

AVIATION OCCURRENCE REPORT

RUNWAY OVERRUN

**KELOWNA FLIGHTCRAFT AIR CHARTER LTD.
BOEING 727-172C C-GKFT
MONCTON, NEW BRUNSWICK
03 APRIL 1996**

REPORT NUMBER A96A0047

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 aircraft, operating as Kelowna Flightcraft (KFA) 280, was on a scheduled night cargo flight from Hamilton, Ontario, to Moncton, New Brunswick. After landing on runway 06 in Moncton, the aircraft overran the end of the runway by 154 feet. There were no injuries to the crew, and there was no damage to the aircraft.

Other Factual Information

The flight crew members of KFA 280 were aware before leaving Hamilton that the runway conditions in Moncton would be a concern because of an ongoing snowstorm in the Moncton area. Snow was accumulating at a rate of about two centimetres per hour in gusty winds, with a steady temperature between zero and minus one degrees Celsius. Runway 06/24 at Moncton, which is 6,150 feet long, was being kept open throughout the night by five airport vehicles doing ploughing and sweeping. The crew added sufficient fuel to the aircraft in order to use Quebec City as an alternate; the weather in Quebec City was clear.

At 0349 Atlantic standard time (AST), 26 minutes prior to touchdown, the flight crew contacted Moncton Air Traffic Control Centre (ACC) and were given the latest weather, runway surface condition, and braking action reports. The weather special at 0335 AST was passed as follows: partially obscured, 200 feet overcast ceiling, visibility 1/2 mile in snow, temperature zero, dew point zero. The runway visual range (RVR) was reported as 3,500 feet with the lights on strength three (before the aircraft landed, the RVR improved to over 6,000 feet with the lights on strength five). The runway surface condition report issued at 2330 AST (4 hours and 45 minutes prior to landing) for runway 06/24 was passed to the crew as follows: 140-foot centre line, 100% snow covered between zero and 1/2 inch in depth, remainder 100% slush between 3 and 18 inches in depth. Braking action reports were passed to the flight crew as follows: various braking action reports through the evening--a McDonnell Douglas DC9, a Boeing 737, and a Convair 580--reported braking action as poor (these aircraft had landed between three and four hours prior to the arrival of the incident aircraft); the latest report was from a second Convair 580 that landed "about an hour ago" and reported braking action as "fair for the type" (this aircraft had landed at 0238 AST).

After the second Convair 580 landed, the crew were asked by the Moncton tower controller for any comments on the braking action. They replied "we were mostly reverse thrust... as far as the amount we used it was fair braking". The tower controller relayed this to Moncton ACC by stating "Braking action fair for the Convair". The Convair 580 crew then relayed further information to Moncton tower, indicating that on the backtrack of runway 06 they "found a few icy patches where it was extremely slippery for the turn-off". The tower controller asked if this was close to the intersection of taxi Delta and runway 06, and the Convair 580 crew replied "That's affirmative, very poor action with numerous ice patches". The tower controller relayed this additional information to Moncton ACC as follows: "The

Flightcraft adds that on the backtracking for the taxiway numerous ice patches where its very slippery". This information was not relayed to the crew of KFA 580. Taxiway Delta is located 3,537 feet from the threshold of runway 06.

At 0401 AST, 14 minutes prior to touchdown, the flight crew of KFA 280 contacted Moncton tower for an updated runway surface condition report and any braking action reports. The tower controller asked the flight crew to monitor Moncton ground frequency and listen in while he obtained a report directly from the field maintenance foreman, who was in one of the vehicles on the runway. The following information was given:

"We got a hundred and twenty foot centre line swept at this time and we are sweeping and ploughing it, it's a hundred per cent snow covered up to a half inch, it's wet snow or slush and outside of that we got snow banks up to three feet."

A review of the Moncton Tower tape revealed that this radio transmission was somewhat garbled. The words "wet snow or slush" were not heard by the flight crew, nor did the crew realize that they had missed part of the transmission. The vehicle operator was not aware that he was being monitored by an aircraft on final approach.

After listening to the above runway condition report from the field maintenance foreman, the tower controller gave the flight crew the following braking action report:

"The last braking action we have was from a ah, that was a Navajo about half an hour ago reported braking action fair, before him was a Gulfstream, a G159 reported braking action fair as well."

When air traffic controllers relay braking action reports given by flight crews, they are required by their manual of operations (MANOPS) to state both the type of aircraft and the time of the report. No times were passed for any of the braking action reports relayed to the occurrence aircraft.

The Navajo referred to by the Moncton tower controller landed at 0307 AST, 1 hour and 6 minutes before the tower controller relayed the information to the incident aircraft, and 1 hour and 14 minutes prior to the landing by the incident aircraft. It was reported to the flight crew that the Navajo had given a braking action report of "fair"; however, the Navajo pilot had not passed a braking action report.

The Gulfstream G159 referred to by the tower controller had landed at 0251 AST, 1 hour and 10 minutes before the tower controller relayed the information to the incident aircraft, and 1 hour and 24 minutes prior to the landing by the incident aircraft. The G159 pilot, replying to a request from the tower controller for a comment on the braking action, had given a one-word comment, "fair".

The field maintenance foreman had determined that, because of the wet snow/slush condition of the runway, it would not be possible to obtain an accurate James Brake Index (JBI) reading on the runway. This information was not passed to the flight crew of KFA 280, nor did the flight crew request a JBI report. There is no requirement for air traffic controllers to inform flight crews that a JBI report has not been issued.

The flight crew used the B727 landing performance chart for wet runways and calculated that the aircraft was more than 40,000 pounds below its theoretical maximum landing weight for the runway length available. They did not attempt to factor in any additional landing distance for a contaminated runway.

Before landing, the flight crew had briefed that, on touchdown, they would do a very quick assessment of the braking action before selecting reverse thrust. If the braking action appeared to be unsatisfactory, they would apply take-off power and not attempt to stop. The approach was stable and the target speeds were met. Although the official weather observation at 0400 AST indicated a ceiling of 200 feet overcast with a visibility of 3/4 mile in light snow, the approach and runway lights were visible to the flight crew at about 200 feet above approach minimums. The main wheels touched down 1,972 feet from the runway threshold. The first officer, who was the pilot flying, thought that the aircraft had touched down closer to the threshold. He attributed the extra distance before touchdown to the fact that he had to align the aircraft in the crosswind conditions, which were 70 degrees to the left of the runway heading at 20 knots.

After touchdown, the flight crew's quick assessment of the braking action was that it was satisfactory. The crew immediately applied full brakes, deployed the spoilers, and selected reverse thrust. As the aircraft slowed, both the captain and the first officer applied brakes (this is acceptable for the aircraft type). It appeared to all three crew members that the aircraft was slowing normally. In accordance with standard procedures, at 70 knots, control of the aircraft was transferred to the captain, and engines one and three were placed in idle reverse. The crew then assessed that the aircraft was no longer slowing normally and they re-applied full

reverse thrust and full brakes. The aircraft stayed in this configuration until it came to a stop in the snow off the end of the runway. As the aircraft exited the end of the runway, it was at "jogging speed" and was no longer slowing. The flight crew reported that the "roll-out" end of the runway appeared to be more slippery than the touchdown portion. That end of the runway also has a slight downslope. When they exited the aircraft, they observed that the ground under the aircraft (in the overrun area) was covered with wet snow over glare ice.

The flight crew reported that all aircraft systems, including the anti-skid system, had functioned normally. No information was available from the cockpit voice recorder (CVR) as the unit was left powered after the occurrence and the tape was recorded over. The aircraft was equipped with a five-parameter foil-type flight data recorder (FDR). There was no information available from this unit because, although such FDRs remain legal for use in Canadian aircraft, there are no longer any FDR readout facilities in North America that have the operational capability to read them.

There are no performance charts in the Boeing 727 Aircraft Flight Manuals to allow flight crews to calculate landing distances on contaminated runways. There is no guidance in the company operating manual to inform flight crews of company policies or procedures for operations on contaminated runways. Tables are available in the Transport Canada *Aeronautical Information Publication* (AIP) to allow pilots to estimate the additional landing distance required for given JBI numbers. A separate table contains average JBI equivalent values for reported runway surface conditions when JBI numbers are not available. This table does not attempt to give equivalent values for runways contaminated with wet snow or slush, as it is not possible to obtain JBI values under such conditions. After the occurrence, the flight crew reported that, had they been aware that the runway was contaminated with wet snow or slush, they would not have attempted the landing.

Analysis

No mechanical discrepancies were found with the aircraft that could have contributed to the occurrence. Also, there was no evidence to indicate that the flight crew members were under any external pressure to attempt the landing. This analysis will focus on the general lack of complete and explicit communications, the flight crew decisions and actions, and the lack of company guidance and aircraft performance information for contaminated runways available to the flight crew.

When the flight crew made their decision to continue with the landing, their assessment of the suitability of the runway was based on incomplete and inaccurate information. There had been numerous opportunities for more complete and accurate information to be collected and passed on; however, for the most part, these opportunities were negated by poor communications. Also, the flight crew did not appreciate that, given that there was a constant snowfall with the temperature near the freezing point, contamination with wet snow or slush was a distinct possibility.

There were several instances where poor communications contributed to this occurrence. When the Moncton ACC controller passed the braking action reports to the flight crew 26 minutes before the occurrence, he did not provide the landing times for the DC-9 and the B737. These aircraft had reported the braking action as poor. Even though these aircraft had landed three to four hours earlier, their assessment of the braking action should have been more applicable to the incident crew than the assessments of aircraft that landed later, particularly given their similarity to the incident aircraft in size and weight, and given that the weather and runway clearing efforts had not changed appreciably in the interim. The low-key manner in which the information from these two aircraft was passed to the flight crew contributed to their dismissing the information as not applicable, so much so that, after the occurrence, they did not even remember these aircraft being mentioned by the controller.

The second Convair 580 that was reported to the flight crew as having landed "about an hour ago" had passed information to the tower controller about very poor braking action and icy patches on the runway where it was extremely slippery. Once again, poor communications kept vital information from reaching the incident flight crew. The information that eventually was relayed to the incident flight crew concerning the Convair 580 (fair for the type) did not accurately reflect either the actual runway conditions or the intent of the message given to the tower controller by the Convair 580 flight crew. What the Convair 580 flight crew had intended to

reflect was that they had used only minimal braking and, therefore, could not provide an accurate assessment of braking action, and that the runway was extremely slippery in spots.

Fourteen minutes prior to touchdown, the tower controller attempted to ensure that the incident flight crew had the most current and accurate information possible by having them monitor a report directly from the maintenance foreman who was working on the runway. During this report, the maintenance foreman stated that the runway was covered with up to 1/2 inch of snow, and that it was being swept and ploughed. He then stated that the snow cover was wet snow or slush. This part of the transmission was heard and understood by the tower controller, but the quality of the transmission was such that these key words were not picked up by the flight crew. A review of the tower tape shows that it is unlikely that the flight crew would have realized that they had missed or misunderstood some of the transmission; therefore, they would not have had reason to ask for the information to be repeated.

The final information passed to the flight crew prior to their landing (braking action "fair" reports from the G159 and the Navajo) served to reconfirm to them that they were landing on a suitable runway. In fact, neither of these reports should have had any relevance to the incident flight crew. In the case of the Navajo, a braking action report had never been made, and in the case of the G159, the braking action report was simply a one-word afterthought by the pilot, with no mention of whether brakes were even used during the landing.

No FDR readout was available to confirm the amount of reverse thrust selected by the flight crew after landing; however, they reported that they used close to maximum, if not maximum, values. By not aggressively targeting to touch down closer to the threshold at the bottom of the glide path (at the 1,000-foot markers), and by taking engines one and three out of full reverse at 70 knots, the flight crew used more runway to stop than they would have had if they used all available deceleration devices to their maximum limits. There are no performance charts available for the B727 to accurately determine a landing distance for the runway conditions that were present during the incident landing. Therefore, it could not be determined if a successful landing would have been possible if the flight crew had used a more aggressive landing/stopping technique.

The flight crew's intention to test the braking action after touchdown before selecting reverse is not an approved and trained procedure for the aircraft. In this case, it is unlikely that their test of the braking action caused any significant delay in applying reverse thrust. However, by having such a procedure as an "out",

flight crews could be influenced to attempt landings on runways of questionable suitability.

The following Engineering Branch report was completed:

LP 45/96 - Flight Recorder Analysis.

Findings

1. Available equipment does not allow accurate measurement of braking action in conditions of wet snow or slush.
2. Incomplete and non-standard communications prevented vital information on the runway condition from reaching the flight crew.
3. Previous landing aircraft did not give detailed braking action reports.
4. ATC MANOPS procedures were not followed when braking action reports were relayed to the flight crew.
5. The flight crew did not adequately assess the potential for contamination on the runway, and did not use all information available to them to make an accurate assessment of the runway conditions.
6. The landing technique used by the flight crew was not consistent with the type of landing technique normally associated with landing on a potentially contaminated runway.
7. Aircraft flight manuals for the B727 aircraft do not provide sufficient information for flight crews to be able to calculate landing distances on contaminated runways.
8. The company operations manual did not provide guidance to flight crews concerning operations on contaminated runways.
9. Information was lost to the investigation because the FDR was old and there was a lack of facilities to read it, and because there was no CVR data available.

Causes and Contributing Factors

Incomplete and inexplicit communications led the flight crew to believe that the runway condition was suitable for landing when it was not. Contributing factors include the flight crew not obtaining and assessing all of the information available to them, and a lack of aircraft performance information and company guidance for operations on contaminated runways.

Safety Action Taken

The company has taken the following safety actions:

1. Supporting documentation and approvals have been obtained to start the change-over of the two remaining foil-type FDRs in their fleet to the newer digital FDRs.
2. A memo to all flight crew has been issued requiring the pilot-in-command to ensure that the CVR and FDR circuit breakers are pulled after landing following an accident or reportable incident. Also, a formal Flight Operations Manual revision covering this subject has been approved and will be issued once it is printed.
3. A memo (96-018) was issued that instructs flight crew to request runway condition reports and JBI readings for all operations on contaminated runways and to ask specific questions of the appropriate agency to ensure that they have an accurate picture of the existing conditions.
4. Memo 96-018 also instructs flight crew, when landing on a contaminated runway, to fly the aircraft firmly to the runway at the aiming point (1,000-foot markers), and, once on the runway with the stopping effort begun, to not attempt a go-around, to use all deceleration devices to the allowable limits, and to not discontinue reverse thrust until a full stop is assured.
5. Memo 96-018 also contains further information on calculating the landing distance required on contaminated runways.
6. The company is actively researching a quick reference type of required landing distance chart.

Transport Canada has taken the following safety action:

1. Transport Canada Civil Aviation has taken the necessary action to ensure that the company's operations manual has been amended to provide guidance to flight crews concerning operations on contaminated runways.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail and W.A. Tadros, authorized the release of this report on 24 October 1996.