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Loss of Control Occurs During Pilot's Attempt to Return to Departure Airport

Contamination by snow, an over-gross-weight condition and the pilot's failure to adhere to the recommended wind shear recovery procedure affected the air-taxi aircraft's performance during departure from an airport in Canada. The aircraft stalled and descended into a river, where three survivors later drowned.

FSF Editorial Staff

At 1111 local time Dec. 7, 1998, a Britten-Norman BN-2A Islander, being operated as Flight 501 by Air Satellite on a scheduled air-taxi flight from Baie-Comeau, Quebec, Canada, stalled when the pilot began a turn to return to the departure airport. The aircraft was destroyed when it struck the St. Lawrence River. Four passengers were killed on impact. The pilot, copilot and four passengers were seriously injured on impact; two of the passengers later drowned, and the copilot is assumed to have drowned.

The Transportation Safety Board of Canada (TSB) on Aug. 13, 2002, released the final report on the accident. The report said that the accident causes and contributing factors were the following:

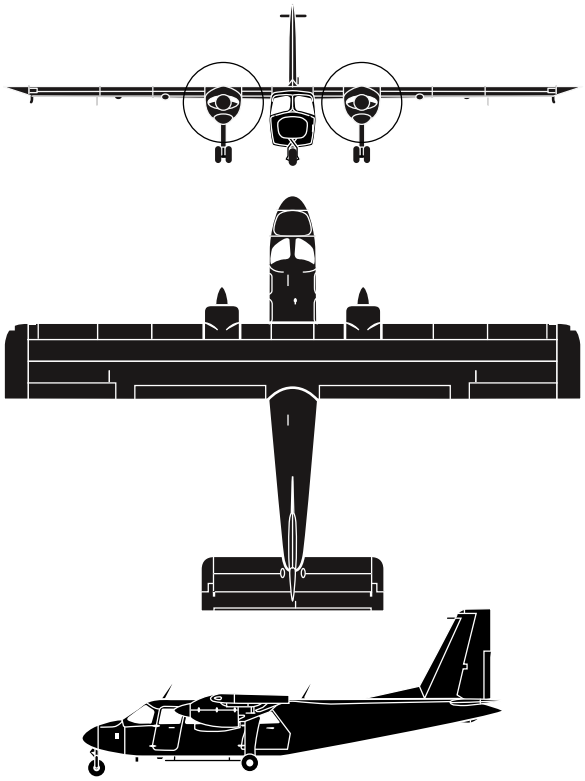
- "The aircraft took off with contaminated surfaces, without an inspection by the pilot-in-command [PIC]. This contamination contributed to reducing the aircraft's performance and to the subsequent stall;
- "At takeoff, the aircraft was more than 200 pounds [91 kilograms] over the maximum allowable takeoff weight. This added weight contributed to reducing the aircraft's performance;
- "During the initial climb-out, the [PIC] did not follow the recommended procedure when he entered an area of wind shear. Consequently, the aircraft lost more speed, contributing to the stall;
- "Insufficient altitude was available for the pilot to recover from the stall and avoid striking the water; [and,]
- "The copilot's shoulder harness was not installed properly. The copilot received serious head injuries because she was not restrained."

The accident aircraft, which was manufactured in 1986 and had accumulated 9,778 airframe hours, was one of 17 reciprocating-engine aircraft operated by Air Satellite under Canadian Aviation Regulations (CARs) Section 703, *Air Taxi Operations*. Air Satellite operated a main base in Baie-Comeau and secondary bases in Havre-Saint-Pierre, Rimouski and Sept-Îles.

Transport Canada (TC) conducted an audit of Air Satellite in September 1998. The audit did not include the company's deicing procedures and equipment.

The report said that flight operations irregularities identified by the audit included "various deficiencies related to the

responsibilities of the operations manager and the chief pilot. For example, the training program was incomplete, the pilot-training records contained many errors and omissions, pilots acted as crewmembers when they did not have the required qualifications, and no training for flight-monitoring personnel was planned."



Britten-Norman BN-2A Islander

The production prototype of the Britten-Norman BN-2 Islander was flown for the first time in 1966. Deliveries began in 1967. The BN-2A was introduced in 1969 with a higher maximum takeoff weight — 6,600 pounds (2,994 kilograms), up from 6,000 pounds (2,722 kilograms).

The Islander can accommodate 10 occupants and was designed and certified for single-pilot operation. The aircraft has nonretractable landing gear, with two wheels on each main landing gear and a single steerable nosewheel.

Each of the Lycoming O-540-E4C5 reciprocating engines produces 260 horsepower (194 kilowatts) and drives a constant-speed, featherable, two-blade Hartzell propeller. Standard fuel capacity is 137 gallons (519 liters); optional wing-tip fuel tanks increase total fuel capacity to 226 gallons (855 liters).

Maximum rate of climb at sea level is 860 feet per minute (fpm). Maximum single-engine rate of climb at sea level is 145 fpm. Service ceiling is 11,300 feet. Maximum cruising speed at 75 percent power at 7,000 feet is 139 knots. Maximum landing weight is 6,300 pounds (2,858 kilograms). Stall speed with flaps extended is 40 knots. Stall speed with flaps retracted is 50 knots.♦

Sources: *Jane's All the World's Aircraft* and Transportation Safety Board of Canada

The report said that maintenance irregularities identified by the audit included the following:

- "The maintenance procedures manual (MPM) and the MCM [maintenance control manual] did not reflect the current status of the company's activities. Many audit observations revealed irregularities needing correction;
- "The company did not keep its regulatory [publications] and technical publications up to date;
- "No records were kept showing that maintenance personnel received training on the company's policies and procedures. The company did not follow the programs outlined in the MPM and MCM;
- "The procedures outlined in the MCM for recording and control of important maintenance events were not followed;
- "The operator deferred the correction of defects essential to the airworthiness of some aircraft;
- "Inspection of the company's different aircraft revealed a number of irregularities requiring immediate action by the company that had not been reported to the maintenance organization;
- "Maintenance schedules were not followed. Planned inspections were not performed within the tolerances specified by the approved programs. Special inspections were not conducted in accordance with the specifications outlined in the programs; [and,]
- "Airworthiness directives were not carried out at the prescribed times, and aircraft were returned to service that should not have been."

After the audit, Air Satellite proposed corrective actions for implementation over several months. TC accepted the proposal.

The report said that the accident flight crew was "certified and qualified for the flight in accordance with existing regulations."

The PIC, 40, held a commercial pilot license and had 1,098 flight hours, including 234 flight hours in type. He failed three flight tests for an instrument rating before passing a flight test for an instrument rating in February 1996. He worked as a Cessna R182 pilot from April 1996 to August 1996 for Patrouille Aérienne du Quebec. He was employed as a pilot by Air Satellite in April 1998.

"This was the first time he had been employed to fly multi-engine aircraft," the report said. "It was also the first time he flew professionally in IFR [instrument flight rules] conditions and with a copilot."

The PIC passed a pilot proficiency check (PPC) in an Islander in May 1998. The TC inspector who administered the PPC graded seven exercises as "satisfactory with briefing."

"The [PIC] had difficulty performing six of the exercises because he did not follow the checklist and the appropriate procedures," the report said. "Among other things, deficiencies were noted during four IFR approach exercises and two emergency (power loss) exercises. … After completion of the PPC, the TC examiner mentioned to Air Satellite's operations manager that the [PIC] was a rather weak pilot."

The report said that training documents and information gathered during the accident investigation indicated that the PIC "had difficulty with IFR flying, did not follow approved checklist procedures rigorously [and] seemed to be unusually nervous in icing conditions. … According to the documents available, he had no previous winter experience. His total experience in snow conditions was four days [in November 1998 and December 1998]."

The copilot, 24, held a commercial pilot license and had 679 flight hours, including 68 flight hours in type. She failed one flight test for an instrument rating before passing a flight test for an instrument rating in May 1997. She worked as a flight instructor from June 1997 to September 1997 for Dynamair. She was employed by Air Satellite as an instructor and pilot in September 1997.

"This was the first time she was employed to fly multi-engine aircraft," the report said. "It was also the first time she had worked as a commercial pilot in IFR conditions and on an aircraft with a minimum of two pilots."

The copilot passed a PPC in an Islander in June 1998. The TC inspector who administered the PPC graded one exercise as satisfactory with briefing and told the copilot to avoid altitude loss during stall-approach maneuvers.

The report said that no documents indicated that either pilot had completed a three-hour introductory course required by the company. Course topics included standard operating procedures, ground deicing/anti-icing procedures and weight-and-balance-control procedures.

On the day of the accident, Flight 501 was scheduled to depart from Baie-Comeau at 0615 for a flight to Rimouski. The report said that the pilots had conducted flights between Baie-Comeau and Rimouski twice a day, five days a week; the period in which the flights were conducted was not specified by the report. [Baie-Comeau is on the northern shore of the St. Lawrence River; Rimouski is on the southern shore of the river, approximately 54 nautical miles (100 kilometers) south-southwest of Baie-Comeau.]

Both pilots had been off duty for eight hours before reporting for work and had been on duty about six hours before the accident occurred.

The PIC arrived at the airport about 0415 and conducted a walk-around inspection of the aircraft, which was in a hangar.

"The [PIC] checked all the systems described in the flight manual; no discrepancies were found," the report said.

Investigators determined that the aircraft's stall-warning system functioned properly when tested on the ground but did not function properly in flight. One of the two fittings (the right screw and nut) that attaches the lift sensor to the wing leading edge was not in place.

"On the ground, [when the lift-sensing vane was moved by hand], the system functioned normally; but in flight, the housing for the [lift sensor] could pivot around the left screw and prevent the vane from closing the circuit when the aircraft approached a stall," the report said. "The stall-warning alarm did not sound during stall exercises performed shortly before the accident. The missing [attachment fitting] was not recorded in the aircraft logbook."

Flight 501's departure was delayed nearly five hours because of freezing rain that was causing severe clear-icing conditions in the area. The freezing rain was associated with a cold front that was forecast to move past the Baie-Comeau airport, from northeast to southwest, about 1100.

About 0620, the PIC obtained weather information from the Quebec Flight Service Station (FSS). The FSS specialist told the pilot to expect strong winds, wind shear and turbulence when the cold front moved past Baie-Comeau.

"The information received by the [PIC] should have made the crew aware that sudden changes of attitude and significant variations in speed could occur during the flight to Rimouski," the report said.

The PIC filed an IFR flight plan with an estimated time of 30 minutes en route to Rimouski and sufficient fuel for four hours of flight. The pilot selected Mont-Joli, which is 14 nautical miles (26 kilometers) northeast of Rimouski, as an alternate airport. Baie-Comeau and Mont-Joli have weather-reporting stations; Rimouski does not have a weather-reporting station.

"The pilots used weather information from Baie-Comeau and Mont-Joli to plan the flight to Rimouski," the report said.

Weather conditions forecast for Mont-Joli included a 300-foot overcast ceiling and 1.0 statute mile (1.6 kilometers) visibility with light ice pellets and mist. The FSS specialist told the PIC that the weather forecasts for airports in the area were "somewhat inaccurate and that conditions would be worse than anticipated," the report said.

(The forecast for Mont-Joli was amended at 1120 to include a 200-foot overcast and 0.5 statute mile [0.8 kilometer] visibility with snow showers.)

At 0900, the hangar door was opened.

"The door of the hangar was opened to allow the [temperature of the] aircraft to reach the outside temperature," the report said. "This was done to prevent the snow that was falling from turning to ice [by melting] on contact with the warm surfaces of the aircraft [and then refreezing; the outside air temperature was zero degrees Celsius (C; 32 degrees Fahrenheit [F])]."

The aircraft was removed from the hangar between 1000 and 1015.

"The [PIC] and the copilot performed the run-up and completed the usual inspection of the aircraft's systems, including the carburetor-heat [system]," the report said. "After being informed that there would be eight passengers, the [PIC] asked Air Satellite's flight-monitoring attendant to enter 500 pounds [227 kilograms] of fuel on the Air Satellite weight-and-balance sheet."

About 1030, the PIC told refuelers to fill the tanks with fuel. The report said that the PIC wanted a greater fuel reserve in anticipation that adverse weather conditions might prevent a landing at Rimouski and at Mont-Joli. The aircraft's maximum fuel capacity was 780 pounds (354 kilograms).

The load sheet and the weight-and-balance form prepared by the flight-monitoring attendant showed that the aircraft's gross weight was 6,368 pounds (2,889 kilograms) and that the aircraft's center-of-gravity (CG) was within CG limits. The aircraft's maximum certified takeoff weight is 6,600 pounds (2,994 kilograms).

The data used to prepare the load sheet and the weight-and-balance form included the 500 pounds of fuel reported by the PIC and standard passenger "summer weights" approved by CARs. The summer weights are 174 pounds (79 kilograms) for male passengers and 127 pounds (58 kilograms) for female passengers. The regulations allow the use of summer weights until the 14th day of December. (The standard winter weights, which account for heavier clothing, are 180 pounds [82 kilograms] for male passengers and 133 pounds [60 kilograms] for female passengers.) All the passengers aboard the accident aircraft — five men and three women — exceeded the standard summer weights.

"Given the winter-weather conditions, use of the standard winter weights, although not mandatory, would have been appropriate," the report said. "Moreover, to determine the weight of the occupants more accurately, the true weight of the occupants and their carry-on bags should have been used."

Investigators calculated that the actual takeoff weight of the aircraft was 6,813 pounds (3,090 kilograms). The data used by the investigators included 780 pounds of fuel and the actual weights of the passengers, which were derived from autopsy reports, information obtained from the surviving passengers and medical reports.

The report said that more than 0.4 inch (1.0 centimeter) of wet snow fell while the aircraft was outside the hangar and that snow accumulated on the aircraft. The PIC did not request aircraft-deicing services before takeoff.

"The [PIC] decided that it was not necessary to deice the aircraft," the report said. "He noticed a very light layer of snow on the wing tips, but the wing surfaces in general, and particularly behind the engines, looked clean."

The upper surfaces of the wings, horizontal stabilizer and elevator were more than six feet (two meters) above the ground.

"Therefore, the [PIC] could not inspect the horizontal surfaces without a stairway," the report said. "The [PIC] could only inspect the upper surface of the aircraft's horizontal surfaces when he refueled the aircraft … 40 minutes before takeoff. Based on this observation and the fact that snow was not adhering to the windshield while taxiing, the [PIC] concluded that the surfaces were not contaminated."

The CARs require pilots to conduct a pre-takeoff inspection for surface contamination when icing conditions exist and prohibit pilots from conducting a takeoff in an aircraft that has frost, ice or snow adhering to a critical surface.

The report said that Air Satellite's operations manual included the following requirements:

- "Frost or snow adhering to any lift [surface] or control surface must be completely removed before takeoff; [and,]
- "If it is impossible to clean the aircraft before departure, the only solution is to delay the flight until acceptable conditions prevail."

The report said that the crew could have removed snow from the aircraft by having the aircraft placed in a hangar, by applying hot water to the contaminated surfaces, by using deicing fluid contained in a portable tank in the company's office or by using a broom.

"Experimental data indicate that the formation of frost, ice or snow of a thickness and roughness comparable to that of medium [sandpaper] or coarse sandpaper on a wing's leading edge and upper surface can reduce a wing's lift by up to 30 percent and increase drag by 40 percent," the report said. "The lift loss comes largely from contamination of the leading edge. Consequently, aerodynamic stall of a contaminated wing may occur before the stall-warning system activates."

The passengers boarded the aircraft and their baggage was loaded about 1045. The PIC conducted a safety briefing of the passengers and then began to taxi the aircraft. The copilot radioed the Mont-Joli FSS to request clearance to conduct the IFR flight to Rimouski.

The FSS specialist told the crew that the wind was calm at Baie-Comeau and that Runway 28 was the preferred departure runway. The report said that an analysis of weather data by Environment Canada indicated that the surface wind likely was from 230 degrees at five knots to eight knots.

The FSS specialist told the crew to remain clear of the runway until five snow-removal vehicles exited the runway. The vehicles had removed snow from a 100-foot-wide (31-meter-wide) section along the center of the runway, which was 150 feet (46 meters) wide and 6,000 feet (1,830 meters) long.

The FSS specialist told the crew to expect to hold en route for five minutes to 10 minutes if they departed from Runway 28; the specialist said that they might avoid holding if they departed from Runway 10.

"To avoid the expected delay, the [PIC] decided to take off from Runway 10, as suggested by the specialist," the report said. "[The PIC] was informed … that he could take off from Runway 10 or [Runway] 28. After observing from the windsock, [which was] covered with ice, that the wind, although calm, was favorable for Runway 28, the [PIC] decided to take off from Runway 10."

After taxiing the aircraft to the threshold of Runway 10, the PIC conducted a takeoff briefing.

"[The PIC] briefed the copilot on the division of tasks, critical speeds and the procedure in case of problems," the report said. "It was agreed that the [PIC] was the pilot flying and that the copilot would be responsible for air traffic control (ATC) communications, monitoring the instruments and reporting any irregularities. The selected rotation speed was 65 knots.

"It was also agreed that if a failure occurred in [instrument] meteorological conditions, the [PIC] would continue the flight under IFR and would return to Runway 10 for an approach using the instrument landing system (ILS)."

The crew selected the appropriate radio frequencies, and the PIC selected the deice/anti-ice systems for the propeller, the stall-warning system, the pitot system and the windshield.

When the crew began the takeoff at 1109, reported weather conditions at the airport included an 800-foot ceiling, sky obscured, and visibility 0.5 statute mile (0.8 kilometer) with moderate snow showers.

Soon after the aircraft lifted off the runway, the PIC reduced engine power to a climb setting. He flew the aircraft on the runway heading and at an airspeed of approximately 100 knots. Climb rate was about 500 feet per minute. The PIC began a right turn at 500 feet to intercept the outbound navigation course. During the turn, the pilot retracted the flaps, which had been extended 25 degrees, the recommended flap setting for takeoff.

The "After Takeoff" checklist calls for flap retraction before climb power is set.

"The change in sequence decreased thrust without reducing drag," the report said.

After the pilot retracted the flaps, the aircraft pitched nose-up and airspeed decreased 25 knots. The report said that, at this time, the aircraft entered the overcast.

"The rapid decrease in speed indicates that the aircraft climbed into a wind shear area," the report said. "The flaps were retracted just before the aircraft pitched up, so, when the aircraft entered the wind shear area, the [PIC] was probably pulling on the control column to compensate for the aircraft's natural tendency to [pitch] nose-down [during flap retraction]. The combination of wind shear and flap setting would then have amplified the rate at which the nose rotated upward and contributed to the rapid loss of speed.

"The [PIC] probably did not realize that the aircraft was crossing a wind shear area. However, even if he had realized it, he was not familiar with the recommended recovery procedure."

The report said that the wind shear recovery procedure recommended by the *Aeronautical Information Publication (AIP Canada)* and by the BN-2A flight manual is to apply maximum power and to establish an aircraft attitude that provides maximum angle-of-attack.

"The investigation revealed that although the [PIC] had received this training, he did not know the recommended procedures for wind shear," the report said.

Airspeed decreased to about 70 knots. The PIC extended the flaps to the 25-degree position, lowered the aircraft's nose and began a left turn. He did not increase power.

"He could see the ground through the left window," the report said. "While making a slightly banked left turn to land on Runway 28, he informed the copilot that he was returning to Baie-Comeau immediately."

The report said that the PIC decided to return to the departure airport "after deciding that the aircraft could not safely continue the flight."

During the turn, the aircraft stalled; it rolled left rapidly and pitched nose-down. The PIC pulled on the control column and turned the control wheel right to level the aircraft. The aircraft descended into the river about 0.5 nautical mile (0.9 kilometer) from shore and less than one nautical mile (two kilometers) from the airport. Examination of the wreckage indicated that on impact, the aircraft was banked 19 degrees left and pitched about three degrees nose-up.

Water depth at the accident site was about 20 inches (51 centimeters); the tide was rising. Water temperature was one degree C (34 degrees F).

The report said that the aircraft's emergency locator transmitter (ELT) was not installed properly: Britten-Norman recommended that the ELT be mounted on the rear bulkhead of the aircraft; the ELT in the accident aircraft was mounted on a plate attached to the floor behind the rear bulkhead.

"The impact seriously damaged the floor of the aircraft, whereas the rear [bulkhead] sustained little damage," the report said.

The ELT detached from its mounting on impact and became immersed in water.

"The emergency signal probably ceased after the ELT was ejected from its mounting plate and the antenna connection contacted the water," the report said. "The ejection contributed to reducing the signal and prevented the SARSAT (search-and-rescue satellite-aided tracking) system from validating the signal."

The SARSAT system recorded a weak ELT signal that began at 1111 and ended at 1115. The report said that the signal-transmission time was not sufficient for SARSAT to validate the signal and determine the location of the accident aircraft.

At the time of the accident, the remote communications outlet (RCO) at Baie-Comeau did not relay radio transmissions on the emergency frequency, 121.5 megahertz, to the Mont-Joli FSS. (Soon after the accident, Nav Canada modified the RCO to relay radio transmissions on the emergency frequency to the FSS.)

When the crew did not respond to radio transmissions by the Mont-Joli FSS specialist and by air traffic controllers, a communications failure was presumed to have occurred aboard the aircraft.

"In accordance with Part 6, 'Emergencies,' in the *Air Traffic Control Manual of Operations*, [ATC] separated other aircraft from [the accident aircraft], blindly transmitted a description of ATC's actions and the weather conditions at the destination and alternate airports, tried to locate the aircraft, performed a communications search and, finally, took the necessary measures at the airports concerned," the report said.

The pilot and copilot, the two passengers in the second row of seats (behind the pilots) and the two passengers in the fifth row of seats survived the impact. The report said that the copilot's shoulder harness had not been installed properly when it was replaced in April 1996 and "did not keep the copilot in place" during impact. She received a serious facial injury and became unconscious.

"The pilot and the [two surviving passengers in the second row of seats] freed the copilot from her seat and brought her up on top of the wreckage, where they awaited rescue," the report said.

The cabin floor had buckled and the wing had collapsed when the aircraft struck the water.

"This destroyed the survival space of the passengers [in the third row of seats and in the fourth row of seats], resulting in asphyxiation due to compression and drowning," the report said. "The passengers in [the fifth row of seats] sustained multiple injuries [and] were unable to move … . The tide rose, bringing water up to their waists. Because of their injuries and resulting incapacity, the survivors on top of the cabin were unable to help those passengers out of the wreckage."

The pilot and one passenger atop the cabin held on to the copilot. The other passenger atop the cabin held the head of a fifth-row passenger out of the water.

"He did so until water submerged the cabin between 1200 and 1215," the report said. "The [other fifth-row passenger] never regained consciousness after the crash and also drowned. Shortly after the water covered the wreckage, the survivors, who were suffering from hypothermia, could no longer hold on to the copilot, who was carried away by the water at about 1230."

The report said that the accident aircraft "was found at noon by a child watching the river."

At 1210, police asked a local helicopter operator, Heli-Manicouagan, to send a helicopter to the accident site. The report said that the helicopter — a ski-equipped Bell 206 with a pilot and an aircraft maintenance engineer aboard — arrived at the accident site at 1236. The helicopter pilot conducted two flights to the accident site to evacuate the pilot and the two surviving passengers. Water depth was about 56 inches (142 centimeters) when the evacuation was completed at 1247.

The St. Lawrence River is approximately 35 nautical miles (65 kilometers) wide between Baie-Comeau and Rimouski. There were no life vests aboard the aircraft.

"[The accident aircraft] flew between Baie-Comeau and Rimouski almost exclusively, making the trip twice a day, five days a week," the report said. "[The aircraft] was capable of maintaining flight in case of engine failure and did not fly more than 50 nautical miles [93 kilometers] from the shore. Therefore, in accordance with existing regulations, the company's management did not equip the aircraft with life [vests]. The company had life [vests] in its hangar, however."

A post-accident examination of the accident aircraft's technical records revealed several discrepancies, including no records of on-condition engine maintenance, completion of work after the compliance times required by three airworthiness directives (ADs), noncompliance with one AD, no record of the replacement of magnetos on the left engine, and no record of action in response to an "oil temperature high" entry in the aircraft logbook in November 1998.

An examination of the engines revealed several discrepancies, including broken compression rings on pistons in several cylinders, significant "blow-by" of oil from the crankcase into the combustion chambers, improperly installed valve rocker arms, a punctured piston and a cracked piston.

"Normally, these irregularities would lead to a decrease in power and engine vibrations, although no vibration or power loss was reported," the report said. "A significant increase in consumption of motor oil was noted in the aircraft logbook [on Dec. 1, 1998]. According to the maintenance schedule, one cylinder in each row should have been removed to allow internal examination of the engines. … No documentation indicating that this work had been done was found in the aircraft technical records."

A performance analysis indicated that the aircraft lifted off the runway after rolling 3,700 feet (1,129 meters).

"The manufacturer calculated that with flaps extended 25 degrees and [at] a weight of 6,850 pounds [3,107 kilograms] at takeoff, the distance required for the aircraft … to take off from a paved, dry runway was approximately 1,200 feet [366 meters]," the report said. "According to Britten-Norman, the difference between the observed ground roll and that calculated may be attributed to a combination of all or some of the following factors: tail wind component greater than reported; aircraft weight greater than 6,850 pounds; snow-covered runway; snow or ice on aircraft surfaces; and decrease in engine power.

"In fact, the manufacturer calculated that even at a weight of 7,500 pounds [3,402 kilograms], the takeoff roll for a BN-2A-26 would be 3,000 [feet] to 3,500 feet [915 meters to 1,068 meters] on a runway covered with 2.0 centimeters [0.8 inch] of snow and with a tail wind component greater than eight knots, as reported at the time of the accident."

The manufacturer's calculations did not include the likely effects of aircraft surface contamination.

"Consequently, contamination of the critical surfaces must have been an important factor in increasing the takeoff roll and affecting aircraft performance," the report said.

Before the accident occurred, Air Satellite had implemented the corrective actions that it proposed after the September 1998 audit by TC. After the accident, TC intended to suspend the company's operating certificate.

"While a TC inspector was on his way to Baie-Comeau to suspend the company's operating certificate, Air Satellite surrendered the certificate voluntarily and stopped its operations for 15 days," the report said. "This time allowed the management to support the [accident] investigation, supervise company personnel and take the corrective actions required by TC, including PDM [pilot decision making] training for company pilots."

The report said that actions taken by the company also included flight-supervision improvements and hiring of a licensed aircraft maintenance engineer and a safety officer.

Based on the findings of the accident investigation, TSB on July 25, 2002, issued Aviation Safety Advisory A010052-1. The report said that the safety advisory described the problems caused by improper installation of the ELT in the accident aircraft and recommended that TC "consider reviewing the CARs to add more precise installation criteria."

[CARs 551.104 prescribes standards for installation of ELTs. In a Sept. 30, 2002, letter to TSB, TC said that its "ongoing review of CAR 551 and the AWM (*Airworthiness Manual*) will address the approval and installation of equipment in general; however, it is unknown when this review will be completed." TC said that it would review in more detail the ELT installation in the accident aircraft.]♦

[FSF editorial note: This article, except where specifically noted, is based on Transportation Safety Board of Canada report no. A98Q0194, *Aviation Investigation Report: Loss of Control, Air Satellite Inc. Britten-Norman BN2A-26, C-FCVK, Pointe-Lebel, Quebec, 07 December 1998*. The 31-page report contains illustrations and appendixes.]

Further Reading From FSF Publications

FSF Editorial Staff. "Icing, Inadequate Airspeed Trigger Loss of Control of Saab 340." *Accident Prevention* Volume 58 (October 2001): 1–6.

U.S. National Transportation Safety Board. "Safety Study: Emergency Evacuation of Commercial Airplanes." *Flight Safety Digest* Volume 19 (December 2000): 1–91.

FSF Editorial Staff. "Double Engine Failure Leads to Ditching of Cessna 402C." *Accident Prevention* Volume 56 (August 1999): 1–6.

FSF Editorial Staff. "Airplane's Low-energy Condition and Degraded Wing Performance Cited in Unsuccessful Go-around Attempt." *Accident Prevention* Volume 56 (July 1999): 1–11.

FSF Editorial Staff. "Thin, Rough Ice Accumulation Causes Twin-turboprop Aircraft Upset." *Accident Prevention* Volume 56 (March 1999): 1–12.

FSF Editorial Staff et al. "Protection Against Icing: A Comprehensive Overview." *Flight Safety Digest* Volume 16 (June–September 1997): 1–237.

Dow, John P. "Pilots Can Minimize the Likelihood of Roll Upset in Severe Icing." *Flight Safety Digest* Volume 15 (January 1996): 1–9.

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Staff: Roger Rozelle, director of publications; Mark Lacagnina, senior editor; Wayne Rosenkrans, senior editor; Linda Werfelman, senior editor; Rick Darby, associate editor; Karen K. Ehrlich, web and print production coordinator; Ann L. Mullikin, production designer; Susan D. Reed, production specialist; and Patricia Setze, librarian, Jerry Lederer Aviation Safety Library

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