All Aircraft: Reportable Incidents	**865**	**853**	**725**	**747**
Risk of Collision/Loss of Separation	194	204	161	185
Declared Emergency	281	255	225	221
Engine Failure	160	175	161	161
Smoke/Fire	100	107	84	89
Collision	21	19	8	10
Other	109	93	86	80

1 Ultralight aircraft excluded.
2 As some accidents may involve multiple aircraft, the number of aircraft involved may differ from the total number of accidents.
3 Other: Contains, but is not limited to, organizations that rent aircraft (i.e. flying schools, flying clubs, etc.)
4 Includes gliders, balloons and gyrocopters.
5 Source: Transport Canada (1996 to 2001 hours flown are estimated.)

AIR Occurrence Summaries

The following summaries highlight pertinent safety information from TSB reports on these investigations.

A CLEAR AND STARLIT NIGHT

The night was clear and starlit. The moon was almost directly behind the crew on approach to the runway. No restrictions to visibility were present. The aerodrome is on a peninsula in a sparsely settled area of relatively featureless terrain. Only the runway lights were clearly visible to the crew. These conditions are conducive to a black hole illusion.

This was the situation for the crew of an Israel Aircraft Industries Astra SPX on a night visual approach to a private aerodrome at Fox Harbour, Nova Scotia, on 22 March 2000. Fox Harbour is an uncertified, single-runway aerodrome; the runway is paved, 4885 feet long, 75 feet wide, and equipped with runway edge lights. No approach lighting or visual approach slope indicating system (VASIS) was installed. The aerodrome information available to the crew for the approach was a hand-drawn sketch of the aerodrome layout, with the latitude and longitude coordinates noted.
— TSB Report No. A00A0051

Damage to an Astra SPX, which struck treetops on approach to Fox Harbour, Nova Scotia, in March 2000.

The captain had flown into Fox Harbour twice before, but never at night. The co-pilot had landed there about ten times, but only once at night; this landing was in a different aircraft and on the opposite runway. Without previous experience or other information to alert them to the potential of a black hole illusion on approach, the crew were not adequately prepared to operate in this higher-risk environment. The descent and the approach were flown in a manner that minimized flying time, resulting in high descent and intermediate approach speeds which delayed pre-landing checks and configuration of the aircraft for landing. About three miles from the runway, the co-pilot went heads down to ensure that all checklist items were complete and to confirm that the aircraft was properly configured to land. There

On short final, the crew saw the tops of trees and initiated an overshoot, but not before the aircraft struck the upper branches of the trees.

were no standard operating procedure calls relating to altitude during the approach.

On short final, the crew saw the tops of trees and initiated an overshoot, but not before the aircraft struck the upper branches of the trees. The aircraft was able to climb away successfully and divert to Charlottetown, Prince Edward Island, where an uneventful landing was carried out. There was substantial damage to the aircraft; however, the passengers and the crew were not injured.

Transport Canada's *Instrument Flight Procedures* manual discusses black hole illusion phenomenon as:

During night visual approaches to runways in dark, featureless areas... the lack of ambient clues to orientation interferes with depth perception. Under these conditions, pilots often overestimate their altitude and, while concentrating on maintaining a constant visual angle of approach... (will fly along a descending) arc which results in premature contact with the ground.

Transport Canada has taken initiatives to raise pilot awareness concerning night flying and the effects of black hole illusion. These include several articles in its newsletter and a briefing package for use by its system safety offices during safety awareness presentations.

Since this occurrence, several safety enhancements have been made at Fox Harbour:

- A PAPI (precision approach path indicator) has been installed.
- ARCAL (aircraft radio control of aerodrome lighting system) has been installed to control runway lighting and the PAPI.
- The trees on the runway approach have been cut back.
- A global positioning system approach is being developed.
- Standard operating procedures have been put in place for all company aircraft operating in and out of the Fox Harbour aerodrome.

IMPAIRED DECISION MAKING?

In the late morning of 17 March 2000, the Points North Air Services Inc. Douglas DC-3 departed Points North Landing, Saskatchewan, on a visual flight rules flight to Ennadai Lake, Nunavut, with two pilots and 6600 pounds of cargo. The load consisted of two crates of construction materials, 26 sheets of plywood, a lift of 2x4 lumber 16 feet long, and a wrap of insulation bundles. During loading of the aircraft, the captain had explained that he wanted an aft centre of gravity (C of G) so that the aircraft would be less likely to nose-over if it ran through an uncleared area off the ice strip. The pilots had completed a similar *flight earlier in the day and had landed short and run through the snow short of the runway. The crew did not recalculate the aircraft's weight and balance for the second flight.*

On landing at Ennadai, the aircraft touched down nearly halfway along the ice strip, the tail of the aircraft remained in the air, and the aircraft took off almost immediately. The main landing gear was seen to retract. The aircraft reached the end of the runway then abruptly entered a steep, nose-up attitude, banked sharply to the left, turned left, and descended into the ice. There was no post-crash fire. The crew were killed instantly. — TSB Report No. A00C0059

A combination of factors led to the crash of this Douglas DC-3 in which both pilots perished at Ennadai Lake, Nunavut, on 17 March 2000.

Wreckage examination did not uncover any control system or engine problem that would have led to a loss of control during the go-around; however, the basic operating weight and centre of gravity (C of G) provided in the weight-and-balance report, as submitted to Transport Canada (TC) in 1995, were found to be incorrect. That report had not been reviewed for accuracy, nor was TC required to do so. The aircraft's C of G on the accident flight was beyond the aft C-of-G limit; moreover, the stack of 2-x-4 lumber was inadequately secured and may have shifted rearward during the go-around.

Toxicological tests revealed that the levels of carbon monoxide in the blood of both crew members were elevated. A pressure-decay test was performed on the Janitrol heater; a leak was found and was determined to have existed before impact. The leak would have allowed exhaust gas to enter the cockpit environment through the heater outlets. The carbon monoxide saturation levels found in the captain likely did not affect his ability to fly and control the aircraft; however, the levels were in a range in which judgement, decision making, and visual acuity may have been adversely affected. The subsequent decisions about the positioning and securing of the 2x4s, as well as the use of the previous weight-and-balance calculation, resulted in a dangerous situation.

Toxicological tests revealed that the levels of carbon monoxide in the blood of both crew members were elevated.

Final Reports

The following investigation reports were approved between 01 January 2002 and 31 December 2002.

DATE	LOCATION	TYPE OF AIRCRAFT	REPORT NO.
98-06-18	Montreal Int'l Airport (Mirabel), Que.	Swearingen SA-226-TC	A98Q0087
98-12-07	Baie-Comeau, Que.	Britten-Norman BN-2A-26	A98Q0194
99-08-01	St. John's, N.L.	Fokker F-28 MK 1000	A99A0100
99-08-12	Sept-Îles, Que.	Beech 1900D	A99Q0151
00-01-20	Downton Lake, B.C.	Aerospatiale SA-315 (LAMA)	A00P0010
00-03-17	Vancouver Int'l Airport, B.C.	Airbus A330-200	A00P0040
00-03-22	Fox Harbour, N.S.	Israel Aircraft (IAI) ASTRA SPX	A00A0051
00-04-11	Maniwaki, Que.	Cessna 172M	A00Q0043
00-04-11	St-Mathieu-De-Beloeil, Que.	Bell Helicopter 206B-III	A00Q0046
00-05-10	Cabot Island, 0.5 nm NW, N.L.	Bell Helicopter 212	A00A0076
00-05-11	Edmonton Int'l Airport, Alta.	McDonnell Douglas DC-9-30	A00W0097
00-05-30	Calling Lake, Alta.	Cessna 177B	A00W0109
00-06-12	Kelowna, B.C.	Boeing 737-200	A00P0101
00-07-19	Porter's Lake, N.S.	Cessna 150M	A00A0110
00-09-15	Ottawa/Macdonald-Cartier Int'l Airport, Ont.	Boeing 727-200	A00H0004
00-09-22	Iqaluit, Nun.	Boeing 727-200	A00H0005
00-09-22	Clearwater, 18 nm W, B.C.	de Havilland DHC-2T MK III	A00P0184
00-09-27	La Grande-4, Que.	General Dynamics 340/580	A00Q0133
00-10-02	Fort Nelson, 90 nm E, B.C.	Eurocopter AS-350 BA	A00W0215
00-10-06	Rouyn-Noranda, 5 nm S, Que.	Cessna 550	A00Q0141
00-10-08	Vancouver Int'l Airport, B.C.	de Havilland DHC-8-200	A00P0199
00-11-01	Vancouver Harbour, B.C.	de Havilland DHC-6-100	A00P0210
00-11-13	Fredericton, N.B.	Boeing 737-200	A00A0176
00-11-28	Fredericton, N.B.	Fokker F-28 MK 1000	A00A0185
00-12-04	Ottawa/Gatineau, Que.	Beech 100	A00H0007
00-12-18	Windsor, Ont.	Antonov AN-124	A00O0279
00-12-31	Fox Creek, 45 nm W, Alta.	McDonnell Douglas Helicopter 369D (500D)	A00W0267
01-01-13	Mascouche, Que.	Piper PA-28-140	A01Q0009
01-01-15	Poteau Cove, B.C.	Sikorsky S-61N	A01P0003
01-01-20	Victoria, 6 nm SE, B.C.	Cessna 172M	A01P0010
01-01-24	Toronto/Lester B. Pearson Int'l Airport, Ont.	Boeing 747-400	A01O0021
01-01-24	Edmonton VORTAC (Vicinity), Alta.	Cessna 560	A01W0015
01-01-24	Edmonton VORTAC (Vicinity), Alta.	Boeing 747-400	A01W0015
01-02-20	Val-D'Or, 2 nm SE, Que.	Piper PA-31-350	A01Q0034

DATE	LOCATION	TYPE OF AIRCRAFT	REPORT NO.
01-03-05	Sydney, 28 nm SE, N.S.	Boeing 767-400	A01H0002
01-03-05	Sydney, 28 nm SE, N.S.	Boeing 767-300	A01H0002
01-03-14	St. John'S Int'l Airport, 1.5 nm ESE, N.L	Piper PA-30	A01A0022
01-03-15	Victoria Int'l Airport, B.C.	Schweizer 269B (300B)	A01P0047
01-03-15	Vancouver Int'l Airport, B.C.	Airbus A319-114	A01P0054
01-03-15	Vancouver Int'l Airport, B.C.	de Havilland DHC-8-200	A01P0054
01-03-25	Eclipse Camp, B.C.	McDonnell Douglas Helicopter 369D (500D)	A01P0061
01-03-27	Montreal Int'l Airport, (Dorval), 60 nm SW, Que.	Piaggio P.180	A01Q0053
01-03-27	Montreal Int'l Airport, (Dorval), 60 nm SW, Que.	Airbus A310-300	A01Q0053
01-03-27	Montreal Int'l Airport, (Dorval), 60 nm SW, Que.	Canadair CL-600-2B19 (RJ)	A01Q0053
01-03-30	Teslin, 4 nm NW, Y.T.	Cessna T210 L	A01W0073
01-04-04	Toronto/Buttonville Municipal, 10 nm N, Ont.	Robinson Helicopter R22 BETA	A01O0099
01-04-28	Baker Lake, 26 nm N, Nun.	McDonnell Douglas Helicopter 369E (500E)	A01C0064
01-05-12	Vancouver Int'l Airport, B.C.	Cessna 172M	A01P0111
01-05-12	Vancouver Int'l Airport, B.C.	Airbus A320	A01P0111
01-05-16	Abbotsford, 10 nm E, B.C.	Robinson Helicopter R22 BETA	A01P0100
01-05-22	Yellowknife, N.W.T.	Boeing 737-200	A01W0117
01-05-25	Russell, Man.	Piper PA-28-140	A01C0097
01-05-25	Red Earth Creek, 33 nm NE, Alta.	Cessna T310Q	A01W0118
01-05-31	Uranium City, 190 nm NE, N.W.T.	Airbus, A340-300	A01W0129
01-05-31	Uranium City, 190 nm NE, N.W.T.	Boeing 747-200	A01W0129
01-06-08	Duxar Intersection, 110 nm NW, N.W.T.	Boeing 737-200	A01P0126
01-06-08	Duxar Intersection, 110 nm NW, N.W.T.	McDonnell Douglas DC-10-30	A01P0126
01-06-09	Vancouver Int'l Airport, B.C.	Boeing 767	A01P0127
01-06-09	Vancouver Int'l Airport, B.C.	Airbus A340-300	A01P0127
01-06-10	Northern Control Area, Nun.	Boeing 767-300	A01C0115
01-06-10	Northern Control Area, Nun.	Boeing 747-300	A01C0115
01-06-14	Victoria Int'l Airport, B.C.	Bombardier CL-600-2B19	A01P0129
01-06-15	Empress, 5 nm W, Alta.	Boeing 737-200	A01W0144
01-06-15	Empress, 5 nm W, Alta.	Boeing 737-200	A01W0144

DATE	LOCATION	TYPE OF AIRCRAFT	REPORT NO.
01-06-17	Toronto/Buttonville Municipal, 1.4 nm WNW, Ont.	Cessna 172N	A01O0157
01-06-18	Lake Lavieille (Algonquin Park), Ont.	Cessna 210	A01O0165
01-06-20	Field Concession #4/Sandford Rd. Uxbridge, Ont.	Robinson Helicopter R22	A01O0164
01-06-20	Field Concession #4/Sandford Rd. Uxbridge, Ont.	Cessna 170B	A01O0164
01-07-04	Empress, 20 nm W, Alta.	Boeing 737-200	A01W0160
01-07-04	Empress, 20 nm W, Alta.	Fokker F-28 MK 1000	A01W0160
01-07-07	Nestor Falls, 2 nm NW, Ont.	de Havilland DHC-2 MK I	A01C015
01-07-13	Red Lake, 35 nm SE, Ont.	Airbus A320-200	A01C0155
01-07-13	Red Lake, 35 nm SE, Ont.	Boeing 757-200	A01C0155
01-07-14	Gloucester, Ont.	Ted Smith Aerostar (56140) RX-7	A01O0200
01-07-18	Cultus Lake, B.C.	Cessna TU206 G	A01P0165
01-07-18	Montreal Int'l Airport (Dorval), Que.	Cessna 172N	A01Q0122
01-07-18	Montreal Int'l Airport (Dorval), Que.	de Havilland DHC-8-100	A01Q0122
01-07-20	Eick Corcaigh Int'l Airport (Cork)	Boeing 727-200	A01F0094
01-07-23	Port Hardy, 48 nm E, B.C.	Cessna 421	A01P0171
01-07-23	Port Hardy, 48 nm E, B.C.	de Havilland DHC-7 (DASH 7)	A01P0171
01-07-26	Haines Junction, 25 nm SW, Y.T.	Cessna 185 F	A01W0186
01-07-30	Grande Cache, 25 nm W, Alta.	Eurocopter AS-350 BA	A01W0190
01-08-03	Timmins, 1.2 nm N, Ont.	Cessna 182Q	A01O0210
01-08-13	Juniper Station, 42 Km NE, N.B.	Bell Helicopter 206B	A01A0100
01-08-13	Mackenzie Lake, 4 nm NE, B.C.	de Havilland DHC-2 MK I	A01P0194
01-08-20	Valemount, 37 nm SE, B.C.	Helio H-295	A01P0203
01-08-24	Invermere, B.C.	Pitts S2A-E	A01P0207
01-09-02	Red Lake, Ont.	Pilatus PC-12	A01C0217
01-09-13	Swan Lake Airstrip, Y.T.	Beech 18	A01W0239
01-10-23	Toronto/Lester B. Pearson Int'l Airport, Ont.	Boeing 767-200	A01O0299
01-10-24	Peace River, Alta.	de Havilland DHC-8-100	A01H0004
01-11-02	Inuvik, 4 nm NE, N.W.T.	Cessna 208 B	A01W0269
01-12-03	Boundary Bay, B.C.	Cessna 152	A01P0296
01-12-11	Victoria VOR, 5 nm N, B.C.	Piper PA-31-350	A01P0305
01-12-11	Victoria VOR, 5 nm N, B.C.	Cessna 208 B	A01P0305
01-12-18	Yellowknife, 5 nm E, N.W.T.	Eurocopter EC120B	A01W0297
02-01-04	Victoria Int'l Airport, B.C.	Boeing 737-200	A02P0004
02-04-16	Winnipeg Int'l Airport, Man.	Fairchild SA-227-AT	A02C0072

TRANSPORTATION SAFETY

REFLEXIONS

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