

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

**AVIATION INVESTIGATION REPORT
A07W0005**



LANDING SHORT OF RUNWAY

**PEACE AIR LTD.
BRITISH AEROSPACE JETSTREAM 3112 C-FBIP
FORT ST. JOHN, BRITISH COLUMBIA
09 JANUARY 2007**

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.

Aviation Investigation Report

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Summary

Peace Air Ltd. Flight PE905, a British Aerospace Jetstream 3112 (registration C-FBIP, serial number 820), was conducting an instrument approach to Runway 29 at Fort St. John, British Columbia, on a scheduled instrument flight rules flight from Grande Prairie, Alberta. At 1133 mountain standard time, the aircraft touched down 320 feet short of the runway, striking approach and runway threshold lights. The right main and nose landing gear collapsed and the aircraft came to rest on the right side of the runway, 380 feet from the threshold. There were no injuries to the 2 pilots and 10 passengers. At the time of the occurrence, runway visual range was fluctuating between 1800 and 2800 feet in snow and blowing snow, with winds gusting to 40 knots.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

The flight departed Grande Prairie at 1040 mountain standard time¹ on the first leg of a scheduled run to Fort St. John (CYXJ), Fort Nelson, British Columbia, and Grande Prairie. It was operated under Part 704 of the *Canadian Aviation Regulations* (CARs).

The captain was the pilot flying and was occupying the left seat. Air traffic control (ATC) cleared the flight to maintain 12 000 feet above sea level (asl), and to hold on the TAYLOR non-directional beacon (NDB), which forms the final approach fix for the instrument landing system (ILS) approach to Runway 29 at CYXJ (see Appendix A). At 1109, Flight PE905 was cleared for an ILS approach to Runway 29. The first approach was discontinued due to the aircraft being too high on the final approach leg, and clearance was given to return to the TAYLOR NDB at 6000 feet. At 1123, ATC cleared the flight for another ILS approach to Runway 29. The second approach was conducted as a full procedure with the outbound leg extended to ensure that the aircraft was positioned to follow the correct vertical approach profile.

The final approach course was flown with a flap setting of 20° and at the company standard operating procedure (SOP) recommended airspeed of 130 knots. At approximately 300 feet above ground level (agl), the first officer informed the captain that he had the ground in sight. The approach lights were visual shortly thereafter. The captain discontinued his instrument scan and confirmed the appearance of the approach lights. The captain made the decision to land, and called for the full flap setting of 35°. The first officer diverted his attention to setting flaps, and to the V_{ref} ² reference cards clipped to the instrument panel. When he looked up, the aircraft was almost on the ground, but short of the runway. There was insufficient time to warn the captain.

The aircraft initially touched down in a nearly wings-level attitude, 320 feet short of the threshold in about 16 inches of packed snow. The left main gear contacted the surface first, followed by the right main gear, and then the nose wheel. The aircraft then struck the last set of approach lights, bounced slightly, and touched down again 180 feet short of the threshold. After sliding through the threshold lights, the aircraft came to rest on the right edge of the runway, 380 feet beyond the threshold. The right main gear had broken off, and the nose gear had collapsed rearward. Both propellers were damaged by ground contact. The aircraft was equipped with a belly-mounted cargo pod, which supported the fuselage during impact.

After the aircraft came to a stop, the captain informed emergency services of the crash in a cellular telephone call to 911, and the Aircraft Rescue and Fire Fighting service was activated. A snow-removal crew was first on the scene soon after the aircraft came to rest; emergency response vehicles arrived within 15 minutes. Due to the poor visibility and high wind chill, the occupants remained in the aircraft with the door closed until they could be transferred to the

¹ All times are mountain standard time (Coordinated Universal Time minus seven hours).

² V_{ref} is defined in the Jetstream 3112 Flight Manual as runway threshold crossing speed with both engines operating. It is calculated as a function of weight and flap setting.

vehicles. All of the passengers were wearing lap belts during the approach and landing, and were retained in their seats. Most of the passenger baggage was loaded in internal and external cargo compartments, and few carry-on items were in the cabin. There were no passenger injuries due to movement of unsecured items during the ground impact and subsequent deceleration. The emergency locator beacon activated automatically on landing, and it was turned off manually.

Weather

While Flight PE905 was conducting its approaches, the weather at CYXJ was deteriorating rapidly in blizzard conditions associated with the passage of a warm front aloft. En route to CYXJ, the crew obtained the weather on the automatic terminal information system (ATIS). Message "N," which was based upon a special weather observation at 1020, stated the following: wind 360° true (T) at 10 knots, visibility 1 to 3 statute miles (sm), vertical visibility 2300 feet, temperature -8°C, dew point -9°C, altimeter 29.65, runway 80 per cent bare and dry.

The 1100 regularly scheduled observation was as follows: wind 350°T at 15 knots gusting to 25 knots, visibility variable from ½ sm to 1½ sm in light snow and drifting snow, Runway 29 runway visual range (RVR) was 3500 feet variable 5000 feet and trending downward, vertical visibility was 1100 feet with remarks of snow obscuring 8 oktas³ of the sky. A special observation at 1125, 8 minutes before the accident, showed the wind increasing further to 340°T at 30 knots gusting to 40 knots, visibility was variable 0 to ½ sm in snow and heavy blowing snow, Runway 29 RVR was 1800 feet variable 2800 feet and stable, vertical visibility was 400 feet, and remarks of snow 8 oktas.

Two revised ATIS messages, "O" and "P," were issued based on the 1100 and 1125 observations respectively. The crew did not tune the ATIS frequency to receive these messages. Information regarding the 1125 observed visibility of 0 to ½ sm was not passed to the crew. When the aircraft was on final approach, nine minutes before the landing, the Flight Service Station (FSS) informed Flight PE905 that the wind was 310° at 30 knots gusting to 40 knots, the sky was obscured, RVR was 2800 feet, and runway lights were at the full-intensity setting of strength five. The RVR of 2800 feet was greater than the CAR approach ban limit of 2600 feet for commercial aeroplanes conducting precision approaches.

The weather observation point at the FSS and the Runway 29 RVR transmissometer are about 0.8 nautical miles (nm) apart. The final stage of the approach to Runway 29 was across a snow-covered field with little visual contrast.

The crew of a scheduled air carrier flight, which departed CYXJ 13 minutes before Flight PE905 landed, reported marginal weather conditions. This report was made on the Area Control Centre (ACC) frequency, and since the crew of Flight PE905 was monitoring the mandatory frequency, they did not hear that information. The report was not relayed to Flight PE905.

There were no indications of ice accumulation on the aircraft before or after the accident.

³ Oktas are fractions of cloud layer or obscuring phenomenon, measured in eighths.

Flight Crew

The pilots were properly licensed in accordance with existing regulations. Their flight and duty times met regulatory requirements, and they were considered to be well rested. The captain held an airline transport licence and was employed by the company since May 2006. His total flying time was 13 000 hours, with 300 hours on type and about 450 hours in instrument flight rules (IFR) operations. The majority of his flying hours were under visual flight rules (VFR), with extensive seaplane experience.

The first officer held a commercial pilot licence, and was employed by the company since September 2006. His total flying time was 275 hours, with 20 hours on type. This was the first officer's first operational instrument approach in instrument meteorological conditions (IMC) on the aircraft type.

Company Procedures

The approach briefing by the captain did not include information pertaining to flap selection. Changes in the flap setting result in changes to V_{ref} . The company's SOPs for a precision instrument approach on the Jetstream 3112 indicated that flaps should be extended to 35° (full flap) no later than crossing the final approach fix. The SOPs also stated that the aircraft should be stabilized in airspeed, landing configuration and descent rate by 500 feet agl. Selection of full flap at an airspeed of 130 knots results in the aircraft pitching up. In order to avoid a climb, the control yoke must be moved forward, to pitch the nose down.⁴

A bound set of approach charts was available for the crew's use. A photocopied set of charts was positioned in front of the first officer, who passed relevant information to the captain as the approaches progressed. The captain did not refer directly to approach charts during the approaches. The first officer read the value for the decision height⁵ (DH) as 2400 feet asl, rather than the published 2454 feet. The captain did not confirm the accuracy of the information.

A cold temperature correction factor⁶ was not applied to altitudes during the approach. The charted cold temperature correction for -8°C at 200 feet agl was an additional 20 feet to the DH.

The pilot monitored approach (PMA) is a common industry procedure used on instrument approaches in low weather conditions; the first officer normally flies the approach while the captain monitors the instruments. Approaching minimums, the captain begins to look outside

⁴ Source of information: Flight Safety International

⁵ Decision height is defined as the specified altitude, or height above ground at which a missed approach procedure shall be initiated during a precision approach if the required visual reference necessary to continue the approach to land has not been established.

⁶ Pressure altimeters are calibrated to indicate true altitude under ICAO [International Civil Aviation Organization] Standard Atmosphere (ISA) conditions. Any deviation from ISA will result in an erroneous reading on the altimeter. In conditions of extreme cold weather, pilots should add the values derived from the altitude correction chart in the Canada Air Pilot to the published procedure altitudes, or a more accurate calculated value.

for the appropriate visual cues. At DH, the captain will take control and land if he has the appropriate visual cues, or he will have the first officer continue on instruments until the appearance of more visual cues and then take control and complete the visual landing.

When control is transferred, the first officer continues to monitor the flight instruments until touchdown. If visual references are lost at any time, the captain would command a missed approach, and the first officer would fly the missed approach procedure. The PMA affords a continuity of instrument monitoring during the critical phase of an instrument approach close to the ground in low ceiling and visibility. It enables the first officer to remain on instruments until touchdown to alert the captain of any small pitch change that could give rise to a significant change in the rate of descent or airspeed.

The company's SOPs did not provide for PMAs, but indicated that the pilot who flies the approach would also carry out the landing. The pilot not flying would

- monitor the performance of the approach;
- call airspeeds in relation to Vref;
- call altitudes, and manage aircraft systems according to checklists;
- set instruments and avionics; and
- handle radio communications.

Fort St. John Airport Information

Runway 29 at CYXJ is 6900 feet long and 150 feet wide. It is equipped with a high-intensity approach light system with sequenced, flashing lead-in lights, and runway alignment indicator lights. The approach light system is 2400 feet long, and terminated by a bar of green threshold lights. Two hundred feet separate each system component.

The runway is served by an ILS with a glide slope angle of 3.0°, which places an aircraft at a height of 50 feet when crossing the threshold. DH for the ILS approach is 2454 feet asl, or 200 feet agl. The published landing visibility⁷ is ½ sm or RVR 2600 feet (see Appendix A). Required visual reference is defined as the section of the approach area of the runway or visual aids including approach lights that, when viewed by the pilot of the aircraft, enables the pilot to make an assessment of the aircraft position and the rate of change of position relative to the nominal flight path.

Aircraft Information

The aircraft was reported to operate normally throughout the flight, and records indicated that it was certified and maintained in accordance with Transport Canada regulations. It was not equipped with an autopilot. A serviceable flight director was installed, but was not used by the crew on this flight. Aircraft weight and balance was calculated to be within limits published in the aircraft weight and balance manual.

⁷ Published landing visibilities associated with all instrument approach procedures are advisory only. Their values are indicative of visibilities, which, if prevailing at the time of the approach, should result in required visual reference being established.

A flight data recorder was not installed, nor was one required by Transport Canada regulations. Cockpit voice recorder (CVR) data from the last 30 minutes of the flight were retrieved by the TSB Engineering Laboratory. During the accident flight, the CVR did not record the first officer microphone or hot microphone channels. However, first officer voice information was recorded on the captain's hot microphone intercom channel. A bench test of the CVR determined that the fault in the first officer microphone channel likely originated in the airframe audio system.

An annual intelligibility test, as required by the CARs, was conducted on the CVR by an avionics shop in May 2006. At that time, it was noted that the first officer's press-to-talk system was satisfactory and the hot boom microphone was unsatisfactory. Overall, the test was evaluated as "marginal." The CVR was returned to service with no further work done on the system. It is the operator's responsibility to interpret the test results, and to determine whether the CVR meets the regulatory standards before returning the CVR to service. Section 625.33 of the CARs states that CVRs shall continuously record the following:

- a. voice communications transmitted from, or received by, the aircraft concerning the operation of the aircraft;
- b. the aural environment of the flight deck, including:
 - (i) the audio signals received from each microphone being used by a flight crew member; and
 - (ii) voice communications of flight crew members using the aircraft's interphone system.

Analysis

While Flight PE905 was conducting its approaches, the visibility varied considerably over time and at different locations on the airport. Visibility observed at the FSS was $\frac{1}{4}$ sm, the RVR was 2800 feet, and at the approach end of Runway 29, visibility was reduced considerably by snow and blowing snow. Flight visibility would have deteriorated as the aircraft descended below the DH of 200 feet agl due to blowing snow in the high winds. The captain, as pilot flying, would have had increasing difficulty maintaining visual contact with the required visual reference elements of the approach.

On the second approach, the ILS was tracked accurately, at a speed of about 130 knots. When the flap setting was increased from 20° to 35° in the final stage of the approach, the aircraft would have become destabilized; there would have been a tendency for the aircraft to pitch up and lose airspeed. In order to maintain a stable airspeed, and to keep the approach lights in view, the captain would have had to pitch the nose down. Since the captain's focus was outside the aircraft, and his attitude reference was reduced in the low visibility, it would have been difficult to judge aircraft pitch attitude and height above ground, as well as any trends in those parameters.

When the first officer announced that the approach lights were visible at about 300 feet agl, the captain discontinued his instrument scan and decided to land. The first officer anticipated calling airspeeds in relationship to V_{ref} , and since the V_{ref} value had changed due to the captain's late call for full flap, he turned his attention to a reference card clipped to the

instrument panel. For the remainder of the approach, neither pilot devoted attention to the aircraft instruments, which would have indicated a significant descent below the glide slope before crossing the runway threshold.

The company did not use a PMA procedure for instrument approaches. Had one of the pilots been monitoring the instrumentation to touch down in a PMA, it is probable that the significant deviation below the optimum glide slope would have been noticed and corrected before ground contact short of the runway.

The one set of approach charts used by the crew was in the possession of the first officer who relayed data to the captain. Without his own set of charts, the captain was not able to confirm the information critical to the safe conduct of the approaches. As a result, the crew used a DH value that was rounded down 54 feet lower than the published value. Also, the crew did not apply a calculated cold temperature correction of 20 feet. Although it was not considered to have been a factor in this occurrence, the combination of these two factors could have resulted in a descent of 74 feet below the DH of 200 feet agl on an approach to minimums and an increased risk of undershoot.

The combined IFR experience between the two pilots was relatively low. The first officer had not conducted any previous operational approaches in actual IMC. During the captain's prior operational instrument flying, few approaches were in actual IMC to minimums. It is likely that the experience level from the pairing of the two pilots affected the decision making, and the execution of the approaches.

The CVR was reinstalled in the aircraft following an intelligibility test that indicated that the first officer's hot microphone channel did not record. As such, the CVR system did not meet serviceability standards required by the CARs because a hot microphone installed and used in the aircraft is expected to be recording continuously. Following reinstallation, a further failure in recording of the first officer's intercom channel resulted in a loss of direct access to the first officer voice information. Although useable information was derived through other means, there was a possibility that no voice information for the first officer would have been available, and the quality of the occurrence investigation would have been reduced.

Findings as to Causes and Contributing Factors

1. A late full flap selection at 300 feet above ground level (agl) likely destabilized the aircraft's pitch attitude, descent rate and speed in the critical final stage of the precision approach, resulting in an increased descent rate before reaching the runway threshold.
2. After the approach lights were sighted at low altitude, both pilots discontinued monitoring of instruments including the glide slope indicator. A significant deviation below the optimum glide slope in low visibility went unnoticed by the crew until the aircraft descended into the approach lights.

Finding as to Risk

1. The crew rounded the decision height (DH) figure for the instrument landing system (ILS) approach downward, and did not apply a cold temperature correction factor. The combined error could have resulted in a descent of 74 feet below the DH on an ILS approach to minimums, with a risk of undershoot.

Other Finding

1. The cockpit voice recorder (CVR) was returned to service following an intelligibility test that indicated that the first officer's hot boom microphone intercom channel did not record. Although the first officer voice was recorded by other means, a potential existed for loss of information, which was key to the investigation.

Safety Action Taken

In response to the accident, adherence to standard operating procedures (SOPs) was emphasized in courses and company communications.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 02 October 2007.

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Appendix A – Instrument Approach for Fort St. John

