Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08W0001

RUNWAY OVERRUN

NORTHWESTERN AIR LEASE LIMITED
BRITISH AEROSPACE JETSTREAM 3212 C-FNAE
FORT SMITH, NORTHWEST TERRITORIES
04 JANUARY 2008

Canada

Aviation Investigation Report

Runway Overrun

Northwestern Air Lease Limited
British Aerospace Jetstream 3212 C-FNAE
Fort Smith, Northwest Territories
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Report Number A08W0001

Summary

The Northwestern Air Lease Limited Jetstream 3212 (registration C-FNAE, serial number 881), operating as flight PLR 599, was landing at Fort Smith, Northwest Territories (CYSM) following an instrument flight rules flight from Edmonton, Alberta. While landing on Runway 29, at 1502 mountain standard time, the aircraft rolled off the end of the runway and stopped 367 feet from the threshold and 60 feet to the left of the runway centreline. There was about 18 inches of snow in the overrun area. Damage was limited to the number two propeller. There were no injuries to the 2 pilots and 16 passengers.

Ce rapport est également disponible en français.

Other Factual Information

The weather at 1500 mountain standard time (MST) [1] was reported as: wind 130° true (T) at 4 knots, visibility 5/8 statute mile (sm) in light snow and mist, sky condition overcast 500 feet, temperature -5°C, dew point -6°C, altimeter 29.07 inches of mercury, remarks snow 4 oktas [2], stratocumulus 4 oktas. A special weather observation at 1521 (19 minutes after the occurrence) indicated the following: wind 130° T at 5 knots, visibility ½ sm in snow and freezing fog, 400 feet overcast, remarks snow 5 oktas, stratocumulus 3 oktas.

Landing weight was calculated at 14 595 pounds, which was under the maximum landing weight of 15 609 pounds. The centre of gravity was within the limits.

Both pilots were certified and qualified for the flight in accordance with existing regulations. The captain held a valid airline transport pilot license and had 6383 hours total time; 1291 hours on type. The first officer held a commercial pilot licence and had 2000 hours total time; 1300 hours on type. The crew's flight and duty times were in accordance with regulations. The captain was on duty for 8.5 hours prior to the occurrence and was off duty for 10 hours prior to reporting for duty. The co-pilot was on duty for 6.5 hours prior to the occurrence and was off for 21 hours prior to reporting for duty. As Fort Smith was the company's main base, the crew was familiar with the airport.

The airport was served by three non-precision instrument approaches: NDB Runway 29, VOR Runway 11 (GNSS), and VOR/DME Runway 29 (GNSS). [3] Runway 11/29 is a paved surface, 6000 feet by 200 feet, with glide path information provided by a two-bar visual approach slope indicator system (VASIS 2). During the visual portion of the final approach, the VASIS indicates an optimal 3-degree glide path for a landing in the touchdown zone within the first 2000 feet of the runway. All airfield lighting was checked after the occurrence and verified as operating properly.

At 1359 (63 minutes before the arrival of PLR 599) the airport maintenance crew conducted a runway surface condition inspection of Runway 29. An aircraft movement surface condition report (AMSCR) based on this inspection was filed with the community aerodrome radio station (CARS) at 1413. This report indicated 70 per cent snowdrifts of 1/8 inch, 30 per cent

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

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

3 NDB = non-directional beacon; VOR = very high frequency omni-directional range; GNSS = global navigation satellite system; DME = distance measuring equipment

frost, centre 100 feet sanded, and a Canadian runway friction index (CRFI) [4] reading of 0.34. At 1430, ploughing and sweeping operations were commenced on the centre 100 feet of the runway. It was reported that the sweeping operations had a polishing effect on the thin layer of snow adhering to the runway surface. Snow and the previously-applied sand were removed by this operation. With PLR 599 expected to land shortly, the runway maintenance equipment left the runway at 1456 and a report of runway conditions was passed to the CARS. At that time, it was estimated that the centre 50 to 60 feet of the runway had been cleared. Insufficient time remained before the arrival of PLR 599 to re-apply sand or conduct a friction test.

At 1522, 19 minutes after the occurrence, a runway surface condition inspection indicated the following: the centre 100 feet 70 per cent snow drifts to 1/8 inch, 30 per cent frost. The remaining 100 feet was 100 per cent loose snow to ¾ inch, with a CRFI reading of 0.18.

The Fort Smith Airport operations manual, approved by Transport Canada, outlined conditions for reporting CRFI. In part, reports were to be made:

- at least once every eight-hour shift;
- every time there is a significant change in runway surface condition;
- every time the runways are cleared of snow or ice;
- whenever the runway cleared width falls below 100 feet; and
- after sweeping, following icing, or sanding.

The crew made initial contact with the CARS at 1454 and received an airport advisory which included the 1413 runway surface condition report (AMSCR 1359). Further contact with the CARS was not made until after the occurrence.

The captain was in the left seat and was the pilot flying (PF). The first officer was the pilot not flying (PNF). The chosen approach was the VOR/DME Runway 29 (GNSS). This approach was selected by the crew for its lower approach minimum and for convenience, considering the inbound track to the airport. The aircraft crossed the initial approach fix, AVPUB, at the minimum altitude of 2100 feet above sea level (asl), and the approach tracks and altitudes were flown as intended until the aircraft passed the SMITH final approach fix (See Figure 1). The aircraft was placed in a continuous descent and the descent profile remained above the minimum step-down altitudes for the latter stages of the approach.

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[4] CRFI is a measure of the decelerating forces acting on a vehicle when brakes are applied. The index numbers range from one to zero. A value of one represents the theoretical maximum decelerating capability of the vehicle on a dry surface and zero represents low braking coefficients of friction. The charts, published in the Transport Canada *Aeronautical Information Manual* and the *Canada Flight Supplement*, are conservative and assume landings from 50 feet, a stabilized approach at Vref, a 3° glideslope, minimum delay to nose lowering, minimum delay to application of ground lift dump devices, application of brakes and/or propeller pitch and/or reverse thrust, and sustained maximum braking until stopped.

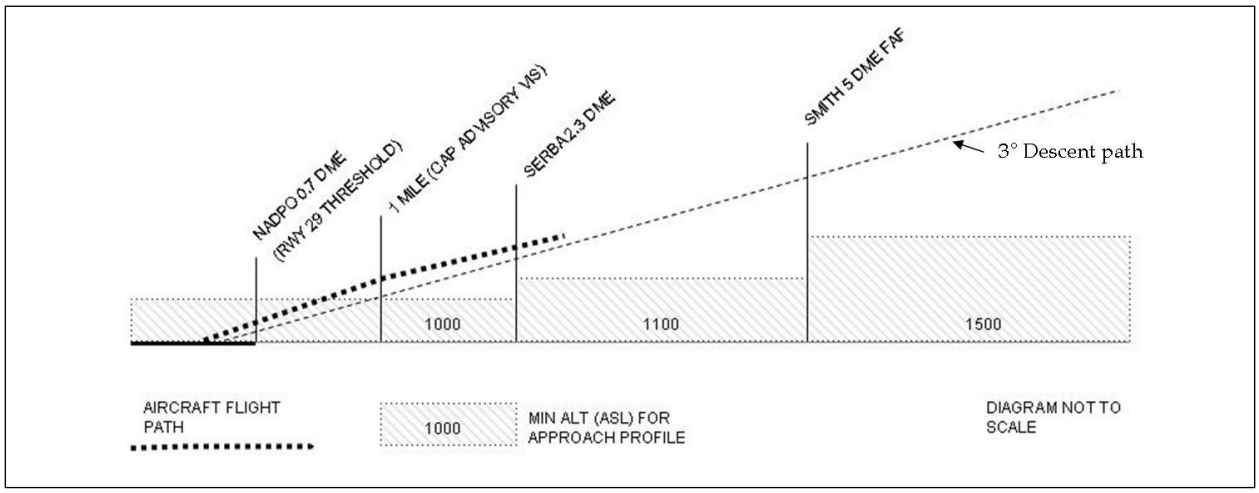

Figure 1. Approach profile

At the 2.3 DME SERBA fix, the aircraft was 200 to 300 feet above the minimum crossing altitude of 1100 feet asl. In accordance with standard operating procedures (SOPs), the crew had added approximately 10 knots to the Vref of 112 knots [5] due to the existence of light ice observed on the engine inlets during the descent.

The reported ground visibility was below the CAP [6] advisory visibility. However, the runway clearway and runway identification strobe lights became visible between 1 and 1.5 DME, and the captain transitioned to visual manoeuvring and called for flaps to be increased from 20 degrees to 35 degrees. At that time, the aircraft was between 1200 and 1300 feet asl, which was 200 to 300 feet above the minimum descent altitude for the approach, and between 0.3 and 0.8 nautical miles from the missed approach point. When the VASIS became visible at approximately 1000 feet from the threshold, it displayed 4 white lights, indicating that the aircraft was above the optimum glide path for a normal touchdown. At that point the aircraft was at 500 feet agl. Engine power was reduced, and the descent steepened in an attempt to regain the optimum glide path on the VASIS. The airspeed increased to between 132 and 137 knots.

When the VASIS became visible, the first officer informed the captain that the aircraft was high on the approach. The approach was continued to the landing and a go-around was not proposed by either pilot.

The aircraft touched down on the centreline of the runway at about 2600 feet from the threshold (see Appendix A - Site Diagram). About 3400 feet of runway remained in which to stop. The touchdown airspeed was at about 120 knots, or 8 knots above the airspeed recommended in the aircraft flight manual (AFM). The power levers were brought to flight idle and after the aircraft slowed to 90 knots, reverse thrust was selected in accordance with flight manual procedures.

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5 Vref is defined as runway threshold crossing speed with both engines operating. It is calculated as a function of aircraft weight and flap setting. (*BAE Jetstream Series 3200 Flight Manual*, section 7)

6 CAP = Canada Air Pilot

Maximum braking with anti-skid was then applied. Braking action was reported to be poor during the landing roll. As the aircraft overran the paved surface, the PF steered the aircraft to the left to avoid the approach lights for Runway 11. During this turn, the right propeller contacted the snow, curling the tips of all four blades. There was no other damage to the aircraft. Steam emanating from the right engine due to snow ingestion was cleared by conducting a venting run on the engine. The passengers were briefed on the situation by the captain and were evacuated by vehicles within 15 minutes.

The Jetstream 3200 AFM indicated a landing distance of 2550 feet for a threshold crossing height of 50 feet to a dry, bare runway, an airport pressure altitude of 1521 feet asl, a landing weight of 14 595 pounds, and a tailwind of 4 knots. Adjusting for a CRFI of 0.34 increased the unfactored landing distance to 4846 feet [7] with a ground roll of approximately 3850 feet. For a CRFI of 0.18, the landing distance was 5695 feet, with a ground roll of approximately 4700 feet.

Re-application of sand to the icy surface following sweeping would have raised the CRFI to approximately 0.30 [8].

The landing distance and ground roll for a four-knot headwind was 2400 feet and approximately 1400 feet on a bare, dry runway. With a headwind of 4 knots, the charted landing distance and ground roll at a CRFI of 0.18 would have been approximately 5400 feet and 4400 feet.

The company SOPs for the Jetstream 3212 stated that the approach speed must not be allowed to exceed 15 knots above applicable threshold speed for normal 35° flap landings, as the risk of exceeding the field length becomes unacceptably high. If it appears that the speed at the threshold will exceed this figure and the runway condition is known to be critical, then the attempt to land should be abandoned. SOPs also stated that for landing on slippery runways, the landing distance required must be calculated using the AFM landing distance chart in conjunction with the CRFI/Crosswind chart. The company did not provide cockpit quick reference charts, with cross referencing to CRFI charts, for calculating the landing distance required. The crew did not consider CRFI adjusted landing distances in the approach brief.

After the occurrence, the aircraft battery power was left on and the cockpit voice recorder (CVR) circuit breaker was not pulled. The portion of the recording covering the descent and initial approach procedures was overwritten and only 3 minutes of the available 30 minutes of recording time was usable for the investigation. Company SOPs did not contain instructions pertaining to preserving post-occurrence CVR data.

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7 From Canadian Runway Friction Index (CRFI) Recommended Landing Distance (Discing/Reverse Thrust) chart, Transport Canada *Aeronautical Information Manual*.

8 From Expected CRFIs by Surface Type chart, Transport Canada *Aeronautical Information Manual*.

Analysis

Advisory visibility is not restrictive for the conduct of an instrument approach at Fort Smith. The crew had no difficulty acquiring adequate runway environment and descent path cues in order to judge the aircraft's position. Although the observed ground visibility was below the advisory visibility for the approach, the crew saw the VASIS at about 1.5 DME, an estimated flight visibility of 1 sm. The visibility did not make a significant contribution to the crew's decision to continue the approach when it became apparent that the aircraft was poorly positioned to land safely.

When the VASIS became visible, the aircraft was above the optimum glide path for a touchdown in the first 1000 feet of the runway. In the attempt to regain the glide path, the pilot allowed the airspeed to increase to at least 20 knots above Vref. By the time the aircraft decelerated to a speed allowing a firm touch-down, a considerable portion of the runway was over-flown. The remaining 3400 feet would have been sufficient for the aircraft to stop on a bare, dry runway after a touchdown at, or near, Vref; however, at a higher touchdown speed on a runway with a CRFI of 0.18 or 0.34, stopping in this distance could not be assured. Conservative CRFI charted landing distances are designed to cue flight crews to consider aircraft performance options for landing. Reference to CRFI charts prior to the approach would likely have prompted the crew of PLR 599 to consider rejecting the landing when the airspeed and height profile exceeded normal parameters.

After landing, the power levers were selected to flight idle. Aerodynamic drag was the only braking action until the aircraft decelerated to 90 knots and full reverse thrust and wheel brakes were selected. Delaying of full braking consumed an additional portion of the remaining runway. Since the coefficient of friction of the runway surface was very low, minimal braking action was available once wheel brakes were applied.

Although the wind at 4 knots was light, it produced a nearly direct tailwind for Runway 29. The difference in charted landing distance on a bare, dry runway with a 4 knot headwind was about 300 feet shorter than that with a tailwind with a CRFI of 0.18. With all other factors in the landing remaining equal, a landing into wind on Runway 11 would have reduced, or possibly eliminated, the overrun.

The crew continued the approach even when it became apparent that the aircraft was high on the approach path and could not land within the first portion of the runway. In accordance with SOPs, the landing should have been abandoned when the approach speed exceeded Vref by 15 knots.

It is likely that the runway maintenance action, completed a short time before the arrival of PLR 599, produced a surface with a low coefficient of friction. Re-application of sand following sweeping would have raised the CRFI and reduced the stopping distance of the aircraft. Because a CRFI reading was not taken following runway sweeping due to the short time available before the arrival of PLR 599, the crew was not aware of the reduction in the coefficient of friction.

Findings as to Causes and Contributing Factors

1. The descent profile on final approach was above the optimal approach path for a landing in the runway touchdown zone. The aircraft landed about 3400 feet from the end of the runway, which afforded insufficient distance to stop on the slippery runway surface.

2. The airspeed during the approach and touchdown was significantly higher than that recommended. This higher speed and the tailwind contributed to the aircraft landing at a point on the runway which afforded insufficient distance to stop.

3. The application of reverse thrust and maximum wheel braking was delayed until aerodynamic drag slowed the aircraft from the touchdown airspeed of 120 knots to 90 knots. The ground roll during that time consumed runway surface available for active braking.

4. Reference to Canadian runway friction index charts prior to the approach would likely have prompted the crew to consider rejecting the landing when the airspeed and height profile exceeded normal parameters.

5. Prior to the landing of PLR 599, runway maintenance removed a light layer of snow and the previously-applied sand. This resulted in a very low coefficient of friction on the runway that was not measured or reported to the flight crew.

Other Finding

1. Following the occurrence, power was not removed from the cockpit voice recorder, which resulted in overwriting of the recording covering the initial descent and early instrument approach. Therefore, cockpit voice recorder information pertaining to that part of the flight was unobtainable for the investigation.

Safety Action Taken

The company instituted an enhanced pilot training program emphasizing crew resource management, conducting stabilized approaches, decision making regarding go-arounds, and airspeed control on approaches. In addition, quick reference charts featuring required landing distance were placed in company Jetstream cockpits, and required landing distance was to be included in pre-landing briefings.

The Board is encouraged by these actions. This occurrence bore many similarities with the Air France runway overrun accident at Toronto's Lester B. Pearson International Airport in 2005. In that accident, issues of pilot decision-making and knowledge of required landing distances played an important role in the outcome. The Board made two recommendations, A07-03 – Pilot Decision Making, and A07-05 – Landing Distance Considerations, in the aftermath of that accident which remain active (accident report A05H0002).

The Fort Smith Airport airfield maintenance specialist stated that he will file runway surface condition reports when doing a visual check of the runway during snow removal operations.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 11 February 2009.

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Appendix A - Site Diagram