



Commuter Aircraft Strikes Terrain During Unstabilized, Homemade Approach

The crew of a Raytheon Beech 1900D used self-programmed global positioning system (GPS) waypoints for navigation during a night approach to a Canadian airport with weather conditions below minimums for the published nonprecision instrument approach.

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FSF Editorial Staff

At 2357 local time on Aug. 12, 1999, a Raytheon Beech 1900D operated on a scheduled flight by Régionnair struck terrain one nautical mile (1.9 kilometers) from Runway 31 at Sept-Îles (Quebec, Canada) Airport during an approach in instrument meteorological conditions (IMC) that included a 200-foot ceiling and 0.25 statute mile (0.40 kilometer) visibility. The aircraft was substantially damaged by the impact and post-accident fire. The captain was killed, the first officer received serious injuries, and the two passengers received minor injuries.

The Transportation Safety Board of Canada (TSB) said, in its final report on the accident, that the causes and contributing factors were the following:

- “The pilot flying [the first officer] did not establish a maximum-performance climb profile, although required by the company’s standard operating procedures (SOPs), when the ground-proximity warning system (GPWS) ‘terrain, terrain’ warning sounded during the descent, in cloud, to the nondirectional beacon (NDB) [4.1 nautical miles (7.6 kilometers) from the runway];
- “The pilot flying did not fly a stabilized approach, although required by the company’s SOPs. The crew did not carry out a go-around when it was clear that the approach was not stabilized;



- “The crew descended the aircraft well below [the] safe minimum altitude [2,400 feet] while in [IMC];
- “Throughout the approach, even at 100 feet above ground level (AGL), the captain asked the pilot flying to continue the descent without having established any visual contact with the runway environment;
- “After the GPWS ‘minimums, minimums’ voice activation at 100 feet AGL, the aircraft’s rate of descent continued at 850 feet per minute until impact; [and,]
- “The crew planned and conducted, in cloud and low visibility, a user-defined global positioning system [GPS] approach to Runway 31, contrary to regulations and safe practices.”

The flight crew was conducting a scheduled 25-minute flight to Sept-Îles from Port-Menier. [Sept-Îles is about 86 nautical miles (159 kilometers) west-northwest of Port-Menier.]

The captain, 39, held an airline transport pilot (ATP) license and had 7,065 flight hours, including 606 flight hours in type. He was president, operations manager, chief pilot and chief aircraft maintenance engineer for another company, Confortair,

and had flown the Beech 1900D part-time for Régionnair since April 1999.

“The captain’s training records indicate that he was a smooth pilot who demonstrated good management and decision-making abilities,” the report said. “Most of his flying experience was acquired in Quebec’s Basse Côte-Nord (Lower North Shore [of the Gulf of St. Lawrence]) area. He knew this area of



Raytheon Beech 1900D

The Beech 1900D is a twin-turboprop regional transport that entered service in 1991 and currently is manufactured by Raytheon Aircraft Co. The airplane is a derivative of the Beech 1900, which first flew in 1982. The 1900D has a flat floor, a maximum cabin height of 5.9 feet (1.8 meters) and 28.5 percent more cabin volume than its predecessor, the Beech 1900C. Standard accommodation is for two flight crew members and 19 passengers.

The airplane is powered by two Pratt & Whitney Canada PT6A-67D engines, each flat rated at 1,279 shaft horsepower (954 kilowatts), and Hartzell four-blade, composite propellers. Maximum takeoff weight is 16,950 pounds (7,704 kilograms). Maximum landing weight is 16,600 pounds (7,546 kilograms). Maximum cruising speed at 15,000 pounds (6,818 kilograms) gross weight and 25,000 feet altitude is 274 knots. Stalling speed at maximum takeoff weight with flaps retracted is 101 knots.♦

Source: *Jane's All the World's Aircraft*

operations very well and was familiar with the region’s [airports] and typical weather patterns. His most recent flight on the Régionnair Beech 1900D was on 8 July 1999, and he had conducted a number of flights for his own company after that.”

The first officer, 28, held an ATP license and had 2,600 flight hours, including 179 flight hours in type. He was employed as a full-time pilot by Régionnair in June 1999 and had flown part-time for Confortair since April 1999.

“On the day of the accident, he had indicated to the captain, who was also his employer at Confortair, that he needed to stop flying for a week because he felt he was becoming too tired and worn out,” the report said.

The report said that Régionnair’s operations manager “did not effectively supervise the flight [times] and duty times of company pilots.” Both accident pilots had exceeded Canadian Aviation Regulations (CARs) flight-time limits. The CARs prohibit commercial pilots from flying more than 120 hours in any 30 consecutive days and more than 300 hours in any 90 consecutive days.

During the 30 days preceding the accident, the captain had flown 127 hours and the first officer had flown 181 hours. During the 90 days preceding the accident, the captain had flown 337 hours and the first officer had flown 368 hours.

“They were thus at increased risk of fatigue, which leads to judgment [errors] and performance errors,” the report said. “The first officer likely suffered from chronic fatigue, having worked an average of 14 hours a day for the last 30 days, with only one day of rest.”

On the day of the accident, the captain left his home about 0730 and conducted two half-hour flights for his own company; the flights began at 0900 and 1400. The first officer arose from rest at 0600 and, at 0700, began a flight for Confortair that comprised five legs and 6.5 flight hours.

Before beginning the scheduled flight for Régionnair at 2104, the captain obtained weather reports and forecasts, and notices to airmen (NOTAMs) from the Canadian Regional Airline dispatch office at the Sept-Îles airport. The weather in the area was influenced by a stagnant air mass and a slow-moving trough of warm air aloft. Low clouds and fog prevailed in the area.

The flight for Régionnair included legs from Sept-Îles to Port-Menier to Mont-Joli [which is about 119 nautical miles (220 kilometers) south-southwest of Sept-Îles] and return to Sept-Îles by way of Port-Menier. During their takeoff from Sept-Îles for the first leg of the flight, the crew observed that the ceiling was about 200 feet and visibility was about 0.25 statute mile.

“The first officer observed that, on the ground, he could count up to nine runway lights, spaced 200 feet [61 meters] apart,” the report said.

The crew departed from Port-Menier at 2334 for the last leg of the flight. They obtained a report from the Sept-Îles Flight Service Station (FSS) that current weather conditions at the airport included a 200-foot ceiling and 0.25-mile visibility.

The airport had three runways in a triangular pattern. One runway (Runway 05-23) was closed permanently; another runway (Runway 09-27) was closed temporarily for resurfacing. The available runway, Runway 13-31, was served by an NDB approach. The published minimums for the straight-in NDB approach to Runway 31 and the circling approach to Runway 13 were 680 feet (506 feet above the runway touchdown zone elevation) and 1.5 statute miles (2.4 kilometers) visibility. Under CARs Part VI, the general operating and flight rules, the crew was authorized to conduct the NDB approach.

“CAR 602.129 specifies that, with respect to visibility, approaches are governed by RVR [runway visual range] values only,” the report said. “With certain exceptions, pilots are prohibited from completing an instrument approach past the outer marker or final approach fix to a runway served by an RVR if the RVR values measured for that runway are below the established 1,200-foot minimum for fixed-wing aircraft.

“Where a runway is not served by an RVR, no regulations prevent aircrew from attempting an approach to that runway. No RVR was available for Runway 31 in Sept-Îles.”

The crew decided not to conduct the published NDB approach to Runway 31.

“The crew planned a straight-in approach to Runway 31, using solely the navigation guidance from the [GPS receiver] set up to provide distance [readouts] and track readouts relative to the runway threshold,” the report said. “The crew planned the following: The approach would be flown on an inbound track of 312 degrees; the desired altitude/distance aim points would be 400 feet AGL at the [NDB], 300 feet AGL at two nautical miles [3.7 kilometers from the GPS waypoint set on the runway threshold] and 100 feet AGL at one nautical mile from the threshold waypoint; and, once at 100 feet AGL, a shallow descent would be flown until the approach lights were seen.”

The crew began the descent from cruise altitude, 10,000 feet, when the aircraft was nine nautical miles (17 kilometers) from the NDB. The rate of descent exceeded 3,000 feet per minute (fpm) until the aircraft was about 1,200 feet above sea level (ASL; see Figure 1, page 4).

The crew extended the flaps to the approach position, and the first officer raised the aircraft’s nose to reduce airspeed to the landing-gear-limiting speed. Indicated airspeed decreased from

200 knots at the NDB to about 137 knots and then began to increase. The aircraft’s rate of descent varied between 1,000 fpm and 1,500 fpm until the aircraft was about three nautical miles (5.6 kilometers) from the runway.

“For the last 30 seconds of flight and from approximately three [nautical miles] from the threshold, the aircraft descended steadily at approximately 850 fpm, at 140 [knots] to 150 knots indicated airspeed, with full flaps extended,” the report said. “The captain coached the first officer throughout the descent and called out altitudes and distances.”

The report said that company SOPs required a missed approach to be conducted at the final approach fix if the landing gear and flaps were not extended or if airspeed was not stabilized at V_{REF} (landing reference speed) plus 10 knots.

“The calculated $V_{REF} + 10$ knots airspeed for the weight of the aircraft during the approach to Sept-Îles with full flaps was 119 knots,” the report said.

Eight seconds before impact, the GPWS announced “minimums” at 100 feet AGL, the decision height selected on the radar altimeter. The captain told the first officer to continue flying a slow descent.

The report said that the captain did not have the runway environment in sight when he told the first officer to continue the approach.

“[The crew’s] decision to continue the unstabilized descent until the runway environment was sighted, in view of the known weather conditions at the airfield, removed all the safety margins that are built into any approved instrument approach procedure,” the report said. “Fatigue and the

desire to terminate the flight for a much-desired rest were likely factors in the crew’s decision-making process.”

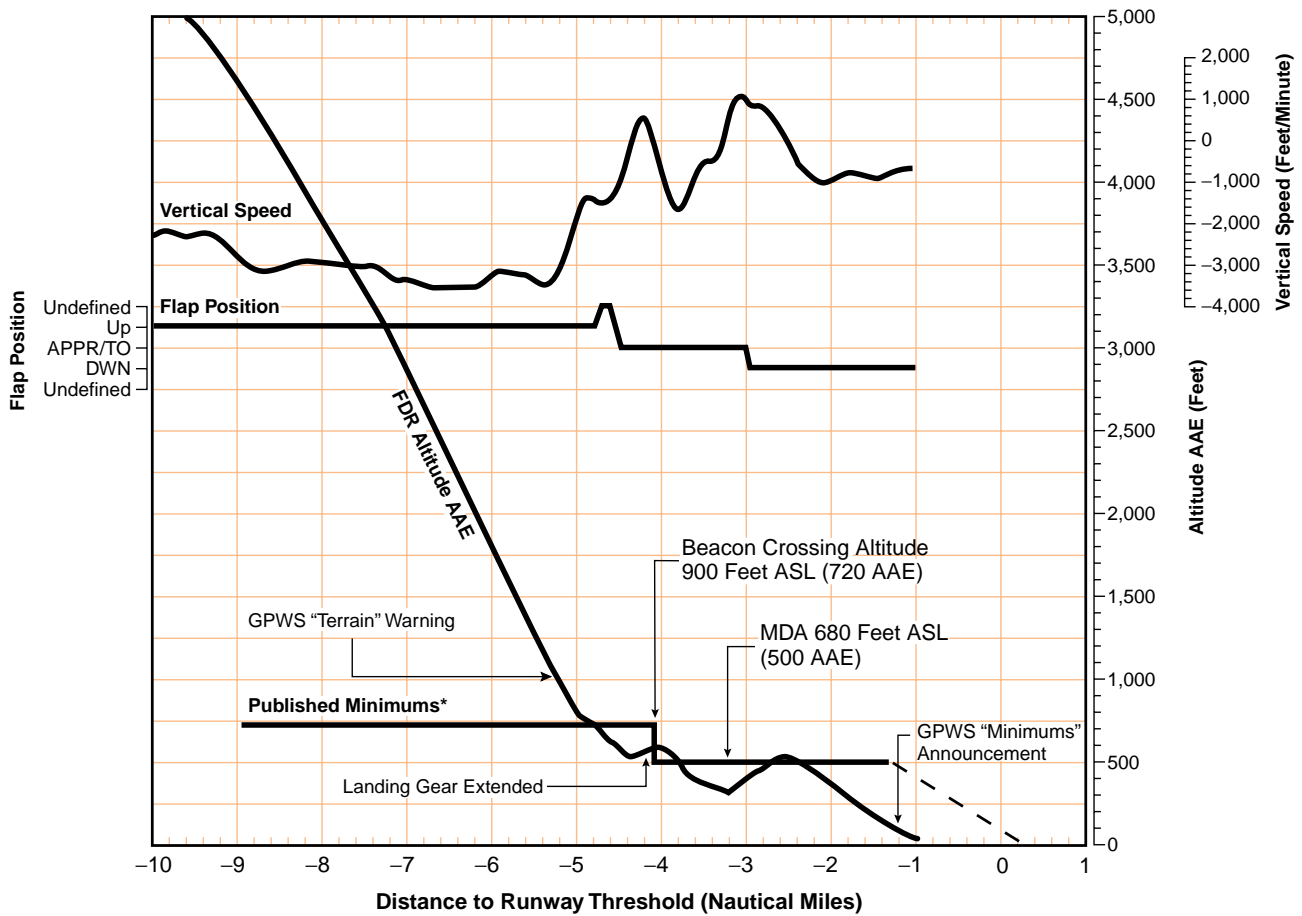
The aircraft was in a wings-level, slightly nose-down attitude and was being flown at 152 knots to 155 knots indicated airspeed when it struck trees on rising terrain.

“The aircraft’s composite propellers shattered on impact, and the wing tips were torn off,” the report said. “As the aircraft descended into the trees, it began a slow roll to the left. It struck the ground in a 50-degree left bank, nose-down attitude and cartwheeled counterclockwise over the left wing, coming to rest upright and pointing back toward the initial impact point

“The cockpit was destroyed by the impact forces. It separated from the fuselage immediately behind the cockpit partition-and-door assembly. The cockpit was crushed by the ground and pushed toward the right wing and [right] engine as the aircraft cartwheeled on top of it.

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**Flight Data Recorder (FDR) Data; Raytheon Beech 1900D;
Sept-Îles, Quebec, Canada; Aug. 12, 1999**



* Nondirectional beacon (NDB) Runway 31 approach.

AAE = Above airport elevation ASL = Above sea level APPR/TO = Approach/takeoff DWN = Down
GPWS = Ground-proximity warning system MDA = Minimum descent altitude

Source: Transportation Safety Board of Canada

Figure 1

“The top of the fuselage above the first row of passenger seats caved in but did not hinder the exit of the two passengers. The rest of the main cabin structure remained largely intact.”

A postaccident fire destroyed the wings, the right engine and part of the fuselage.

An autopsy showed that the captain, who wore only his lap belt, died from traumatic shock and multiple injuries. Toxicological tests for the presence of common drugs were negative.

The report did not describe the injuries received by the first officer, who wore his lap belt and shoulder harness.

“The first officer managed to crawl on his elbows through a hole he found in the partition and dragged himself a few feet away from the wreckage,” the report said. “He remained there until found by ERS [emergency response services] personnel.

“The two passengers, sitting in the left and right seats of row 2, escaped with minor injuries because the cabin structure from row 2 and back remained essentially intact. Fearing an explosion, the passengers undid their seat belts, jumped through the opening and walked away from the aircraft.”

The passengers walked about 400 meters [1,312 feet] through woods and thick fog toward the sound of traffic until they reached a highway.

A Sept-Îles FSS specialist heard an emergency locator transmitter (ELT) signal for about five seconds and attempted to radio the crew. (The report said that the aircraft's ELT likely activated on impact and continued functioning, but its transmitting range was reduced when the antenna was sheared off during the accident.) The FSS specialist notified the Montreal Area Control Centre and was told that the center did not have radio contact with the crew. The specialist then notified the Sept-Îles ERS personnel, who were based at the town's fire station.

ERS personnel found the two passengers about 0100 Aug. 13 and transported them by ambulance to a hospital. ERS personnel reached the accident site about 0107 and stabilized the first officer, who was then transported by ambulance to a hospital.

The Sept-Îles accident was the second accident involving a Régionnair aircraft in 1999. The first accident occurred on Jan. 4, 1999, and involved controlled flight into terrain (CFIT) during a nonprecision approach to Saint-Augustin.¹

[In that accident, the crew of a Beech 1900C conducted a LOC/DME (localizer/distance-measuring equipment) approach in reported weather conditions that included a 300-foot ceiling and 0.25-mile visibility in snow flurries. The captain continued descent below the minimum descent altitude (MDA) after the first officer said that he observed the ground beneath the aircraft. The aircraft struck the frozen surface of a river three seconds after the GPWS announced "minimums." The aircraft was substantially damaged. The 12 occupants were not injured. In its report on the accident, TSB said that the following were causes and contributing factors:

- "The crew did not follow the company's SOPs for the briefing preceding the approach and for a missed approach;
- "In the approach briefing, the captain did not specify the MDA or the MAP [missed approach point], and the first officer did not notice these oversights, which shows a lack of coordination within the crew;
- "The captain continued descent below the MDA without establishing visual contact with the required references;
- "The first officer probably had difficulty perceiving depth because of the whiteout;
- "The captain did not effectively monitor the flight parameters because he was trying to establish visual contact with the runway; [and,]

- "The chief pilot (the captain of [the accident aircraft]) set a bad example to the pilots under him by using a dangerous method — that is, descending below the MDA without establishing visual contact with the required references and using the GPWS to approach the ground (i.e., selecting 100 feet AGL on the radio altimeter and using the GPWS 'minimums' announcement as a signal ... that the aircraft was too close to the ground)."²

After the Saint-Augustin accident, Régionnair management "verbally briefed its pilots on the requirements to adhere to established ceiling and visibility criteria during approaches in [IMC]," the report said. "A written directive to this effect was not produced for the flight crews' circulation file, nor was the [SOPs] manual amended.

"The crew involved in this occurrence [the Sept-Îles accident] were not employees of the company at the time of the previous accident; consequently, they might not have been aware of this briefing."

After the Saint-Augustin accident, the company asked Transport Canada (TC) to conduct a crew resource management (CRM) course for its pilots. TC conducted a CRM course for Régionnair's pilots in March 1999, but neither the captain nor the first officer of the accident aircraft were company employees at that time.

"On 13 August 1999, [TC] conducted a post-occurrence audit of Régionnair," the report said. "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 ... The company's response to

the identified shortcomings resulted in the reinstatement of the air operator certificate on 18 August 1999."

The report said that between Jan. 1, 1994, and April 30, 1999, 20 Canadian-registered aircraft were involved in accidents during instrument approaches or missed approaches conducted in low visibilities and/or low ceilings. The investigations indicated that many of the accident pilots regularly conducted user-defined GPS approaches below the minimums for published instrument approaches.

"Some pilots do not recognize the safety value in the criteria used to design approaches," the report said. "Consequently, they may disregard the established approach procedures in favor of user-defined GPS approaches."

Published GPS approaches are conducted using preloaded data in an approved GPS receiver's database. The data for an approved approach cannot be changed by the user.

The investigations indicated that many of the accident pilots regularly conducted user-defined GPS approaches below the minimums for published instrument approaches.

“Because of the risk of mis-entry, pilots are not permitted to manually input waypoints to be used in any phase of flight under IFR [instrument flight rules],” the report said.

A GPS receiver automatically sets course-deviation-indicator (CDI) sensitivity for full-needle deflection at five nautical miles (nine kilometers) in en route areas, one nautical mile in terminal areas and 0.3 nautical mile (0.6 kilometer) in final-approach areas.

“When the aircraft is flying to a manually entered [user-defined] waypoint, the receiver will remain in the en route [five-nautical-mile CDI] mode,” the report said. “Approved stand-alone GPS approaches are based on surveyed runway reference points, which are usually certified by accredited surveyors.”

The report said that if a GPS overlay approach to Runway 31 at Sept-Îles were developed — authorizing the use of GPS guidance to conduct the published NDB approach — the minimums would be the same as for the NDB approach because of an obstacle (an antenna) three nautical miles from the runway.

The CARs 602.129 prohibition against completing an instrument approach in a fixed-wing aircraft past the outer marker or final approach fix if the measured RVR for the runway is below 1,200 feet is called an *approach ban*. The report said that TSB’s investigation of an accident involving a Canadair Regional Jet on Dec. 16, 1997, led to a recommendation that TC “strengthen” the approach ban.

[The accident involved an Air Canada flight crew that conducted an instrument landing system (ILS) approach to Runway 15 at the Fredericton (New Brunswick) Airport. The ceiling and visibility were below the minimums published for the approach, but the RVR on Runway 15 was 1,200 feet. The captain saw the runway approach lights when the aircraft was 100 feet above decision height (DH). The first officer (the pilot flying) continued the approach, but the aircraft began to drift above the glideslope and left of the runway centerline. The captain commanded a go-around. During the go-around, the aircraft stalled at an angle-of-attack approximately 4.5 degrees lower than normal, struck the runway and then veered off the runway into a ditch and trees. The captain and eight passengers were seriously injured; the first officer, the flight attendant and 31 passengers received minor injuries or no injuries. TSB said that the aircraft’s premature stall was caused by a thin accumulation of ice on the wing leading edges.]^{3,4}

In response to the TSB recommendation, TC issued a notice of proposed amendment (NPA) to the CARs.

The report said, “[The] portion of NPA 2000-01 that applies to airplane nonprecision approaches states that the visibility is less than the minimum visibility required for a nonprecision approach in the following instances:

- “Where both RVR ‘A’ [measured near the runway threshold] and RVR ‘B’ [measured near the runway

midpoint] are measured, RVR ‘A’ or RVR ‘B’ for the runway of intended landing is less than 4,000 feet [1,220 meters];

- “Where only RVR ‘A’ or RVR ‘B’ is measured, the RVR is less than 4,000 feet;
- “The current takeoff visibility is less than 4,000 feet; or,
- “The reported ground visibility is less than the greater of [0.75] statute mile [1.21 kilometer] or one-half of the published visibility for the approach procedure flown if:
 - “An RVR does not serve the landing runway;
 - “An RVR report is not available; or,
 - “A current takeoff visibility is not available.”

In March 2000, the Civil Aviation Regulation Advisory Council (CARAC) reviewed the proposed approach ban and decided that it should apply only to CARs Part VII commercial operators.

“A post-implementation review two years [after the proposed approach ban is adopted for commercial operators] will assess whether CAR 604 [passenger-transport operations conducted in pressurized, turbine-powered airplanes or large airplanes] and general aviation operations should be included,” the report said.

The report said that the proposed approach ban will reduce the risk involved in conducting approaches in marginal weather conditions.

“However, the regulations may not be changed for some time,” the report said. “In the meantime, commercial operators will continue to legally conduct approaches in visibility conditions lower than those contained in the NPA.

“Because enough information suggests that a number of aircrews continue to ‘push’ the ceiling and visibility criteria, the risk remains high that these accidents will continue to occur under the present regulations. Timely implementation of the approach ban is required.”

The report said that the proposed approach ban includes only visibility minimums. Nevertheless, of the 20 accidents that occurred from Jan. 1, 1994, through April 30, 1999, eight accidents occurred when visibilities were greater than the published approach minimums but ceilings were below the MDAs.

The report said that low ceilings were involved in two recent accidents in Canada:

- On Feb. 27, 2000, an air-taxi aircraft struck terrain while returning to land at an airport after a missed NDB approach. “The MDA for this approach was 695 feet, and the recommended visibility was 1.75 statute miles

[2.82 kilometers],” the report said. “The reported ceiling was 300 feet, and visibility was three statute miles.” [The aircraft, a Piper Chieftain operated by Athabaska Airways, struck trees while being maneuvered on a visual approach to land at Stony Rapids (Saskatchewan) Airport. The pilot and one passenger received serious injuries; five passengers received minor injuries.]⁵

- On the night of June 13, 2000, a flight crew was circling to land, after attempting two NDB approaches to the airport, when the air-taxi aircraft struck terrain. “The MDA for this approach was 572 feet, and recommended visibility was 1.75 statute miles,” the report said. “The automatic weather observation system [reports showed that the ceiling varied] between 400 feet at the time of the first approach and 300 feet at the time of the crash. The visibility remained steady at nine statute miles [15 kilometers] in fog.” [The crew of the Dassault Falcon 20E, operated by Grand Aire Express on a cargo flight, acquired visual contact with the runway environment during the second NDB approach to Peterborough (Ontario) Airport and landed the aircraft near the runway midpoint. The captain rejected the landing and then conducted a visual approach. The aircraft struck terrain during the turn to final approach. Neither pilot received serious injury.]⁶

“In both of these instances, the proposed approach ban would not have prevented the crews from conducting these approaches because the ban is not based on the height of the ceiling,” the report said. “While it is acknowledged that visibility is a factor in more accidents, aircrew are also at increased risk when conducting nonprecision approaches in reported ceiling conditions below the minimums stated for the approach. ... Unless measures are taken to address this ceiling issue with respect to nonprecision approaches, a risk to life and property will remain.”

Based on the findings of the Sept-Îles accident investigation, TSB made the following recommendations to TC:

- “Expedite the approach-ban regulations prohibiting pilots from conducting approaches in visibility conditions that are not adequate for the approach ban to be conducted safely. (A02-01); [and,]
- “Take immediate action to implement regulations restricting pilots from conducting approaches where the ceiling does not provide an adequate margin for the approach or landing. (A02-02).”

[TC responded to the TSB recommendations as follows:

- “Transport Canada has prepared 16 [NPAs] to address TSB Recommendation A02-01 concerning approach ban regulations. These NPAs are currently under review at the Department of Justice, and it is expected that the

final product will be published in the June 2002 issue of the Canada Gazette. The TSB will be sent a copy of the approved version once [it is] available.”

- “Transport Canada ... agrees that including a ceiling limit in the approach ban [as recommended in A02-02] merits consideration. [TC] is also aware of the difficulty in creating a practical and enforceable regulation based on the known limitations of the available weather-observation services and the associated implications of defining what ceiling and sky condition could be used to constitute an adequate safety margin.

“Transport Canada will bring forward this recommendation to [CARAC] for further consideration and discussion with stakeholders to evaluate the feasibility and potential benefits of adding ceiling criteria to current approach regulations.”♦

[FSF editorial note: This article, except where specifically noted, is based on the Transportation Safety Board of Canada *Aviation Investigation Report A99Q0151: Controlled Flight Into Terrain, Régionnaire Inc.; Raytheon Beech 1900D, C-FLIH; Sept-Îles, Quebec; 12 August 1999*. The 48-page report contains appendixes and illustrations.]

Notes

1. Controlled flight into terrain (CFIT) occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew.
2. Transportation Safety Board of Canada (TSB). *Aviation Investigation Report: Controlled Flight Into Terrain; Régionnaire Inc. Beechcraft 1900C, C-FGOI; Saint-Augustin, Quebec; 4 January 1999*. Report no. A99Q0005.
3. TSB. *Aviation Occurrence Report A97H0011: Loss of Control on Go-around (Rejected Landing); Air Canada Canadair CL-600-2B19, C-FSKI; Fredericton Airport, New Brunswick; 16 December 1997*.
4. FSF Editorial Staff. “Airplane’s Low-energy Condition and Degraded Wing Performance Cited in Unsuccessful Go-around Attempt.” *Accident Prevention* Volume 56 (July 1999).
5. TSB. *Aviation Investigation Report: Controlled Flight into Terrain; Athabaska Airways Ltd. Piper Navajo Chieftain PA-31-350, C-FATS; Stony Rapids, Saskatchewan; 27 February 2000*. Report no. A00H0001.
6. TSB. *Aviation Investigation Report: Controlled Flight into Terrain; Grand Aire Express Inc. Dassault-Breguet Falcon 20E, N184GA; Peterborough Airport, Ontario, 0.5 nm W; 13 June 2000*. Report no. A00O0111.

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The nominating deadline is July 31, 2002; the award is presented at the FSF International Air Safety Seminar (IASS).

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