Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A02A0038

RUNWAY EXCURSION

AIR CANADA REGIONAL AIRLINES (JAZZ)
FOKKER F-28 MK-1000 C-FCRK
SAINT JOHN, NEW BRUNSWICK
27 MARCH 2002

Canada

Aviation Investigation Report

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Report Number A02A0038

Summary

Air Canada Regional Airlines Flight 8610 (TCN8610), a Fokker F-28 MK 1000 aircraft (C-FCRK), serial number 11087, was on a scheduled IFR, night passenger flight from Toronto/ Lester B. Pearson International Airport, Ontario, to Saint John, New Brunswick. On board were 4 crew members and 51 passengers. The en route portion of the flight was uneventful and, at 0030 Atlantic standard time, the aircraft landed on the centreline of Runway 05 at Saint John.

After the nosewheel touched down, the aircraft started to drift uncontrollably to the left and the left main wheels went off the side of the runway for approximately 900 feet before regaining the runway surface. The left main gear track was 15 feet from the runway edge at its furthest point. Aircraft damage was limited to minor cuts in the tires of the right main gear and the nosewheel. There were no injuries to the passengers or crew.

Ce rapport est également disponible en français.

Other Factual Information

Saint John Airport is a certified, uncontrolled airport. The airport has two runways; Runway 05/23, which is 7000 feet long, and Runway 4/32, which is 5100 feet long. Both are 200 feet wide and asphalt surfaced.

At 0006 Atlantic standard time,[1] Air Canada Regional Airlines Flight 8610 (TCN8610) checked in with the Saint John Flight Service Station (FSS), reported that they were estimating arrival at approximately 0030, and requested airfield information for Saint John. The FSS specialist advised that the weather at Saint John was as follows: visibility ¾ mile in light snow; precipitation ceiling at 800 feet; winds from 140 degrees magnetic at nine knots; temperature -2°C; dew point -5°C; and altimeter setting 30.38. The airfield was snow covered and a runway surface condition (RSC) report was being prepared; however, the report was not yet available.

Saint John FSS records indicate that it had started snowing at 2308. The temperature had been fluctuating slightly above and below the freezing point in the hours prior to the snowfall; at 2300, the temperature was 0.1°C. Prior to this snowfall, there had been no precipitation for days and both runways had been 100 per cent bare and dry. Airfield snow removal personnel, off shift at 2300 hours, had departed the airfield. They were recalled shortly after the snowfall commenced.

At 0012, airfield maintenance staff reported to the FSS that the RSC for Runway 05/23 was 100 per cent snow covered up to ¼ inch. The Canadian Runway Friction Index (CRFI)[2] was measured and the average reading obtained for the runway was 0.52. This value is equated with good friction characteristics, approximately equivalent to a wet runway covered with 0.02 inches of water. The RSC report was passed to the FSS specialist who, in turn, attempted to relay it to TCN8610; however, the crew was no longer monitoring the Saint John radio frequency. At 0019, snow removal vehicles were available to start sweeping operations, but because the aircraft was expected to land at 0030, the vehicles were told to remain clear of the landing runway.

At 0020, TCN8610 switched to the Saint John FSS frequency and advised FSS that they were 21 miles back, out of 10 000 feet, and would be conducting an ILS approach via the 17 DME arc to Runway 05. The FSS specialist acknowledged the radio transmission and passed the RSC report for Runway 05 to the flight. The specialist also advised that the sweepers were prepared for a centreline sweep and the time required for the sweep would be 11 to 13 minutes. The crew declined the offer of a centreline sweep of the runway. At about 0022, airfield maintenance reported to the FSS specialist that the non-landing runway (Runway 14/32) was 100 per cent

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

2 Runway friction is measured using a decelerometer; the values given in increments from 0 to 1, with 1 being equivalent to the theoretical maximum decelerating capability (friction) on a dry runway. These values are referred to as the Canadian Runway Friction Index (CRFI).

snow covered to a depth of ¼ inch, with a CRFI of 0.23. This information was not passed to TCN8610, and the crew did not ask for an update of the CRFI before landing. Snow removal vehicles then commenced clearing Runway 14/32.

The aircraft flew an uneventful ILS approach with a landing reference speed (Vref) speed of 117 knots indicated airspeed (KIAS). Flap 42 was used for the approach and landing.

Flight data recorder information showed that the aircraft touched down near the centreline at 0030, at a speed of about 114 KIAS, and on a heading of 054 degrees (three degrees right of runway heading). The nosewheel touched about two seconds later at 106 KIAS. After nosewheel contact, the aircraft heading increased to 065 degrees, while the aircraft drifted toward the left side of the runway. The drift was likely due to the combined effect of the crosswind and a small amount of pre-existing left drift at touchdown. However, the extent to which either contributed to the drift could not be established.

The crew attempted to correct the ground path of the aircraft by using rudder and nosewheel steering inputs; however, the aircraft continued to drift toward the left and off the runway, despite the increased heading to the right. The left main wheels were off the runway edge for about 900 feet, the furthest point of excursion being 15 feet. The aircraft was slewed 15 to 20 degrees right of the runway heading, with the right main gear tracking in about the same path as the nosewheel during the excursion. Partial control of the aircraft was regained as the left main wheels returned to the runway surface. Steering response was still ineffective, and the aircraft continued sliding with the nose slewed to the right as it approached the runway centreline. The crew shut down the left engine at about 60 KIAS and the aircraft aligned with the runway. They brought the aircraft to a stop then taxied to the ramp. During the taxi, the crew advised the FSS specialist that the braking action on Runway 05 was very poor and that they believed the aircraft had come very close to the runway edge.

After the occurrence, ground personnel confirmed that the aircraft had slid off the runway edge. Both runways were cleared, and a subsequent RSC report indicated that there was ⅛ inch of slush contamination on the cleared centre 100-foot portion. Although a CRFI is not normally done with slush, a measurement is taken whenever a runway excursion occurs. The CRFI for the cleared portion of Runway 05/23 was 0.36; for Runway 14/32, it was 0.34. The aircraft did not leave any significant tire skid marks on the runway surface.

After the flight, the crew inspected the aircraft for damage, consulted with company maintenance personnel in Toronto, and then re-inspected the aircraft the following morning. No damage was apparent, and the aircraft departed Saint John for passenger revenue flights to Toronto, Fredericton, and Toronto.

After the aircraft departed for Fredericton, it was discovered that the aircraft tires had struck a runway edge light. Because of snow cover, the broken light had not been noticed immediately after the occurrence. When the aircraft landed at Toronto, small cuts, normally associated with operations from gravel runways, were noted in the right main tires and the tires of the nosewheel. Although the cuts were not sufficient to render the tires unserviceable, the operator replaced them as a precaution. The aircraft braking and steering functioned normally.

Surface conditions have a great influence on the friction characteristics of the runway. Poor friction characteristics will lead to both decreased stopping and steering performance. RSC/CRFI reports are a "snapshot" of runway conditions that exist at the time of the observation. They do not indicate if a contaminant is accumulating, the rate of accumulation, whether melting or freezing is ongoing, or other factors that would help crews to decide on the suitability of the runway for landing.

Transport Canada's Aerodrome Safety Circular (ASC) 2000-002 entitled *Aircraft Movement Surface Condition Reporting (AMSCR) for Winter Operations* describes conditions when RSC reports are required. The ASC states the following:

> The information is to be current, factual, and comprehensive, and is to be provided when:
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> a. there is frost, snow, slush or ice on a runway, a taxiway or an apron;
> b. there are snow banks, drifts or windrows adjacent to a runway, a taxiway or an apron;
> c. sand, aggregate material, anti-icing or de-icing chemicals are applied to a runway, a taxiway or an apron;
> d. whenever the cleared runway width falls below full width;
> e. whenever there is a significant change in runway surface conditions;
> f. following any aircraft accident or incident on a runway, taxiway or apron.

Revisions to RSC reports are required when there is a "significant change" in surface conditions; however, the meaning of this term is not clearly defined by the ASC.

CRFI measurements are accurate only for packed snow or ice. For this reason, measurements are not taken when there is a layer of slush on the runway surface with no other type of contamination condition present. When a CRFI reading is not available, crews can refer to the Runway Surface Condition and CRFI equivalent chart found in the A.I.P. Canada. Using this chart, crews can determine a CRFI equivalent from among typical runway surface contaminants such as water, snow, or ice. This chart does not, however, have a CRFI equivalence value for slush contamination. Without either a CRFI measurement or a CRFI equivalence value for slush, crews do not have a standard means of estimating the effect of the slush on stopping performance, and consequently, must use their best judgement as to the suitability of the runway for landing.

The A.I.P. Canada also contains a crosswind limits table for various CRFI readings. The chart shows that the recommended minimum CRFI for the crosswind, which was 90 degrees at 9 knots, was 0.3. Landing with a CRFI below this minimum value could result in uncontrollable drifting and yawing. The crew had received a CRFI reading of 0.52, well above the recommended minimum CRFI.

The ICAO *Airport Services Manual* states the following:

> Before giving detailed consideration to the need for, and methods of, assessing runway surface friction, or the drag effect due to the presence of meteorological contaminants such as snow, slush, ice or water, it cannot be over-emphasized that the goal of the airport authority should be the

> removal of all contaminants as rapidly and completely as possible and elimination of any other conditions on the runway surface which adversely affect aeroplane performance.

The manual also states:

> In considering the relative merits of measuring the friction coefficient on a compacted snow- and/or ice-covered runway, compared with effective measures to maintain a surface free of any contaminants at all times, it should be noted that immediate removal of snow and ice should receive the highest priority.

Analysis

The left drift continued after touchdown despite both rudder and nosewheel steering inputs. The ineffectiveness of these inputs is indicative of poor runway friction characteristics at landing. The CRFI for Runway 05 had been measured 20 minutes prior to the landing and was reported to the crew 10 minutes before touchdown. Given this relatively short time, the crew would not expect there would be a significant change to the friction characteristics and consequently relied on the RSC/CRFI report to establish the suitability of Runway 05 for landing and the requirement for snow removal.

Although the runways were equally contaminated, the pre-arrival CRFI readings for the two runways were substantially different: 0.52 for Runway 05/23; 0.23 for Runway 14/32. When snow falls onto a surface that is just above the freezing point, it melts and turns into slush. Subsequent snowfall, landing on a now-cooled surface, remains as snow. Runway 05 was visibly snow covered when the CRFI was taken. Melting under the snow cover on this runway either was not detectable at the time of the CRFI run, or happened mostly after the measurement was taken. In either case, the CRFI was considered valid when the measurement was taken, but was not an accurate indication of the runway's friction characteristics at the time of landing. The low CRFI value on Runway 14/32 suggests that a substantial amount of melting was occurring under the snow cover when the CRFI reading was taken. Subsequent sweeping of the runways uncovered the layer of slush that had formed under the snow layer.

The significance of the discrepancy in the CRFIs was not recognized by ground personnel. Consequently, there was no re-assessment of the validity of the Runway 05 CRFI measurement. The RSC for Runway 14/32 was not provided to the crew. It is not known if the provision of this information would have altered their decision to land or require runway cleaning. However, the CRFI and weather information provided to the crew did not suggest that melting was taking place on the airfield or on the landing runway surface. It would seem appropriate that all available RSC information be assessed to ensure that the information provided to arriving crews is valid. Likewise, in situations where runway surface conditions are changing rapidly in temperatures near the freezing point, or where a subsequent CRFI reading on an adjacent surface indicates a significant change in stopping performance, the validity period of RSC/CRFI reports should be restricted.

The CRFI equivalence chart does not indicate a value for runways that are contaminated with slush, and crews have no means of readily assessing the effects of slush on an aircraft's stopping performance. Had the presence of slush been known, the crew would still have been unable to assess its effect on the runway surface characteristics.

As the landing runway CRFI indicated good friction characteristics, the crew was not expecting slippery conditions, and the use of available snow removal equipment was not considered necessary by the crew. The actual runway friction available at touchdown was well below the value reported, and was likely nearer the 0.23 value of Runway 14/32. This value is below the recommended minimum CRFI value for the crosswind. As a result, the aircraft began to drift and yaw uncontrollably after touchdown. Given the differences in RSC reports on the two runways, increased emphasis on the removal of contaminants as rapidly and completely as possible should have received the highest priority.

Findings as to Causes and Contributing Factors

1. The poor friction characteristics of the runway, due to slush contamination, did not allow the crew to correct the aircraft's ground track after touchdown and the aircraft slid off the side of the runway.

Findings as to Risk

1. The significance of the discrepancy in the Canadian Runway Friction Index (CRFI) values between the two runways was not recognized by ground personnel; consequently, there was no re-assessment of the validity of the Runway 05 CRFI measurement.

2. The reported CRFI value of Runway 05 was considered valid at the time it was taken; however, it was not accurate for the time of landing and the crew did not ask for an update. The crew's decisions to forgo runway clearing and proceed to land was based on RSC/CRFI information that became invalid shortly after it was measured.

3. Crews have no means of readily assessing the effects of slush on a runway's friction characteristics.

Safety Action Taken

Transport Canada

On 14 May 2002, the TSB forwarded an Aviation Safety Advisory (A020014) to Transport Canada (TC) regarding the adequacy of Runway Surface Condition (RSC)/Canadian Runway Friction Index (CFRI) 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 the removal of runway contaminants should be a high priority, particularly in these environmental conditions.

TC agrees that more work has to be done on these issues, with TC leading a coordinated effort within the civil aviation community.

On 05 July 2002, a second advisory (A020016-1) was forwarded to TC suggesting that it considers establishing CRFI equivalents for slush contamination.

TC responded to Advisory A020016-1. Current technology does not provide for accurate measurements of the CRFI when taken on a slush-covered runway. Data collection has not demonstrated a correlation between readings taken and actual aircraft landing characteristics, mainly because there are too many variables. Given the above, publishing an equivalent slush CRFI has little meaning and could provide misleading information. TC will publish an article in the Aviation Safety Letter dealing with "landing in slush."

Air Canada Regional Airlines

The operator, Air Canada Regional Airlines, has indicated that it will take the following steps to reduce the likelihood of further runway excursions in conditions where slush might be encountered:

- Publish a Flight Operations Bulletin advising flight crews of the potential for CRFI reports to become invalid quickly after the reading was taken, particularly during changing weather conditions where temperatures are at or near the freezing level and surfaces are contaminated with snow, slush, ice or standing water, or where precipitation or visible moisture is present during the approach and landing.

- Direct crews to consider delaying a landing and consider the validity of CRFI reports only after the runway has been swept giving due consideration to depth of contaminates between the time of the CRFI measurement and the landing. CRFI reports taken prior to the removal of contaminants from the runway should be considered unreliable and extreme caution should be taken prior to landing in such conditions.

- Require crews to confirm the type of runway de-ice treatment used prior to the CRFI being taken on ice-covered runways.

- Include a review of winter operations, with emphasis given to runway conditions, in recurrent ground school and simulator programs.

- Add discussion on aircraft directional energy after break out and prior to landing on contaminated runways to recurrent ground school and simulator training programs.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 December 2002.