

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A99Q0005



CONTROLLED FLIGHT INTO TERRAIN

RÉGIONNAIR INC.
BEEHCRAFT 1900C C-FGOI
SAINT-AUGUSTIN, QUEBEC
4 JANUARY 1999

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The Régionnair Inc. Beechcraft 1900C, serial number UC-85, with two pilots and 10 passengers on board, was making an instrument flight rules (IFR) flight between Lourdes-de-Blanc-Sablon, Quebec, and Saint-Augustin, Quebec. Just before initiation of descent, the radiotelephone operator of the Saint-Augustin Airport UNICOM (private advisory service) station informed the crew that the ceiling was 300 feet, visibility a quarter of a mile in snow flurries, and the winds from the southeast at 15 knots gusting to 20 knots. The crew made the LOC/DME (localizer transmitter / distance-measuring equipment) non-precision approach for runway 20. The approach proceeded normally until the minimum descent altitude (MDA). When the first officer reported sighting the ground beneath the aircraft, the captain decided to continue descending below the MDA. Thirty-five seconds later, the ground proximity warning system (GPWS) "MINIMUMS" audible alarm sounded. Three seconds later, the aircraft flew into the frozen surface of the Saint-Augustin River. The occupants escaped the accident unharmed. The aircraft was heavily damaged.

Ce rapport est également disponible en français.

Other Factual Information

At 0728 Atlantic standard time (AST),¹ about one hour before departure from Lourdes-de-Blanc-Sablon, the captain obtained weather and Notice to Airmen information for the planned flight. The area forecast issued for the areas of Gaspé, Sept-Îles, Moisie, and Natasquan called for a ceiling of 600 feet above sea level (asl) with ground visibility occasionally reduced to half a mile in snow flurries and blowing snow. Since the airport did not have an automated weather observation system or a qualified Environment Canada observer, no aerodrome forecast or aviation weather report was available for Saint-Augustin.

The Beechcraft 1900C took off from Lourdes-de-Blanc-Sablon Airport at about 0835 for the scheduled IFR flight GIO 1707. Two pilots and 10 passengers were on board. The aircraft was to land 20 minutes later at Saint-Augustin on the Basse Côte-Nord (Lower North Shore). At about 0845, 28 nautical miles (nm) east of Saint-Augustin, just before leaving cruising altitude at 10 000 feet asl, the first officer contacted the authorized approach UNICOM (AAU) radiotelephone operator, who provided the following information: the runway was snow-covered, the ceiling was 300 feet, visibility was a quarter of a mile in snow flurries, the winds were from the southeast at 15 knots gusting to 20 knots, and the altimeter setting was 29.80 inches of mercury.

Because of the winds, the captain decided to conduct the LOC/DME approach for runway 20. The approach descent profile involved three levels. First, the aircraft would intercept the localizer, then descend to 1 500 feet asl. Next, when the aircraft was 5 nm from the runway threshold, over the Desmarais approach fix, the pilot would continue descending to 960 feet asl. Finally, 2.5 nm from the threshold, the pilot would descend to the MDA of 500 feet asl.

The captain did not brief the first officer according to the company's standard operating procedures (SOPs) before the descent. He did not state the issue date of the approach chart, the altitude of the airport, the minimum sector altitude, the MDA, and the missed-approach point (MAP). The first officer did not notice these oversights. As he had frequently done in the past, the captain asked the first officer to set the radio altimeter minimum altitude pointer to 100 feet above ground level (agl). They then agreed that the captain would be the pilot flying (PF) and that the first officer would monitor the general situation and guide the PF in the approach.

At 0849:11, the AAU advised the crew that the weather had improved, with visibility increased to half a mile. At 0854:54, once established on the localizer course, the flight crew activated the aircraft radio control of aerodrome lighting system (ARCAL). Thirty seconds after flying over the Desmarais approach fix, the first officer reported sighting the ground at about 1 200 feet asl. From that point on, he began to report to the captain the aircraft's position relative to the ground and the significant geographical features being flown over.

The approach proceeded normally as far as the MDA. At 0858:26, eight seconds after reaching the MDA, the first officer suggested to the captain to descend 100 feet lower. Six seconds later, he announced that the aircraft was over water and could therefore descend a little lower; he did

¹ All times are AST (Coordinated Universal Time [UTC] minus four hours).

not, however, give any further details. The captain then confirmed sighting the river. At 0858:46, the first officer reported visibility of $\frac{1}{4}$ nm to $\frac{1}{2}$ nm. Immediately thereafter, the crew activated the ARCAL. At 0858:58, the GPWS "MINIMUMS" audible alarm sounded. Three seconds later, at 0859:01, the aircraft flew into the frozen surface of the Saint-Augustin River at about 109 knots. The aircraft was on the final approach path 0.7 nm from the runway threshold. The crash occurred 1 400 feet from either side of the river. The aircraft bounced before coming to a halt on its belly 1 300 feet farther on. In the collision, the landing gear was torn off, the left propeller separated from the engine, and the right propeller blades broke off. The rear wall of the nose wheel bay was punctured by the nose gear. While the aircraft was sliding on the surface of the river, snow entered the cockpit through the split in the rear wall of the nose wheel bay, and the first officer's legs were trapped. Once the aircraft came to rest, the captain had to help him to free himself. The cockpit and the cabin remained relatively intact. However, some fuselage frames, longerons, and wing spars were twisted. All the occupants escaped the accident unharmed. The main door and the emergency exits were used in the evacuation.

A few minutes after the occurrence, a competitor's aircraft following the same path as C-FGOI had to perform a missed approach on runway 20. Although the aircraft continued flying level beyond the MAP, thereby exceeding the approach limits, the crew was unable to see the runway because of the adverse weather conditions. According to Transport Canada's files, Régionnair and this operator engaged in fierce competition on the Basse Côte-Nord, with each company repeatedly reporting certain operating practices engaged in by the other to Transport Canada. The crew of C-FGOI knew that they were being followed during the approach by a competitor's aircraft.

The crew is not to continue descending below the MDA unless the required visual references have been established in order to complete a safe landing. The crew of the occurrence aircraft could not continue as far as the MAP, 1.3 nm from the threshold, where it was to abort the approach if it had not established visual contact with the required references. Visual contact had to be established with one of the following references during the approach to runway 20 at Saint-Augustin Airport:

- the runway or runway markings;
- the runway threshold or threshold markings;
- the touchdown zone or touchdown zone markings;
- the approach lights;
- the approach slope indicator;
- the runway identification lights;
- the threshold and runway end lights; or
- the parallel runway edge lights.

These references must allow the pilot to estimate the aircraft's position and rate of change of position relative to the nominal flight path.

According to the information gathered, the crew of the occurrence aircraft and other Régionnair crews were in the habit of descending below the MDA even if visual contact had not been established with the required references. Among Régionnair pilots, it was agreed that the first officer would set the radio altimeter minimum altitude pointer to 100 feet agl and then, while monitoring the controls, announce what was observed outside the aircraft. The pilot conducting

the instrument approach would follow the first officer's instructions and continue descending at his/her discretion. As a last resort, if the aircraft reached the selected terrain clearance margin of 100 feet agl, the GPWS "MINIMUMS" alarm would sound to signal to the crew that the aircraft was too close to the ground.

The visibility published on the approach chart for landing on the runway was 1.5 nm. This published visibility is advisory only. It indicates the visibility that should permit the pilot to establish visual contact with the required references during approach. At Saint-Augustin, pilots can conduct an approach regardless of the visibility and continue descending to the ground if they have established visual contact with the runway.

When the aircraft reached short final, the visibility, as estimated by the first officer, was between $\frac{1}{4}$ nm and $\frac{1}{2}$ nm. Because the approach lights of runway 20 are at the threshold of the runway, the crew could see the runway threshold at a distance of $\frac{1}{4}$ nm to $\frac{1}{2}$ nm. Consequently, it can be concluded that, at the approach speed of 109 knots, the aircraft would have overflown the runway threshold 8 to 16 seconds after the pilot saw it.

The captain could have chosen to conduct a pilot-monitored approach (PMA), as recommended in the SOPs. The first officer would conduct the instrument approach, and, near the MDA, the captain would monitor outside to establish visual contact with the required landing markers. If the captain established visual contact with the runway environment, he would then take the controls and complete the landing while the first officer, who was at the controls up to that point, would continue to monitor the instruments until touchdown. If visual contact was not established with the runway environment, the PF would remain at the controls and abort the approach. Using the PMA method when weather conditions are equal to or better than the approach limits gives the captain more time during landing to assess the situation and decide whether he is going to land and to visually determine the position of the aircraft relative to the desired profile. The SOPs specify that PMA helps to improve safety during the approach and landing/pull-up phases of a flight. They also specify that:

Being freed of all physical piloting work, the captain is not overloaded and is in a better position to analyze and, because of his authority, can and shall make the calls and give the instructions.

The first officer's job is to control the aircraft, not look outside, in order to avoid dizziness or disorientation.

In the final stage of the approach, C-FGOI flew over the Saint-Augustin River. The frozen river's surface was snow-covered and wind-swept, and consequently virtually featureless and devoid of visual references. Witnesses saw the aircraft fly into the ground before disappearing in moderate snow showers and drifting snow. The reported weather conditions and the topography of the site were conducive to whiteout. In a whiteout situation, a layer of freshly fallen snow on the ground blends into a white sky and an indistinct horizon such that depth perception is next to impossible. *A.I.P. Canada* cautions pilots that the real hazard in whiteout is the pilot not suspecting the phenomenon.

The flight crew was licensed and qualified for the flight in accordance with existing regulations. The company operations manual indicated that the Beechcraft 1900 simulator training program included SOPs for the GPWS and PMA, among other things. However, as neither crew member's training file made any reference to such training, the investigation was unable to determine with certainty the pilots' experience. Both pilots were qualified to act as pilot-in-command of the Beechcraft 1900C. The captain, sitting in the left-hand seat, had been in Régionnair's employ since 1993. At the time of the accident, he had a total of approximately 6 500 hours' flying time, most of it on the Basse Côte-Nord. In May 1997, he was appointed as company chief pilot. In that capacity, he was responsible for issues of professional standards for the flight crews placed under his responsibility. Among other duties, he was to develop SOPs, develop or implement all approved training programs required for the air operator's flight crews, and, if necessary, give orders and instructions to and supervise flight crews.

The first officer started to work for Régionnair in April 1998. At the time of the accident, he had a total of approximately 4 000 hours' flying time, including 500 hours on type. Before joining Régionnair, he had been chief pilot for another Basse Côte-Nord air carrier.

Examination of the crew's work/rest schedules revealed that fatigue was not a contributing factor in this accident.

Neither the captain nor the first officer had taken a pilot decision-making (PDM) course. The company operations manual states that air operators operating an air service under Subpart 704 of the *Canadian Aviation Regulations* (CARs) must provide a course on command and decision making during upgrading training and pilot verification checks. Air operators have the responsibility of elaborating a curriculum for this course. According to Transport Canada, the course on command and decision making can be different from the PDM course, as defined in the regulations

Nothing indicates in their training files that the pilots took a command and decision-making course. Also, the company had not elaborated a curriculum for that course. PDM training initiates pilots in the factors influencing human performance, among other things, the decision-making process, and ways to counter human errors. Neither the company's managerial and supervisory staff nor the Transport Canada inspectors who monitored the two pilots' proficiency checks detected this irregularity.

Two days after the occurrence, Régionnair's operations manager asked Transport Canada to deliver a crew resource management (CRM) course to company pilots. CRM training, more advanced than PDM training, encompasses the factors associated with effective crew coordination, such as communication, PDM, and workload management. In February 1999, only three pilots took the CRM course offered by Transport Canada in Sept-Îles. All the pilots received the training eight months later, in August 1999, after a Régionnair Beechcraft 1900D accident at Sept-Îles (Occurrence No. A99Q0151) during a non-precision approach in adverse weather conditions. Transport Canada, who had suspended the company operating certificate following this latter accident, required in particular, that all the pilots take the CRM course before Régionnair could continue to operate its aircraft.

The aircraft was certified and maintained in accordance with regulations and approved procedures. The aircraft's weight was within the prescribed limits, and the centre of gravity was

within the normal range. C-FGOI was not equipped with an automatic pilot and was not required to be. The examination of the GPWS did not reveal any malfunction. The GPWS "MINIMUMS" alarm, like the one that sounded just before the accident, is based on the radio altitude preset by the crew. This alarm, however, deactivates when less than 50 feet agl. The following caution is published in the aircraft flight manual GPWS supplement:

This ["MINIMUMS" alarm] is a radio altimeter setting used to back up but not supplant approved Barometric Minimum Descent Altitude (MDA) or Decision Height (DH).

The "MINIMUMS" alarm procedure published in the SOPs differs from the procedure published in the aircraft flight manual supplement. The supplement states:

Execute go-around if: Runway is not in sight, and/or aircraft has not reached the Barometric MDA or DH Altitude.

The procedure published in the SOPs reads as follows:

Execute go-around if: Runway is not in sight and aircraft has not reached the Barometric MDA or DH Altitude.

In short, the SOPs imply that it is not necessary to go around if the aircraft reaches the MDA, whereas the supplement suggests that the pilot execute a go-around as soon as the alarm sounds. As a result, the Flight Safety Foundation has published a Safety Alert recommending the following action:

When a GPWS warning occurs, pilots should immediately, and without hesitating to evaluate the warning, execute the pull-up action recommended in the company procedure manual;

In the absence of a company procedure, an immediate maximum performance full-power climb should be initiated and continued until the GPWS warning stops and the crew determines that terrain clearance is assured;

This immediate pull-up procedure should be followed except in clear daylight visual meteorological conditions when the flight crew can immediately and unequivocally confirm a false GPWS warning; and

Air traffic control (ATC) should be notified as soon as possible after a GPWS warning or pull-up.

The examination of the radio altimeter at the accident site revealed that the minimum altitude pointer was set to 40 feet. The radio altimeter was operating properly, but the indicator light was inoperative. The SOPs confine themselves to noting that the radio altimeter indicates the absolute altitude above the ground and provides a warning when the aircraft descends to the preset decision height. No specific instruction for using it in a non-precision approach is given by the company.

Both the aircraft's altimeters were set on the current altimeter setting for Saint-Augustin; however, their calibration was slightly off standard. The altimeter system exhibited some minor irregularities that did not affect its operation. The investigation did not reveal any deficiency or malfunction of the aircraft's systems and components that might have contributed to the occurrence.

Saint-Augustin Airport is a Transport Canada-certified aerodrome owned and operated by the Department of Transport of Quebec in accordance with Part III of the CARs. It is an uncontrolled airport, meaning that it does not have aerodrome controller services to control ground traffic and local air traffic. When C-FGOI contacted the AAU, the radiotelephone operator (the airport manager) began by describing the weather as adverse and then gave the altimeter setting, the wind direction, and the state of the runway as he was supposed to. Although not a qualified observer, the airport manager provided for advisory purposes the ceiling height and visibility as estimated by him based on a hill situated near the runway. The airport's two altimeters were calibrated according to Transport Canada standards.

The aerodrome's reference altitude is 20 feet asl. The airport has an asphalt runway (02/20) 4 590 feet long by 100 feet wide. The threshold of runway 20 is approximately 1 400 feet from the Saint-Augustin River. Just west of the runway midpoint, a hill rises to 300 feet asl. The airport is served by a non-directional beacon (NDB), DME, and an LOC. These navigation aids allow non-precision approaches to runways 02 and 20. This equipment did not exhibit any malfunction at the time of the occurrence.

Runway 20 is equipped with runway identification lights, threshold and runway end lights, and three-way medium-intensity runway edge lights. The ARCAL, used to control the airport lights within 15 nm for some fifteen minutes, was activated for the first time less than 10 nm from the runway and a second time about 1 nm from the threshold. Each time, the crew ordered maximum intensity. According to the information gathered, all the lights were operating normally at the time of the occurrence. The runway was also equipped with a V1 visual approach slope indicator system that is usually visible from at least 4 nm.

Runway 20 did not have any approach lights, nor were they required at Saint-Augustin Airport. Transport Canada had, however, installed approach lighting for runway 02, judged the one most suitable for bad-weather landings. The runway 02 lighting system consisted of a single low-intensity ramp on the centre line, extending 2 400 feet.

Like all communities east of Natashquan, Quebec, on the Basse Côte-Nord, Saint-Augustin is accessible only by air and snowmobile between January and April. Essential and non-essential services depend primarily on air transport. These communities are served by airports equipped with navigation aids that allow only non-precision approaches. Accordingly, pilots conducting approaches at these airports are not provided with any vertical guidance for a precision approach. A precision approach allows pilots to follow a glide slope to the decision height, which is generally set at 200 feet agl, about 300 feet lower than the MDA. Because the decision height is lower than the MDA, specific airport equipment is required to make a precision approach, equipment that was not available at Saint-Augustin. According to a study published

by the Flight Safety Foundation titled *Airport Safety: A Study of Accidents and Available Approach-and-Landing Aids*,² although decision heights are lower than MDAs, the accident risk is five times lower in a precision approach than in a non-precision approach. The *Aeronautics Act* does not provide any exemption from weather and approach minima. The pilot is responsible for ensuring the safe transport of passengers in accordance with existing regulations. However, at isolated locations in certain circumstances, pilots may think that completing the mission is more important than following the regulations.

Régionnair, which has held an operating certificate since September 1992, operates a charter air service and a scheduled air service under Subparts 703 and 704 of the CARs. The operation of C-FGOI was subject to Subpart 704, Commuter Operations. Régionnair mainly serves the Basse Côte-Nord coastal communities. Besides the main base at Chevery, Quebec, Régionnair has seven secondary bases. At the time of the occurrence, the company operated five aircraft: two Beechcraft 1900C's, one Cessna 208 Caravan, one Beechcraft 90 King Air, and one de Havilland DH6 Twin Otter.

Régionnair had approximately 30 pilots in its employ under the supervision of two chief pilots. The crew members of the Beechcraft 1900's came under one of the chief pilots; the pilots of the Caravan, the King Air, and the Twin Otter came under the other chief pilot (the captain of C-FGOI). The two chief pilots came under the operations manager.

The operations manager, who was a founding member and shareholder of the company, was responsible for ensuring that flights proceeded safely in accordance with government acts and regulations and in accordance with the standards, practices, procedures, and specifications set out in the Régionnair operations manual. He also served as company president, company check pilot, and line pilot. He supervised the chief pilots, based at the Lourdes-de-Blanc-Sablon secondary base, from the main base at Chevery.

About two weeks after the occurrence, as a result of a regulatory inspection on 19 and 20 January 1999, Transport Canada revoked the captain's right to serve as chief pilot and also revoked the president's right to serve as operations manager. It was felt that the captain 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. However, the company president submitted a corrective action plan, and Transport Canada decided to restore his right to serve as operations manager.

The last regulatory audit performed by Transport Canada at Régionnair was in August 1995. Eighteen irregularities were found, all of which were corrected to the satisfaction of Transport Canada. Following the occurrence, Régionnair underwent another audit in March 1999. The audit period began in 1996. This audit identified 32 maintenance irregularities and 27 operational irregularities. The inspectors identified various maintenance-related shortcomings, but only one problem, relating to the length of time between inspections, was deemed serious and capable of compromising safety. A number of identified operational irregularities related to

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http://www.flightsafety.org/fsd/fsd_nov-feb99.pdf

Flight Safety Foundation, *Flight Safety Digest*, November 1998–February 1999.

the responsibilities of the operations manager and the chief pilots. Among other deficiencies, the training program was incomplete; the pilot training files contained numerous errors and omissions; the methods of calculating weight and centre of gravity were not consistent with commercial air service standards; one flight service was conducted by pilots who worked more than 14 hours without a rest period, including the chief pilot of the Beechcraft 1900's; and the operations manager served as a crew member on a medical evacuation although he did not have the required qualifications. Transport Canada's evaluation of these deficiencies did not seem to establish any direct link with safety. Following this audit, Régionnair implemented a corrective action plan phased over several months. Transport Canada accepted all of the proposed corrective actions.

Analysis

The possibility of a malfunction of one of the aircraft's systems was ruled out because examination of the aircraft did not reveal any deficiency, and the crew members did not mention any malfunction during the flight. Since the examination of the GPWS did not reveal any abnormality and the alarm deactivates at less than 50 feet agl, there is reason to believe that the radio altimeter minimum altitude pointer was set at more than 50 feet agl and was accidentally displaced after the occurrence. There is nothing to indicate that there was an emergency, or that the aircraft exhibited any problems, before the crash.

According to the regional forecast, the ceiling on arrival at Saint-Augustin was to be higher than the MDA. The crew could therefore expect to be under the cloud layer before reaching the MAP. The likelihood of sighting the runway upon exiting the approach was therefore greater. Consequently, the decision to proceed to Saint-Augustin was reasonable. At destination, the weather information supplied by the AAU indicated that the ceiling and visibility were below the approach minima. However, as runway 02/20 was not under an approach ban, the decision to conduct an approach was consistent with existing regulations.

The captain gave a routine briefing for the approach. Yet the prevailing environmental conditions necessitated a thorough briefing. Bearing in mind the discrepancy between the reported visibility and the visibility on landing, the crew should have expected not to establish visual contact with the required references before reaching the MDA and to have to pull up. Since the captain did not follow standard procedure when he gave the approach briefing, he did not cover several important points that would have let the first officer know his intentions in the various stages of the approach, specifically the MDA that he had set. The point where he wanted to abort the approach was not clearly established because he did not specify the MDA or the MAP. These oversights, and the fact that the first officer did not notice the missing items, reveal a lack of coordination within the crew and a lack of thoroughness, probably due to incomplete formal training and a lack of hands-on training and supervision. Consequently, the crew members did not have a common plan for pull-up, the most dangerous phase of an approach, when the obstacle clearance height was decreasing. The decision to go around appears to have rested implicitly on the loss of sight of the ground, or else the aircraft's position relative to the runway did not allow safe continuation of the landing.

Although Régionnair recommends using the PMA method in adverse weather conditions, the captain decided not to do so. The PMA method, however, would not have improved the safety

of the flight because conditions did not permit descent below the MDA. Since the crew did not establish visual contact with the required references, PMA would not have simplified the transition to visual flight. The PMA method would thereby offer no safety advantages because the aircraft was being operated under the safety requirements for approach obstacle clearance.

The approach was not conducted in accordance with the requirements of existing regulations. After flying level for a few seconds at the MDA, the captain decided to continue descending even though he had not established visual contact with the required references. He also knew that the visibility would at best let him sight the runway half a mile from the threshold, or about one mile past the MAP. The fact that the first officer established and maintained visual contact with the ground before reaching the MDA probably played a role in his decision. The fact that the aircraft of a competing company was coming behind his may also have influenced his decision.

The fact that the pilot of C-FGOI (Régionnair's chief pilot) and the crew of the aircraft following him in approach did not comply with the approach minima for Saint-Augustin Airport reveals that "going to look below the MDA or past the MAP" may be a widespread practice on the Basse Côte-Nord. The investigation established that, when the weather did not allow the runway environment to be sighted during a non-precision approach, some Régionnair pilots would descend below the MDA and use the GPWS to approach the ground. It may reasonably be asserted that the accident risk is much greater when a crew descends to 100 feet agl without sighting the runway, in low visibility, aboard an aircraft without an automatic pilot, to try to land on a runway devoid of navigation aids and equipment designed for that purpose. The crew consciously decided to descend 200 feet lower than the terrain adjacent to the runway in conditions where visual references were difficult to discern in visibility that left the crew between 8 and 16 seconds to acquire the visual references and cross-check the instruments, check the aircraft's position laterally and vertically, determine a visual flight path, and make the necessary corrections before landing on a snow-covered runway where gusting winds might decrease control of the aircraft.

A variety of factors could have motivated the crew members who adopted such an approach procedure not to abide by established safety standards and regulations, including the following:

- the desire to improve the efficiency of the service provided to a community that practically depends on air transport to travel;
- competition among the region's operators;
- concern about financial loss due to diversion;
- thorough knowledge of the terrain surrounding Basse Côte-Nord airports;
- lack of regulatory supervision;
- lack of operational control;
- lack of supervision of the procedures used by crew members; and

- lack of precise, standard GPWS procedures.

When the aircraft reached 100 feet agl, which is the minimum descent height that the crew had set for themselves, the captain, who was flying on instruments, had planned to abort the descent and maintain this height until he could see the runway. Normally, the GPWS warning should have sounded to alert the captain that the aircraft was below 100 feet agl. Three factors might have contributed to the aircraft's continued descent below that limit:

- The "MINIMUMS" alarm sounded at a height that did not leave the captain time to abort the descent and thus avoid striking the ground.
- While manoeuvring at an altitude below the safety margin for the approach in adverse weather conditions 28 seconds before impact, the captain had to monitor outside and conduct the instrument descent at the same time. Quite clearly, in trying to establish visual contact, the captain did not effectively monitor the aircraft's flight parameters.
- In the final moments of the approach, the flight proceeded in the presence of phenomena conducive to whiteout. Depth perception was virtually impossible. In these conditions, the first officer, confident that he could see the ground, did not suspect that the aircraft was descending.

It may be concluded that the aircraft continued to descend inadvertently until it flew into the ground. If the captain disregarded the alarm, thinking that the aircraft was 100 feet above the river, then he probably did not have time to initiate pull-up.

The chief pilot (the captain of C-FGOI) did not exercise the operational control arising from his duties. He did not follow the SOPs, implement all the training programs, or supervise the flight crews. He 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.

The company's management is responsible for controlling the operation of its aircraft and must ensure that pilots comply with existing regulations. As noted by Transport Canada in the audit performed after the occurrence, the operations manager did not exercise good supervision over air operations. The operation manager's multiple operational, administrative, and financial functions within the company probably adversely affected the exercise of his air operations control and supervision responsibilities. It is also conceivable that it was difficult for him to supervise the chief pilots because he did not work at the same base as they.

Several of the training and supervision deficiencies identified in the regulatory audit performed after the occurrence probably contributed to the accident. In all likelihood, the irregularities that compromised the safety of the flight appeared between the audit carried out in 1995 and the day of the occurrence. Although the Transport Canada inspectors visited the company numerous times during that time, for undetermined reasons, they did not note these problems.

The following TSB Engineering Branch Laboratory Report was completed:

LP 20/99—Instrument Analysis.

Findings as to Causes and Contributing Factors

1. The crew did not follow the company's SOPs for the briefing preceding the approach and for a missed approach.
2. In the approach briefing, the captain did not specify the MDA or the MAP, and the first officer did not notice these oversights, which shows a lack of coordination within the crew.
3. The captain continued descent below the MDA without establishing visual contact with the required references.
4. The first officer probably had difficulty perceiving depth because of the whiteout.
5. The captain did not effectively monitor the flight parameters because he was trying to establish visual contact with the runway.
6. The chief pilot (the captain of C-FGOI) 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.

Findings as to Risks

1. The operations manager did not effectively supervise air operations.
2. Transport Canada did not detect the irregularities that compromised the safety of the flight before the occurrence.
3. Régionnair had not developed GPWS SOPs for non-precision approaches.

Other Findings

1. The GPWS "MINIMUMS" alarm sounded at a height that did not leave the captain time to initiate pull-up and avoid striking the ground because of the aircraft's rate of descent and other flight parameters.
2. Neither the captain nor the first officer had received PDM training or CRM training.
3. At the time of the approach, the ceiling and visibility unofficially reported by the AAU were below the minima published on the approach chart.
4. The decision to make the approach was consistent with existing regulations because runway 02/20 was not under an approach ban.

5. Some Régionnair pilots would descend below the MDA and use the GPWS to approach the ground if conditions made it impossible to establish visual contact with the required references.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 15 November 2000.