AVIATION INVESTIGATION REPORT
A00A0185

RUNWAY OVERRUN

CANADIAN REGIONAL AIRLINES
FOKKER F-28 C-GKCR
FREDERICTON, NEW BRUNSWICK
28 NOVEMBER 2000

Aviation Investigation Report

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Canadian Regional Airlines
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Report Number A00A0185

Summary

A Fokker F-28 MK 1000 aircraft, C-GKCR, serial number 11101, operated as flight 8604 by Canadian Regional Airlines, was on a scheduled, night passenger flight from Toronto, Ontario, to Fredericton, New Brunswick. On board were 42 passengers and four crew members. After landing on runway 09 in Fredericton, the aircraft overran the end of the runway. There were no injuries to passengers or crew, and there was no damage to the aircraft.

Ce rapport est également disponible en français.

Other Factual Information

The en route flight was uneventful. At 0122 Atlantic standard time,[1] the crew advised the Fredericton Flight Service Station (FSS) that they were 18 minutes from the airport and requested current Fredericton weather for their approach. The FSS specialist reported that visibility was as low as 4 statute miles in snow, winds were from 020° magnetic at 7 knots, and the temperature was 0.4°C. The FSS specialist also advised that sweepers were sweeping a thin layer of slush from the centreline of runway 15/33 but that the official runway surface condition (RSC) report was 100% bare and wet. The crew indicated that, since wind were favouring runway 09, they would like runway 09 to be swept. At 0125, 19 minutes before the aircraft touched down, vehicles were cleared to sweep Runway 09.

At 0134, Moncton Area Control Centre advised the FSS specialist that the flight was cleared for a straight-in approach to runway 09, with the option to circle for landing on Runway 33. At 0135, the FSS specialist passed an RSC report for runway 09 to the flight crew. The RSC was reported to be, on a 100-foot centreline, 50% bare and wet and 50% thin slush with ¼ inch of slush on the sides. The crew responded that they received the information, were estimating arrival in five minutes, and had been cleared for a VOR (VHF omnidirectional radio range) approach to runway 09, with the option to circle to the south for landing on runway 33. Since they had the option to land on either runway, the crew requested that snow removal vehicles be cleared from all runways. At 0137, the FSS specialist passed an updated RSC report for runway 15/33 indicating that the runway was 100% covered in wet snow and, on a 100-foot centreline, 1½ inches of slush. The crew were not told that slush was accumulating rapidly on both runways.

At 0138, six minutes before touchdown, the final report to the crew of visibility at the airport was 2 to 3 statute miles, and just before touchdown, the winds were relayed as 010° at 7 knots.

The aircraft flew an uneventful, straight-in, VOR approach. Flap 42 was used for approach and landing, with a landing reference speed (V_{REF}) of 117 knots indicated airspeed. Speed brakes were selected out at approximately 100 feet above ground level, in accordance with standard operating procedures (SOP). At 0144, the aircraft touched down at 118 knots indicated airspeed, approximately 1400 feet beyond the threshold of runway 09, within the touchdown zone. Lift dumpers had been set to auto-deploy on landing. Immediately after the main wheels touched, the captain backed up auto deployment of the lift dumpers by activating the lift dumpers manually. Brakes were applied approximately one second after nosewheel touchdown. The crew sensed that, although braking action was poor, the anti-skid system was cycling. As the anti-skid system was functioning and provides maximum braking performance, the alternate braking system was not used.

The aircraft overran the runway end at 58 knots and came to rest about 320 feet beyond the end of the runway near the airfield perimeter fence. The flight crew reported the overrun to the FSS, shut down engine No. 1, started the auxiliary power unit and selected it, then shut down engine No. 2.

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[1] All times are Atlantic Standard Time (Coordinated Universal Time minus four hours) unless otherwise stated.

Two airfield firefighting vehicles responded to the overrun; the first was cleared onto the airfield at 0145. The first airfield firefighting vehicle arrived on site approximately 1½ minutes after the initial alarm was sounded, and the second arrived about one minute later. The passengers were deplaned in groups and shuttled to the terminal by taxis.

Fifteen minutes after the occurrence, an RSC report on runway 09 showed that most of the runway was covered in ¼ inch of slush. Only the departure end of the runway was still 50% wet and 50% covered in ¼ inch of slush.

The cockpit voice recorder (CVR) and the flight data recorder (FDR) were shipped to the TSB Engineering Laboratory. Playback of the CVR revealed that it continued to operate for more than 30 minutes after the occurrence, overwriting the occurrence information. The FDR yielded useful data, which showed that the flight was routine and that the aircraft touched down on the runway within normal parameters. The data were also used to calculate actual stopping performance achieved during the ground roll. Stopping performance was found to be significantly below that obtainable on a standard wet runway. During the initial part of the landing roll, the deceleration was similar to a deceleration profile for the aircraft without any wheel brake application.

No mechanical discrepancies were found that would have contributed to the overrun. Aircraft loading was within its prescribed weight and balance limitations throughout the flight. Calculated weight of the aircraft at landing was 55 435 pounds. The tires were in good condition and were properly inflated. None of the tires exhibited damage in the form of scuffing or reverted rubber. Intermittent tire skidmarks were found slightly left of the runway centreline, beginning approximately 150 feet before the end of the runway and continuing to the runway end. Wheel brake systems functioned normally during static and dynamic tests conducted after the accident.

The Canadian Runway Friction Index (CRFI)[2] Recommended Landing Distances table was available to the crew; however, readings are not taken for slush-covered runways since CRFI measurements are accurate only for packed snow or ice.

Fredericton Airport is a certified, uncontrolled airport at which FSS specialists operate out of the former control tower. The airport has two runways: 15/33 is 6000 feet long, and 09/27 is 5100 feet long. The asphalt surfaced runways are 200 feet wide and do not have a notable longitudinal slope. Runway 15 has an instrument landing system precision approach and is the priority runway for snow-clearing operations. Runways 09 and 27 are served by non-precision instrument approaches. Runway 33 has no instrument approach. It is possible to circle to land on runway 33 from other runway approaches; however, the weather at the time of the occurrence did not allow for circling.

Charts in the Canadian Regional SOP manual allow crews to calculate landing distances for various weights and CRFI combinations. When a CRFI reading is not available, crews refer to the Runway Surface Condition and CRFI Equivalent chart found in the company SOP or in *A.I.P. Canada* (Figure 1). Using this chart, crews can choose a CRFI equivalent from among typical runway surface contaminants such as water, snow, or ice. This chart does not, however, have a CRFI equivalent for slush contamination.

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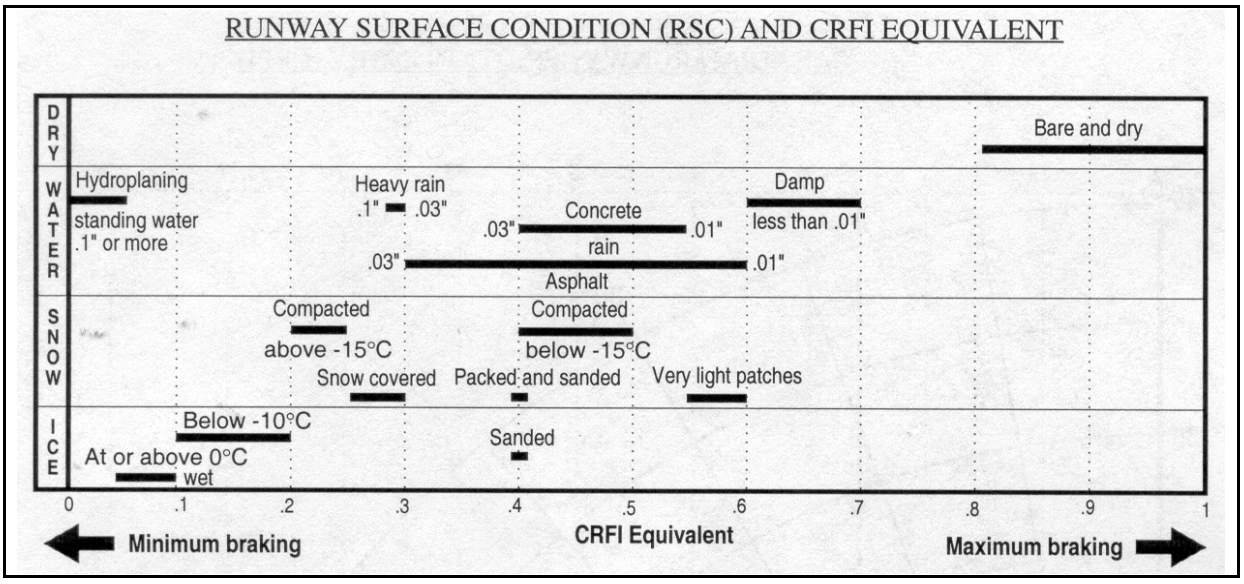
[2] Runway surface condition has a great influence on braking action and, therefore, on stopping distance. A decelerometer measures the coefficient of friction of runways covered in whole or in part with ice or snow. The decelerometer is graduated in increments from 0 to 1, the top number being equivalent to the theoretical maximum decelerating capability on a dry runway. These numbers are referred to as the CRFI.



Although the crew did not have the means to establish a calculated friction index, they estimated that the runway friction was equivalent to the lowest value for a wet runway, .3 CRFI. Using the .3 value and a 2-knot headwind component, the crew calculated a landing distance of 4525 feet for Runway 09. Using the same methods for Runway 15 and applying a 6-knot tailwind component yields a landing distance of 5100 feet.

The Landing on Slush or Snow chart in the SOP manual, which is used to plan flights, provides data on the maximum landing weight for airports reporting slush or snow contamination of up to 0.5 inch. According to this chart, for a 5000-foot runway using flaps 42, the maximum landing weight for the aircraft is 52 600 pounds. The aircraft was about 2835 pounds over this weight on landing. Since conditions at the time of departure did not forecast snow, there was no reason to refer to this chart before departure.

Analysis

The approach to landing was stable, and the aircraft touched down within normal parameters, one knot above V_{REF}. Wheel brakes were applied from shortly after touchdown until the end of the landing roll. Intermittent skid marks on the runway confirm that the brakes were applied and that the wheel brakes and antiskid system were functioning during the landing roll. The tires were in good condition, and post-occurrence testing of the aircraft showed that the brakes functioned normally. Therefore, the poor stopping performance of the aircraft most likely resulted from slush contamination on the runway.

Twenty-two minutes before landing, before the first communication with the Fredericton FSS, weather was suitable for an approach to either runway. The reported winds (020/07) favoured runway 09, giving a slight headwind component compared to a tailwind component on runway 15. The FSS specialist reported that there was a light coating of slush on runway 15/33 that was being swept, and the official RSC was 100% bare and wet. After the crew requested that runway 09 be swept, nothing indicated that the runways would not be usable for landing. The crew likely believed that both runways would essentially be bare and wet and that the aircraft would be able to land safely on either runway.

The RSC for runway 09 reported to the crew about 10 minutes before arrival indicated that the runway centreline was 50% covered in thin slush. The CRFI equivalence chart does not give a value for runways that are partially or fully contaminated with slush. The crew, therefore, had no means of estimating a CRFI equivalence for the landing on runway 09. About 8 minutes before landing, the crew indicated to the FSS specialist that they had the option to land on either runway and requested that the vehicles be cleared from all runways. This suggests that the crew continued to believe that both runways would be usable for landing and that they were not aware that the slush contamination was accumulating on runway surfaces. Seven minutes before landing, the RSC reported to the crew for runway 15/33 indicated that the entire runway surface was covered in slush, eliminating 15/33 as a usable runway. This report could have served as an indication that slush was also accumulating rapidly on runway 09; however, this fact was not made clear to the crew.

RSC reports are a snapshot of runway conditions that exist at the time of the observation. RSC reports do not indicate if a contaminant, such as slush, is accumulating or the rate of accumulation. A considerable amount of slush was noted on the runway 15 minutes after the occurrence. Much of this slush likely accumulated on the swept centreline of Runway 09 during the approximately 10 minutes between the cessation of sweeping on runway 09 and the aircraft's arrival. This amount of slush was not anticipated by the crew and significantly degraded stopping performance from what was expected. When the crew calculated the required landing distances, they assumed a .3 CRFI , equivalent to the lowest value for a wet runway. This assumption was not valid for the slush-contaminated runway, and the crew had no means of establishing a CRFI equivalent.

The following TSB Engineering Laboratory report was completed:

LP 120/2000—FDR/CVR Analysis F-28 MK 1000, C-GKCR

Findings as to Causes and Contributing Factors

1. Slush reduced the stopping performance of the aircraft, and the aircraft was not able to stop in the runway length available.

2. The crew was advised that the landing surface was 50% thin slush and 50% bare and wet; however, their decision to land was based on bare and wet runway conditions.

3. The crew was not advised that slush was accumulating rapidly on the runway surface during the approach.

Findings as to Risk

1. The Canadian runway friction index equivalence chart does not indicate a value for runways contaminated with slush. Crews have no means of readily assessing the effects of slush on an aircraft's stopping performance.

2. Runway surface condition reports do not indicate if a contaminant, such as slush, is accumulating or the rate of such accumulation.

Safety Action

In September 2001, the Transport Canada Civil Aviation Regulation Advisory Council (CARAC) Part III Technical Committee accepted Notices of Proposed Amendments (NPA) 2001-257 and 2001-258. The NPAs introduced new regulations and standards for Aircraft Movement Surface Condition Reporting (AMSCR) operations and Airport Winter Maintenance and Planning. These regulations and standards are meant to improve upon shortfalls in RSC reports and CRFI equivalence charts.

Fredericton Airport will no longer accommodate non-essential requests for snow removal on runway 09/27.

On 14 May 2002, TSB forwarded an Aviation Safety Advisory (A020014) to Transport Canada (TC) regarding the adequacy of RSC/CRFI reporting and crews' knowledge of the limitations of these reports. The advisory suggested that TC consider a means of advising aircrews and other members of the aviation community of the limitations of RSC and CRFI reports, particularly when airport ambient temperatures are near freezing and precipitation or visible moisture is present. It also suggested that TC emphasize that removal of runway contaminants should be a high priority, particularly in these environmental conditions.

On 20 June 2002, a second advisory (A020014-1) was forwarded to TC suggesting that TC consider establishing CRFI equivalents for slush contamination.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 16 October 2002.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.