

AVIATION INVESTIGATION REPORT

A0100299

RUNWAY INCURSION

BETWEEN AVITEC TRACTOR 197

WITH AIRBUS A310 IN TOW

AND

AIR CANADA BOEING 767-200 C-GAUH

TORONTO/LESTER B. PEARSON INTERNATIONAL

AIRPORT, ONTARIO

23 OCTOBER 2001

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

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and

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Summary

Avitec Tractor 197 was towing an Air Transat Airbus A310 aircraft from Terminal 3 on the east side of Toronto/Lester B. Pearson International Airport to the central de-icing facility on the west side of Runway 15L. The tractor driver had received and acknowledged authorization to tow via taxiway Sierra (which crosses Runway 15L) and taxiway Echo, to hold short of taxiway Tango. At the same time, Air Canada Flight 757, a Boeing 767-200 aircraft, was cleared to position on Runway 15L. A minute and a half later, Flight 757 was cleared for take-off. At that moment Tractor 197 was crossing the hold line on taxiway Sierra, proceeding to cross Runway 15L in accordance with his authorization. The tractor driver saw Flight 757 in position on the runway but did not perceive it to be in motion until he was fully onto the runway and in a position where he had no alternative but to continue to cross in order to vacate the runway as quickly as possible. After commencing their take-off, the flight crew of Flight 757 observed the tractor and tow entering the runway. They rejected the take-off, reaching a speed in excess of 90 knots approximately 2500 feet down the runway, 3500 feet from taxiway Sierra. When Tractor 197 cleared the runway, the aircraft had slowed to less than 40 knots and was 1000 feet from taxiway Sierra. Flight 757 cleared the runway at taxiway Sierra.

Ce rapport est également disponible en français.

Other Factual Information

On the morning of the occurrence, the airport started operations using Runway 05 for departures and Runway 06L for arrivals. During the two hours prior to the occurrence, visibility had been 10 to 12 statute miles, the ceiling 5300 feet, and winds generally 120° M at 8 to 9 knots. There had been a brief, very light rain shower at 0738 eastern daylight time¹, just over two hours before the occurrence, during which the winds were 130° M at 10 knots with gusts to 15 knots. The use of Runway 05 was consistent with the Toronto/Lester B. Pearson International Airport (LBPIA) preferential runway policy, which favours the use of 05/06L (or the reciprocals) up to a crosswind component of 15 knots for wet runways and 25 knots for dry runways. Thunderstorms northwest of Toronto caused departure restrictions and delays for aircraft flying to the northwest.

About 30 minutes before the occurrence, a tailwind of 25 knots at 400 feet above ground level (agl) was reported for departures off Runway 05. Ten minutes later, the winds at 2000 feet agl were reported to be 250° at 50 knots, and departing flights began to refuse Runway 05. The departure runway was changed to Runway 15L approximately 10 minutes before the occurrence. Flight 757 was the fourth aircraft to depart from Runway 15L.

At the time of the occurrence, the tower was staffed by a tower supervisor, a tower controller in the South Tower, an on-job trainee (OJT) and an on-job instructor (OJI) in the North Tower position, two ground controllers (north and south ground), and a clearance delivery controller. There is provision for a centre ground controller, but it was not staffed. Tower staffing was consistent with NAV CANADA policy and the controllers were properly qualified for their functions. Shift schedules the preceding day and breaks on the morning of the occurrence were also consistent with NAV CANADA policy.

With the exception of the north ground controller, air traffic control (ATC) workload was neither heavy nor complex. The north ground controller had a heavy workload, though not complex. The runway change, 10 minutes prior to the occurrence, had necessitated amending the departure clearances for most aircraft. In addition, aircraft affected by departure restrictions to the northwest had to be re-sequenced.

At 0939:12, Tractor 197 requested clearance from the Terminal 3 apron to the central de-icing facility. The north ground controller issued authorization that implicitly included clearance across Runway 15L, the active departure runway. He did not co-ordinate the movement of Tractor 197 with the north tower controller. After ensuring that Tractor 197 understood his sequencing behind a taxiing DHC-8 aircraft, the north ground controller was occupied with other taxiing aircraft and with entering data into the extended computer display system (EXCDS). He was unaware of the conflict until he was alerted to the incursion by the clearance delivery controller.

At 0939:08, after clearing the aircraft ahead for take-off, the north tower OJT cleared Flight 757 to position on Runway 15L and at 0940:40, cleared it for take-off. The OJT had scanned the runway before issuing the clearance but did not notice Tractor 197, which at the time was approaching the hold line on taxiway Sierra. The OJI also scanned the runway prior to the take-off clearance being issued; he saw Tractor 197 and assumed that it would hold short. While Flight 757 was on the take-off run, both controllers looked away from the runway to glance at the weather display on the enhanced traffic management system (ETMS) monitor. As the OJI returned his attention to the runway, he saw the crossing tractor and tow at the same time as the clearance delivery controller spoke.

¹ All times are eastern daylight time (Coordinated Universal Time minus four hours).

The first indication of the incursion to ATC controllers in the tower came from the clearance delivery controller, whose position had him facing almost directly toward taxiway Sierra. He happened to glance outside and notice Tractor 197 entering the runway while Flight 757 was on its take-off run. He shouted a warning to alert the tower and ground controllers to the conflict. Realizing that continuing across the runway was the most expeditious way for Tractor 197 to get clear, the north ground controller decided not to intervene. The north tower OJI instructed Flight 757 flight crew to abort the take-off, but they had already begun to reject the take-off and had already made a transmission to that effect to the tower.

The day before the occurrence, the north ground controller requested and was allowed to leave early because of his mother's illness and admission to hospital. The next day, understanding the staffing level to be adequate but not sufficiently flexible to easily accommodate an unplanned absence, he came to work at approximately 0545 for his normal shift. He did not indicate any duress to the tower supervisor and he handled a heavy workload and performed his duties competently during the time leading up to the occurrence.

The north ground controller was aware that the active runway had been changed to Runway 15L. He had issued amended clearances to several aircraft and had seen the first three aircraft depart from that runway. A ramp hold had been imposed earlier while the decision was being taken to change the runway, but it had been lifted by the time of the occurrence. The north ground controller had approximately 10 aircraft, three ground vehicles, and Tractor 197 under his control. One aircraft was inbound to Terminal 3 and was being held on taxiway Alpha between Terminal 1 and Terminal 3 until Tractor 197 could be cleared out of his route.

The driver of Tractor 197 was properly qualified under the Greater Toronto Airport Authority (GTAA) airside vehicle operator (AVOP) program. He had been on duty since midnight, but since he had no calls, he had slept during the night and was well rested. After receiving authorization from the north ground controller to proceed to a point on the other side of Runway 15L, the driver was under no obligation to obtain further clearance to cross the runway and he believed his task was to comply fully and promptly. It was not abnormal to see an aircraft lined up on the runway, and he did not perceive any motion nor did he notice any lights on the aircraft until after he entered the runway. He continued to clear the runway as expeditiously as possible although he was already near the maximum speed at which he could tow.

When Flight 757 was cleared to position, the flight crew turned on their strobe lights and landing lights while they taxied onto the runway. The aircraft under tow had not crossed the hold line when Flight 757 was cleared for take-off. During the initial part of the take-off run, the attention of both pilots was partly directed inside the cockpit. The first officer was first to notice the tractor-plus-tow. Initially, he expected the tractor to stop short of the runway and it took a few seconds before it was apparent that it was not going to stop. The first officer then alerted the captain and they rejected the take-off.

Toronto/LBPIA is equipped with airport surface detection equipment (ASDE) that provides a real-time display of aircraft and other traffic operating on airport manoeuvring areas. It was operating on the day of the occurrence but was not used by the north ground controller nor was it required that it be used in controlling ground traffic.

The Toronto/LBPIA ASDE system is equipped with a feature known as runway incursion monitor/collision avoidance system (RIMCAS), a software enhancement that is intended to provide an alarm in advance of potential conflicts on the runway so that avoidance action can be taken. It does not rely on visual detection, which may not be effective in night or instrument flight rules (IFR) conditions. At the time of the occurrence, the RIMCAS was not on, nor was it required to be as it was not yet commissioned and was used only selectively while false alarm problems were being addressed. It has since been commissioned for operational use after some minor changes to software.

The preferential runway system at Toronto/LBPIA calls for use of Runways 05/23 and 06L/24R, subject to wind and surface contamination limits, for capacity maximization and noise abatement purposes². When Runways 15L and 15R are active, Runway 15L is usually used for take-offs due to GTAA noise abatement procedures. Capacity limitations inherent in the Runway 15 operation result in a greater than normal backlog of departing traffic, congesting taxiways parallel to Runway 15L. In this scenario, the north ground controller usually handles aircraft taxiing for departure. That was the situation at the time of the occurrence.

The main terminals are east of Runway 15L, and the central de-icing facility, and a growing amount of infield ramp facilities are to the west. There is a heavy volume of ground traffic crossing Runway 15L/33R at all times. This ground traffic is also the responsibility of the north ground controller. The control tower at Toronto/LBPIA has provision for a third ground controller (centre ground), intended to relieve workload on the other two ground controllers, typically in adverse weather conditions or when the de-icing facility is in operation. The centre ground controller position was not in operation on the day of the occurrence, nor was it required to be in operation.

Taxiway entrances to Runway 15L/33R are equipped with a stop bar lighting system for use during low-visibility operations on Runway 33R. The stop bar lighting is controlled by the appropriate tower controller. It can only be selected in conjunction with lighting for Runway 33R and cannot be turned on from the Runway 15L control screen. Visibility at the time of the occurrence was good and did not require adherence to low-visibility procedures;

i. e., the stop bar lighting was not turned on, nor was it required to be turned on.

Runway incursions have been recognized as a worldwide problem for some years. In July 1999, the Transport Canada National Civil Aviation Safety Committee (NCASC) formed a sub-committee on runway incursions (SCRI) to develop a national strategy. NAV CANADA undertook a parallel study. The studies shared some common meetings with the aviation community and a panel of experts to review the data.

² NAV CANADA, Toronto Control Tower, Operations Bulletin No. 01-35, Urgent ATS Operational Publication Change Crosswind Operations, 08 May 2001.

According to the Transport Canada SCRI final report³:

traffic volume, capacity-enhancing procedures, and aerodrome layout have been shown to increase the *potential* for a runway incursion . . . [but] *human error* is the mechanism . . . in an actual occurrence”; and,

the majority of Canadian runway incursions are associated with pilot errors.

The report recommended that, “Transport Canada focus on developing preventive strategies for runway incursions that result from *pilot deviations* . . .”. It also recommended, *inter alia*, that:

- 4.5 Transport Canada require that an explicit ATC clearance be given for an aircraft to cross any runway.
- 4.6 Transport Canada ensure that existing “line up and wait” procedures are revised to preclude aircraft from being positioned on an active runway if a take-off delay is anticipated.
- 4.9 Transport Canada develop and implement *common* standards and recommended practices (CAR 322) for all Canadian aerodromes.
- 4.11 In consultation with airport authorities, Transport Canada investigate the viability of an automated runway incursion warning system, using inductive loop or similar technology, that provides a direct warning of an approaching hold line to the pilot.

Transport Canada has formed an incursion prevention action team (IPAT) to oversee the implementation of the common recommendations of these studies and to develop an awareness program. The awareness program commenced with an article in the *Aviation Safety Letter*⁴ issued in October 2001. The article summarized the analysis contained in the Transport Canada report, stated that 23 recommendations were made in the Transport Canada study and 27 recommendations in the NAV CANADA study, and that “many of the recommendations . . . have been . . . or are being implemented”. Specific preventive measures were not identified, and there is no document or statement indicating the status of recommendations—whether they have been accepted or not, or what implementation action is planned.

On 04 October 2001, *Aeronautical Information Publication* (AIP) section RAC 4.2.5 was amended to require pilots to hold short of any runway until obtaining a specific clearance to cross; and to emphasize the pilot’s obligation to acknowledge instructions to *hold short* while taxiing either by reading back the clearance or by repeating the hold point, except that read-back is not required in the case of a *hold short* issued with respect to communications transfer.

³ Transport Canada, *National Civil Aviation Safety Committee, Sub-committee on Runway Incursions*, Final Report, 14 September 2000, TP 13795E.

⁴ Transport Canada, *Aviation Safety Letter*, Issue 4/2001, October 2001, TP 185E.

A Transport Canada *Aviation Safety Letter*⁵ issued January 2002 continued the awareness campaign with an article by NAV CANADA. It outlined the problem, gave examples of runway incursion accidents, and indicated steps being taken by NAV CANADA to address issues within its control. It mentioned that the requirement for pilots to read back hold-short instructions was a result of a recommendation in a 1987 Canadian Aviation Safety Board special investigation. The procedural change, requiring pilots to hold short of any runway until obtaining a specific clearance to cross, was not mentioned in this article nor was it publicized by other facets of the safety promotional campaign.

On 10 October 2001, Transport Canada issued an *Aerodrome Safety Circular*⁶ indicating that Aerodrome Safety was considering the strengthening regulatory requirements for, inter alia, “procedures for access and control of vehicles” and that other initiatives “may be addressed in the future development of part 302 of the *Canadian Aviation Regulations* (CARs) and standard 322⁷ of the CARs”. CAR 302 presently requires airside vehicle operations to be controlled by the individual airport’s operations manual in accordance with “the applicable standards set out in the aerodrome standards and recommended practices publications as they read on the date on which the airport certificate was issued . . .”.

Aerodrome standards and recommended practices are published in Transport Canada TP 312, *Aerodrome Standards and Recommended Practices*: the most recent version was issued in March 1993⁸. It requires that vehicles be operated on manoeuvring areas “only as authorized by the air traffic service unit . . .” It contains no specific direction to the driver, equivalent to the instruction provided to pilots in AIP section RAC 4.2.5, as to the instruction needing to be specific, nor does it explicitly instruct the driver to stop and hold short in the absence of a specific authorization. The driver of Tractor 197 obtained authorization to proceed from the air traffic service unit. He did not receive, nor did the *Aerodrome Standards and Recommended Practices* require him to receive, an explicit clearance to either cross or hold short of Runway 15L.

TP 312, *Aerodrome Standards and Recommended Practices* also refers to TP 2633, *Manual of Airport Traffic Directives for the Operation of Vehicles on Airport Movement Areas* and TP 11465, *Airport Safety Programs Manual*. Both of these publications have been withdrawn. Although they are still used as a basis for individual AVOP programs at various airports, they were applicable only to airports that were owned or operated by Transport Canada. Transport Canada has formed a working group within the Canadian Aviation Regulation Advisory Committee (CARAC) to develop recommendations to ensure a more formal approach to airside vehicle activities.

⁵ Transport Canada, *Aviation Safety Letter*, Issue 1/2002, January 2002, TP 185E.

⁶ Transport Canada, *Aerodrome Safety Circular* ASC 2001-012, “Runway Incursion Initiatives”, 02 October 2001.

⁷ CARs standard 322 does not exist.

⁸ Transport Canada, *Aerodrome Standards and Recommended Practices*, 4th edition, March 1993, TP 312E.

The NAV CANADA report⁹ also analyzed the available data and indicated the following:

A direct correlation exists with traffic volume, and most incursions occur during daylight [visual flight rules] VFR conditions;

Studies have shown that the highest accident potential is during IFR weather conditions or during periods of darkness; and

Pilot deviations represent the highest number of reported incursion events, however, there is very little information collected from the pilots . . . to analyze performance or determine procedural deficiencies [of the air traffic control system].

The NAV CANADA report contained, *inter alia*, recommendations that:

7. airport authorities meet with Transport Canada to discuss an awareness program for airport vehicle operators.

[Note: the Transport Canada report was silent as to an awareness program for AVOPs.]

8. a decision be made by NAV CANADA on the requirement for a standard national incursion warning system [as a defence against forgetfulness which is identified as the most common cause of runway incursions by controllers]. It notes that there is a wide range of alerting devices and memory aids already in place at different locations but that the effectiveness and usefulness of each should be re-evaluated.

14. ATC procedures be modified so that aircraft are *not* taxied into position on a runway if a delay for take-off clearance is anticipated.

18. authorization should be required for all aircraft/vehicles movements to cross runways, whether active or not.

[Note: the Transport Canada report contained a similar recommendation with respect to aircraft but not vehicles.]

22. Airport authorities consider the installation of an inductive-loop system similar to the system in operation at Long Beach, California at high-risk airports.

⁹ NAV CANADA, *Runway Incursion Study at NAV CANADA ATS Facilities*, Final Report, February 2001.

On 18 October 2001, NAV CANADA amended the *Air Traffic Control Manual of Operations* (ATC MANOPS) to require that aircraft and vehicles be instructed to “either ‘cross’ or ‘hold short’ of any runway it will cross” while taxiing or operating on the airport manoeuvring area¹⁰. The taxi authorization given to Tractor 197 did not contain the requisite instruction in accordance with this procedural change.

Analysis

There was no clear reason why the north ground controller gave Tractor 197 authorization to proceed on a route that crossed the active runway without co-ordination with the north tower controller. At the time of the occurrence, he was handling a heavy load of ground traffic, though not complex, mostly taxiing for take-off on Runway 15L. The workload was exacerbated by the need to provide amended clearances to many of the aircraft. He went about his duties competently up to the point of the occurrence. His tasks, although quantitatively heavy, were routine and repetitive. His performance was therefore skill-based, essentially responding automatically to routine demands in a highly familiar, but task-saturated, situation. It was an unconscious momentary lapse of attention that led the controller to authorize Tractor 197 to proceed with an implicit clearance across the active Runway 15L. In skill-based performance, this kind of failure mode is considered to be one of inattention, specifically, a capture error¹¹ wherein the performance of the correct action, that is, the sequence of actions required to clear Tractor 197 across an *active* runway, was interfered with by a stronger habit pattern associated with that runway not being active and, therefore, not requiring co-ordination with the tower controller.

The controller may have been under a degree of personal duress due to the hospitalization of his mother. The tower supervisor was aware of the situation, and, although somewhat surprised that the controller had not requested time off, accepted his decision to work on the day of the occurrence. Prior to the incursion, there was nothing in the controller’s behaviour or performance to indicate to the tower supervisor or to his co-workers that he was having any difficulty or was otherwise unfit to perform his normal duties.

The amendment to the ATC MANOPS requiring that aircraft and vehicles be instructed to “either ‘cross’ or ‘hold short’ of any runway it will cross” while taxiing or operating on the airport manoeuvring area had become effective five days before the occurrence. The controller was aware of it. Clearances given to other aircraft conformed with the new requirement. The lapse of awareness that led the controller to overlook the fact that the route of Tractor 197 crossed a runway, also led him to omit an explicit instruction to cross or hold short. The requirement to provide an explicit clearance may serve as a defence against pilot or vehicle operator inattention, but it is ineffective against a lapse on the part of the controller. Also, it is clear from the Transport Canada report that the requirement for specific ATC clearance across all runways was targeted against pilot inattention, not air traffic controllers.

The recommendation in the NAV CANADA report that authorization be required for all aircraft *and vehicle* movements to cross runways, whether active or not, has the potential to offer an effective defence against controller error or forgetfulness. The pilot/vehicle operator would serve as an independent safeguard against a lapse, such as committed by the controller in this case, by holding short until getting an *explicit* clearance to

¹⁰ NAV CANADA, Ref AVNE5400-102-8, Urgent ATS Operational Publication Change. Effective date 18 October 2001, Subject: Taxi Authorization to Aircraft and Vehicles.

¹¹ Transportation Safety Board of Canada, *An Integrated Process for Investigating Human Factors*, Appendix A, Failure Modes.

cross. Such a level of defence is not assured by implementation measures to date. The present requirement in the AIP addresses only pilots and only when taxiing for departure. There is no corresponding requirement for pilots taxiing to the ramp after arrival, nor is there a national regulatory means to impose the same requirement on vehicle operators.

The procedural change adopted by NAV CANADA, requiring that controllers give an explicit clearance to aircraft and vehicles to cross any runway, whether active or inactive, was accompanied by a regulatory change by Transport Canada requiring that pilots hold short of any runway, whether active or inactive, unless they have an explicit clearance to cross. The regulatory change was published in the AIP as part of the 84-day revision that involved numerous routine page replacements without any mention, conspicuous or otherwise, to heighten awareness that one page mandated a new procedure to prevent incursions. Without more conspicuous presentation, such as in the *Aviation Safety Newsletter*, this change may not have been noticed by some pilots. The procedural change by NAV CANADA was not mentioned at all in the *Aerodrome Safety Circular* or other material sent to airport operators.

In response to the SCRI recommendation for a comprehensive awareness program, Transport Canada, under the auspices of IPAT, has undertaken promotional activities to increase awareness of the problem and to encourage adherence to incursion prevention measures. Issues such as signage and markings have been highlighted, but new measures such as the procedural/regulatory change have not. The *Aviation Safety Newsletter* and AIP are distributed directly to pilots. The media that are relevant to vehicle operators, such as the *Aerodrome Safety Circular*, posters and a video, are distributed to airport operators and depend on voluntary initiatives and local programmes in order to reach vehicle operators. They are not necessarily effective in creating awareness amongst airport vehicle operators.

Awareness of potential conflicts by vehicle drivers is limited by them being on a different radio frequency than the aircraft being cleared for take-off, with the result that drivers are unaware of the precise status of arriving and departing aircraft. It is normal practice for ground traffic to remain on the ground control frequency rather than changing to the tower frequency for clearance across active runways. The ground controller co-ordinates crossings of active runways with the tower controller; this means that no one outside the control tower, specifically the operators of vehicles or taxiing aircraft, has sufficient situational awareness to offer an effective defence in the event of error in the control tower.

When Runways 15L/33R and 15R/33L are in use, the overall ATC workload in the tower appears to be reduced because of their lower overall capacity, compared to simultaneous parallel operations from Runways 05/23 and 06L/24R. While the capacity limitation reduces the quantity of traffic being handled by tower controllers, it has the opposite effect on ground controllers because of the backlog that builds up on the ground. When Runways 15L/R are in use, the backlogged ground traffic from all three terminals is concentrated on the north ground controller. The north ground controller also has to handle ground traffic crossing Runway 15L, with the added workload of coordinating with tower and closely monitoring the runway

crossing. As a result, the north ground controller experiences an inordinately high workload when Runway 15L is active. This situation is not recognized as cause to activate the centre ground controller position or to offload runway-crossing traffic to the tower controller.

As commissioned, the RIMCAS provides a “stage 1” alarm, a visual indication on the ASDE display but no audible signal, when an intruding aircraft or vehicle passes the runway edge in good visibility or 100 feet back from the runway edge in poor visibility. A “stage 2” audible alarm sounds only when the aircraft taking off exceeds a speed of 60 knots. Had the RIMCAS, in this configuration, been operating at the time of the occurrence, it probably would not have alerted tower controllers early enough to allow them to warn the flight crew before they detected and reacted to the incursion on their own. That warning may have been insufficient to prevent an accident had the intruder been closer to Flight 757 on its take-off run.

This occurrence has resulted in some changes at Toronto/LBPIA with regard to vehicle operators, as a result of changes made by the GTAA to procedures that are within their purview. The lack of a national AVOP program inhibits the dissemination of lessons learned to other airports.

Findings as to Causes and Contributing Factors

1. The north ground controller inadvertently cleared Tractor 197, with an Airbus A310 aircraft in tow, across the active runway at the same time as Flight 757 was cleared for take-off by the north tower (on-job trainee) controller. The north ground controller clearance to Tractor 197 did not contain an explicit instruction to ‘cross’ the runway as required by the *Air Traffic Control Manual of Operations* (ATC MANOPS), nor did the north ground controller co-ordinate the movement of Tractor 197 with the north tower controller.
2. Task saturation of the north ground controller, as a result of weather delays and a runway change, likely contributed to his momentary lapse of attention.
3. Airside vehicle operators are not required to stop and hold short of runways, as are pilots, if they do not have an **explicit** clearance from ATC to cross that *specific* runway. As a result, vehicle operators do not serve, as do pilots, as an independent defence against air traffic control error.

Findings as to Risk

1. There is a high volume of traffic between east-side terminals and the infield and central de-icing facility to the west of Runway 15L/33R at Toronto/Lester B. Pearson International Airport. This is a hazard with the potential for serious consequences at night or in poor visibility.
2. The north ground controller has an inordinately high workload whenever Runway 15L is in operation. A third ground controller position (centre ground) is available for certain high-workload situations, but is not typically used when Runway 15L is in use.

3. Transport Canada's runway incursion prevention program is focused on pilot deviations; NAV CANADA's is focused on controllers. Present efforts to promote awareness of the runway incursion problem do not communicate directly with, and therefore do not necessarily reach, airside vehicle operators.

Other Findings

1. There is no automated runway incursion warning system, such as inductive loop or similar technology, that warns pilots directly of incursions; the runway incursion monitor/collision avoidance system (RIMCAS) may not provide sufficient warning to prevent an accident.
2. Ground traffic crossing an active runway is not changed to the frequency of the controller controlling that runway and is therefore unable to hear clearances given to aircraft taking off or landing.
3. With the discontinuation of TP 2633, *Manual of Airport Traffic Directives for the Operation of Vehicles on Airport Movement Areas*, there is no national standard that regulates airside vehicle operations.
4. The runway incursion prevention program, influenced by the statistical predominance of pilot deviations in day VFR, does not necessarily address underlying hazards to night and IFR operations.
5. The awareness program including the *Aviation Safety Newsletter* has not publicized new procedures and regulations recently adopted as preventive measures against runway incursions. As a result, the recent changes concerning clearances across runways may have gone unnoticed.
6. Explicit information is not available as to the status of the recommendations of the Transport Canada subcommittee on runway incursions or of the NAV CANADA runway incursion study.

Safety Action

The TSB held a meeting with the Greater Toronto Airport Authority (GTAA), at which it was suggested that the GTAA may wish to consider having airside vehicle operators get explicit clearances across all runways, consistent with the NAV CANADA instruction to controllers and *Aeronautical Information Publication* (AIP) section RAC 4.2.5 requirement for pilots. The GTAA responded very quickly by issuing an urgent safety bulletin outlining the requirement and emphatically requiring that the vehicle operator ***must stop short*** of the mandatory hold line for a runway, whether active or inactive, if he does not have a specific authorization to proceed¹².

¹² GTAA, Airport Operations Bulletin No. 01-11-005, Urgent Safety Bulletin: AVOP Radiotelephone Procedures: Crossing or Operating on Active or Inactive Runways, 26 November 2001.

NAV CANADA has considered activating the centre ground controller position when Runway 15L/33R is active. NAV CANADA does not plan to implement a third ground controller on a regular basis. The third ground controller is implemented *when staff is available* under adverse weather/traffic conditions. This is the procedure that has been in practice during the three years prior to the occurrence.

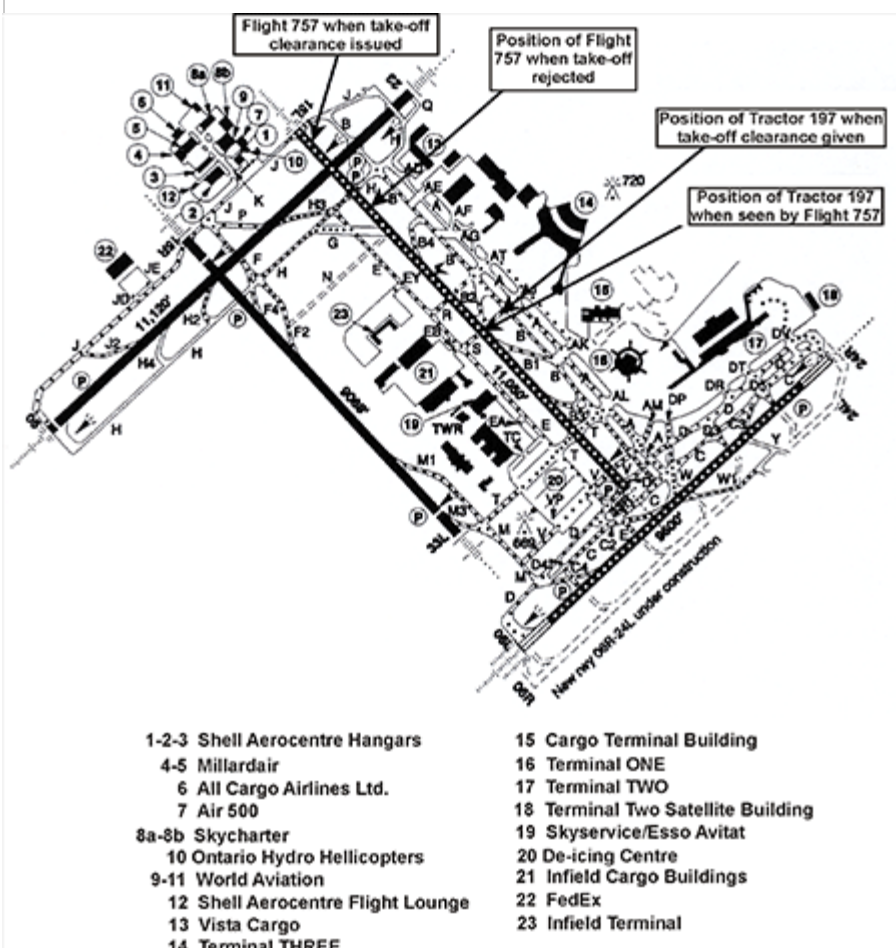
NAV CANADA considered requiring vehicle traffic crossing runways to be on tower frequency rather than ground frequency. A limited trial was conducted, constrained by some vehicles not having tower frequency. It resulted in an unacceptable increase in controller workload, and crossings of non-active runways distracted the controller from the active runway.

Transport Canada has recognized the need to update Canadian Aviation Regulation 302 and TP 312, *Aerodrome Standards and Recommended Practices*, regarding airside vehicle operations. New draft regulations and standards were presented to the Canadian Aviation Regulation Advisory Committee (CARAC) Part III Technical Committee in April 2002 proposing to strengthen the regulatory requirements with respect to, *inter alia*, procedures for access and control of vehicles. The documents are now at a working group level for final recommendations for improvements.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 05 December 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.

Appendix A - Airport Diagram with Positions of the Aircraft and the Tractor



1. All times are eastern daylight time (Coordinated Universal Time minus four hours).
2. NAV CANADA, Toronto Control Tower, Operations Bulletin No. 01-35, Urgent ATS Operational Publication Change Crosswind Operations, 08 May 2001.
3. Transport Canada, *National Civil Aviation Safety Committee, Sub-committee on Runway Incursions, Final Report*, 14 September 2000, TP 13795E.
4. Transport Canada, *Aviation Safety Letter*, Issue 4/2001, October 2001, TP 185E.
5. Transport Canada, *Aviation Safety Letter*, Issue 1/2002, January 2002, TP 185E.
6. Transport Canada, Aerodrome Safety Circular ASC 2001-012, "Runway Incursion Initiatives", 02 October 2001.
7. CARs standard 322 does not exist.
8. Transport Canada, *Aerodrome Standards and Recommended Practices*, 4th edition, March 1993, TP 312E.
9. NAV CANADA, *Runway Incursion Study at NAV CANADA ATS Facilities*, Final Report, February 2001.
10. NAV CANADA, Ref AVNE5400-102-8, Urgent ATS Operational Publication Change. Effective date

18 October 2001, Subject: Taxi Authorization to Aircraft and Vehicles.

11. Transportation Safety Board of Canada, *An Integrated Process for Investigating Human Factors*, Appendix A, Failure Modes.

12. GTAA, Airport Operations Bulletin No. 01-11-005, Urgent Safety Bulletin: AVOP Radiotelephone Procedures: Crossing or Operating on Active or Inactive Runways, 26 November 2001.