AVIATION INVESTIGATION REPORT
A00P0206

RUNWAY INCURSION

AIRBC LTD.
DE HAVILLAND DHC-8-100
AND
HORIZON AIR
DE HAVILLAND DHC-8-200
VANCOUVER INTERNATIONAL AIRPORT,
BRITISH COLUMBIA
25 OCTOBER 2000

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

Runway Incursion

Between
AirBC Ltd.
de Havilland DHC-8-100
and
Horizon Air
de Havilland DHC-8-200
Vancouver International Airport, British Columbia
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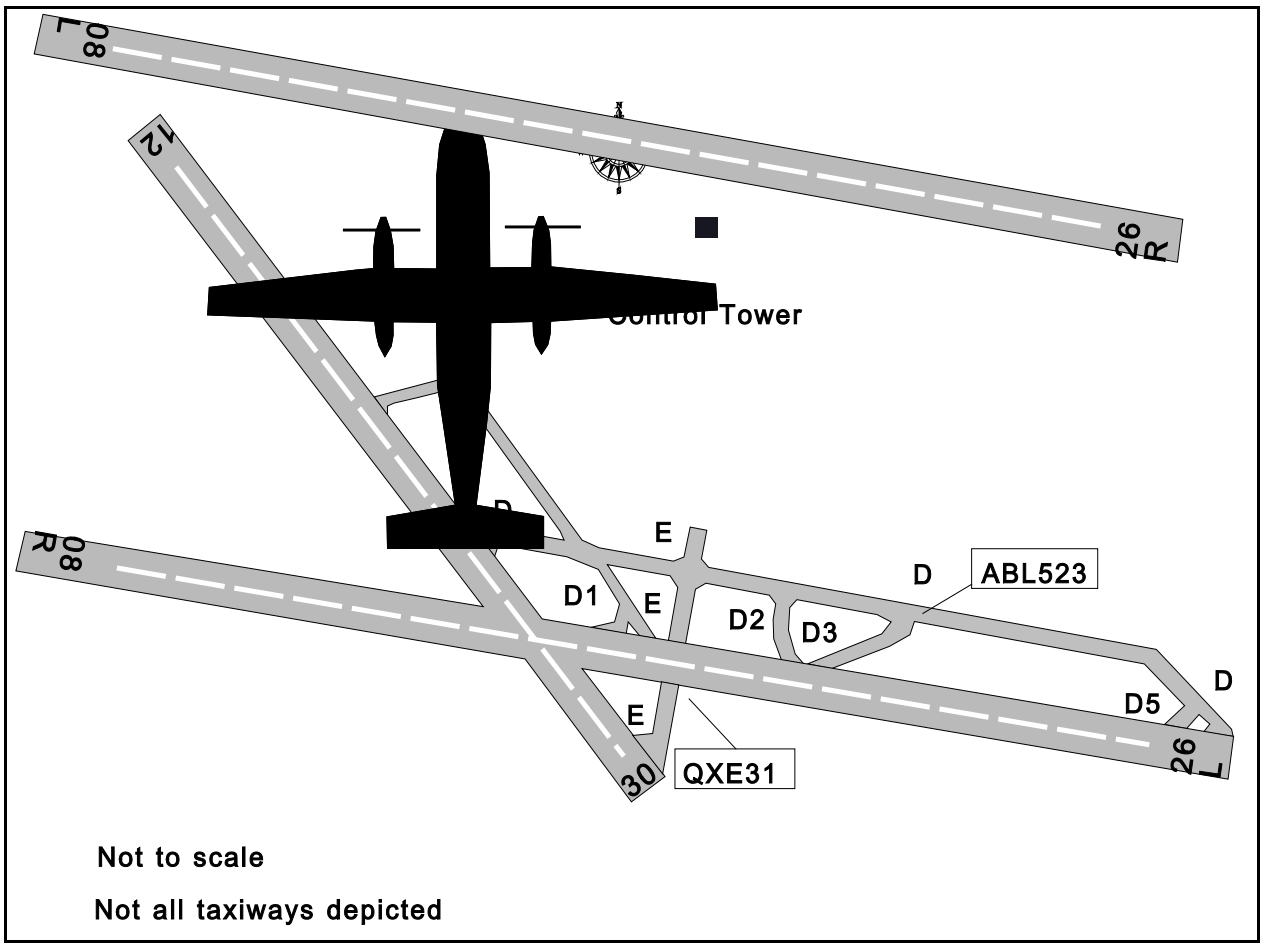
Summary

At 1909 Pacific daylight time, Horizon Air flight 31 (QXE31) was in position on runway 26 left (26L) at taxiway E, awaiting take-off clearance at Vancouver International Airport, British Columbia. At the same time, AirBC flight 523 (ABL523) was taxiing toward runway 26L on taxiway D3 and was approaching the hold line when its crew requested take-off clearance. The tower did not respond to ABL523's request, but cleared QXE31 for take-off. Both QXE31 and ABL523 acknowledged the take-off clearance; ABL523 began an unauthorized take-off run on runway 26L from intersection D3 while QXE31 was taking off ahead. After both aircraft were airborne, the tower instructed ABL523 to fly runway heading and to maintain flight under visual flight rules.

Ce rapport est également disponible en français.

Other Factual Information

Vancouver International Airport is served by two parallel runways, 08R/26L and 08L/26R, and one crossing runway, 12/30. On the night of the occurrence, runway 26L was being used for departures. Runway 26L is an 11 000-foot, hard-surface runway that can be entered from the end or from a number of intersections along its length.



A pilot may request an intersection take-off when the full runway length is not needed. Such a request will normally be approved provided noise abatement procedures, traffic, and other conditions permit. QXE31 had requested departure from intersection E, and ABL523 had requested departure from intersection D3.

When aircraft are being sequenced for take-off from the end of a runway, their position in the queue is readily apparent, because other aircraft are lined up ahead. However, when aircraft are awaiting departure from various intersections along the runway, their sequence for departure will be less apparent to the crew. Aircraft are not normally provided a sequence number for departure by airport or ground controllers, nor is this a requirement.

Radio communication serves a central role in the creation and maintenance of proper situational awareness. The likelihood of successful communications depends on several factors, such as the clarity of the transmitted message, the level of attention of the recipient, the level of comprehension of the recipient, the level of acceptance of the message, and the effectiveness of the feedback from the recipient to the communicator.

Because these factors present a risk of communication error, it is essential to confirm that the content of a transmission has been properly received and understood. This process is often referred to as "readback/hearback" and involves the mutual verification of information passed between a controller and the involved aircrew. Through the readback of an air traffic control (ATC) clearance, a pilot expresses understanding of the clearance and provides the controller the opportunity to identify any errors that might have occurred in the communication. Hearback is the process whereby the controller actively monitors the pilot's readback for deviation from the original instruction. The redundancy provided by this readback/hearback process is an effective measure to reduce communication errors.

Established radio protocols and standardized terminology help reduce communication errors. Distinct call signs identify each flight in a departure queue. Aircrew are expected to listen carefully to any transmissions made by the control agency to ensure that the transmissions are received and that they are acknowledged only by the aircraft to which they are being directed.

The US Aviation Safety Reporting System database shows that verbal information transfer problems account for roughly 85 per cent of all reported information transfer incidents.[1] The imprecision of natural language, coupled with the expectancies of the situation, can sometimes lead to serious misinterpretations of controller instructions. People tend to hear what they are expecting to hear; conversely, they frequently do not hear what they are not expecting to hear. On occasion pilots read back and act on clearances that they were expecting to receive, rather than on the actual clearance parameters given them by the controller. Similarly, a controller may not detect an erroneous readback from the pilot because his or her attention has been diverted to resolving some concurrent, and often higher priority, air traffic control issue. Readback/hearback errors often result in operating irregularities, risks of collision, or other unsafe practices.

The Vancouver ATC tower has adopted a procedure to minimize frequency congestion. Pilots are to monitor the tower frequency when approaching the runway and refrain from initiating a call to the tower to obtain their take-off clearance. The underlying concept is that the tower controller knows that the aircraft is at the hold line for the runway; most of the time, the aircraft will be issued a take-off clearance before having a chance to request it. In the event that the tower controller does not issue a take-off clearance immediately, there are likely specific reasons for the delay (ex. the runway may not be cleared, traffic may be taking off from an intersection, traffic may be on final approach for landing, or a vehicle may be crossing the runway). A waiting pilot may not be aware of these reasons.

The *Air Traffic Control Manual of Operations* requires a controller to ensure, as the originator of a message, that the readback is correct (in those instances when a verbatim readback is required) and to identify and correct any errors in the readback or restate the clearance or instruction in full if there is any possibility of misunderstanding. Verbatim readbacks are only required when a controller is issuing or relaying the following:

A. an instrument flight rules (IFR) clearance or IFR instruction;
B. an amendment to an IFR clearance or IFR instruction; or
C. an instruction to an aircraft or vehicle to HOLD or HOLD SHORT of a runway or taxiway.

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[1] Earl Wiener and David Nagel, eds., *Human Factors in Aviation*, Academic Press, San Diego, California, USA, 1988, p. 284.

There is no stated requirement for a controller to obtain an accurate readback of a take-off clearance. In this occurrence, QXE31 and ABL523 both read back the take-off clearance that was intended for QXE31. The first part of that readback was garbled by interference between the two simultaneous transmissions. The latter portion of the readback was clear and ended with the call sign of ABL523. The tower controller saw QXE31 begin the take-off roll but did not notice, from the aural readback, that the clearance had also been accepted and read back by ABL523.

In Vancouver, ATC has adopted a local procedure whereby the controller will normally include the taxiway designator on which the aircraft is positioned when clearing the aircraft to position or take off from an intersection. This procedure provides an additional defence in that the take-off clearance now includes the aircraft's call sign and its position on the airfield. In this occurrence, the controller did not include the intersection in the take-off clearance directed to QXE31 because the aircraft was already established on the runway and clear of the intersection.

The runway incursion occurred in the darkness approximately one and a half hours after sunset. The weather conditions then were a few clouds at 13 000 feet above sea level (asl), a few clouds at 17 000 feet asl, and a broken layer at 24 000 feet asl. The wind was 310 degrees at 4 knots, and the temperature was about 9 degrees Celsius.

At night, visual acuity in the normal eye decreases significantly, contrasts are less sharp, a central blind spot appears, some depth perception is lost, and the eye must move constantly to achieve accommodation.[2] Furthermore, in the dark the field of vision is narrowed by about one-sixth, and colour perception is adversely affected. Diminished capability of the human eye at night will adversely affect pilots' and controllers' ability to see unlit objects, to identify the location and the motion of objects on the ground or in the air, to judge distances between objects, and, therefore, to maintain good situational awareness based on visual inputs alone.

ATC procedures at Vancouver airport are routinely adjusted to compensate for conditions of low visibility brought on by poor weather. In part, intersection departures are restricted under those conditions, and departing aircraft must normally begin their take-off from the threshold end of the active runway. The tower is equipped with airport surface detection equipment (ASDE), a radar system that is used to monitor the movements of aircraft on the ground. However, there are no routine adjustments to ATC procedures to use the ASDE to compensate for the increased risk of night operations, as is currently done for low-visibility conditions.

Airline procedures often require flight crews to turn on the aircraft's landing lights and strobes after receipt of a take-off clearance. Before that, the aircraft will normally have navigation lights and rotating beacons on (if so equipped). At night, depending on the background, it may be difficult to see another aircraft on the ground when viewing it from the stern quarter. The visible lights from that viewing point will be limited to a small white light on the tail and a rotating beacon. However, once the aircraft has received its take-off clearance, its visibility from the rear increases with the illumination of the strobe light and landing light systems and because the landing lights then reflect off rotating propellers, causing a visible discing effect (as was the situation for the aircraft involved in this occurrence).

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[2] "Accommodation" refers to the adjustments made by the focusing system of the eye to obtain maximal sharpness of the retinal image.

Before this occurrence, a number of similar events had occurred at Vancouver International Airport. In most of those events the unsafe conditions occurred during daylight. They were recognized visually by the involved aircrew or by the involved controller, and action was initiated to resolve the unsafe situations.

Analysis

This event took place during the hours of darkness, under a cloud-covered sky. Therefore, it is reasonable to conclude that the vision of the involved crew and of the tower controller was adversely affected.

The chance of identifying and correcting a runway incursion error, through the use of radio protocols, is directly dependant on the rigour with which those radio protocols are applied. When the crew of ABL523 indicated to the tower that the flight was ready for take-off at taxiway D3, they anticipated that the controller would either clear them for an immediate take-off or direct them to hold. Although the controller heard ABL523's request for take-off, the controller did not respond—because of higher priority tasks. One of those tasks involved clearing QXE31 for take-off from runway 26L with a Richmond 6 departure to 3000 feet. With the exception of the call sign QXE31 at the beginning of that transmission, the entire clearance was exactly what the crew of ABL523 was anticipating.

Because the crew of ABL523 had missed the call sign in the controller's transmission to QXE31, and because the clearance had been transmitted immediately following their request for take-off, the crew believed that the clearance had been directed to their aircraft in response to their request.

When the controller did not correct ABL523's readback of the take-off clearance, the crew took it to mean that the readback had been correct and that they were cleared to take off and follow a Richmond 6 departure to 3000 feet.

Darkness, the controller's focus on the departing aircraft, and other potential workload distractions likely made it more difficult for the controller to notice that a second aircraft had moved onto the runway. It is not known why the controller did not detect the runway incursion by using available ASDE. Darkness and reduced aircraft lighting also degraded the ability of ABL523's crew to see the aircraft on the runway ahead of them until they were on their take-off roll.

Although a number of similar events had occurred at Vancouver International Airport, these events had occurred in daylight, and the unsafe conditions that developed were seen by the involved aircrew or by the involved controller. Once each error was recognized, action was initiated to resolve the situation.

The risk of a runway incursion error occurring is increased with the use of multiple intersections for departure, because several aircraft could be positioned adjacent to the runway and ready for take-off. At night, once an error *does* occur, the chance that the error will be seen is reduced. ATC procedures may not adequately compensate for this increased risk during night operations.

Findings as to Causes and Contributing Factors

1. Expecting its requested take-off clearance, ABL523 accepted and read back a take-off clearance that had been directed to QXE31 and that had not included the taxiway intersection.

2. The tower controller did not recognize that ABL523 had accepted the clearance.

3. Darkness and limited aircraft lighting during taxiing operations adversely affected the controller's ability to see ABL523 taxi onto the runway and prevented the ABL523 crew from seeing the preceding aircraft before the take-off roll was initiated.

Findings as to Risk

1. The opportunity to identify and correct a runway incursion error, through radio protocols, is decreased where there is no requirement for readback/hearback procedures for take-off clearances.

2. The risk of a runway incursion error occurring is increased by the use of multiple intersections for departures.

3. Requiring pilots to refrain from calling the tower to obtain a take-off clearance, while resulting in a less-congested frequency, increases uncertainty and reduces pilots' situational awareness.

Safety Action

The Vancouver air traffic control tower has formalized a procedure of adding the taxiway intersection to the take-off clearance as a second indicator of which aircraft has been cleared to depart. The adoption of this practice should provide an additional defence against this type of operational error.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 30 May 2001.