AVIATION OCCURRENCE REPORT

A97H0002

RISK OF COLLISION

BETWEEN AVIONAIR INC.

SWEARINGEN AVIATION METRO II C-GBXX

AND AIR CANADA

CANADAIR LTD. CL-600 REGIONAL JET C-FSKI

OTTAWA/MACDONALD-CARTIER

INTERNATIONAL AIRPORT

12 MARCH 1997

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

Aviation Occurrence Report

Risk of Collision

between
Avionair Inc.
Swearingen Aviation Metro II C-GBXX and
Air Canada
Canadair Ltd. CL-600 Regional Jet C-FSKI
Ottawa/MacDonald-Cartier International Airport
12 March 1997

Report Number A97H0002

Synopsis

At approximately 0751 eastern standard time, Air Canada Flight 330 was cleared to position on runway 25 at the Ottawa/MacDonald-Cartier Airport. Immediately thereafter, the airport controller on duty was relieved by another controller. Approximately five minutes later, Avionair Inc. Flight 403, conducting an instrument approach to runway 25, was cleared to land while the Air Canada flight was still holding in position on the runway. While descending through 200 feet above ground, the Avionair flight crew saw the Air Canada aircraft on the threshold. The Avionair flight crew initiated a missed approach and landed uneventfully at 0818.

The Board determined that a risk of collision occurred as the result of an ineffective controller handover procedure. Contributing to this occurrence were the following: no method other than memory was used to ensure the completeness of the handover briefing; the relieving controller did not adequately monitor incoming communications; the location of the airport surface detection equipment monitor was inadequate for airport controller use; there was no standard method by which controllers kept track of uncompleted critical actions; there were deficiencies in the management and supervision of the unit; and NAV CANADA audit procedures of the unit were inadequate.

Ce rapport est également disponible en français.

Figures

1.0 Factual Information

1.1 History of the Flight

Air Canada Flight 330 (ACA330), a passenger flight with 2 flight crew, 1 cabin crew and 12 passengers on board was scheduled to depart Ottawa for Washington, DC, at 0700 eastern standard time (EST), but was delayed because the aircraft needed to be de-iced.[1,2] At 0749:08, the crew of ACA330 advised Ottawa Tower that they were holding short of runway 25, and that they would be ready for takeoff in a few minutes. At 0751, the crew informed Ottawa tower that they were now ready for takeoff, and the airport controller cleared the aircraft to position on runway 25. Runways 25 and 32 were in use for landing aircraft, and all departing commercial aircraft were taking off on runway 25. An airport controller handover, commonly called "transfer of position responsibility," was effected between 0751:46 and 0752:05. The out-going controller did not advise the relieving controller that ACA330 was in position on runway 25.

At approximately 0754:36, Avionair Flight 403 (ANU403), a cargo flight on a direct flight from Mirabel, Quebec, to Ottawa, was handed over to tower from the approach terminal controller. The flight advised the airport controller that it was inbound to runway 25 on a localizer back course (LOC BC) approach. At 0755:38, the controller cleared ANU403 to land on runway 25, and ANU403 acknowledged the clearance. Radio communications with ANU403 were in French.

During the approach the crew of ANU403 levelled off at the minimum descent altitude of 800 feet above sea level (asl), 427 feet above ground level (agl). Because of the low visibility, the crew did not see the runway environment until they were approximately one mile from the threshold, where they resumed the descent. As the aircraft descended through approximately 200 feet agl, the crew noticed that there was an aircraft on the threshold of runway 25. ANU403 advised the controller and began a go-around procedure. The crew completed a second approach and landed uneventfully on runway 25.

1.2 Injuries

There were no injuries as a result of this occurrence.

1.3 Damage to Aircraft

There was no damage to either aircraft.

1.4 Other Damage

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1 See Glossary at Appendix B for a list of acronyms.

2 All times are EST (coordinated universal time minus five hours) unless otherwise noted.

There was no other damage.

1.5 Personnel Information

1.5.1 Flight Crew

The respective companies indicated that the flight crews of both aircraft were certified and qualified for their respective flights in accordance with existing regulations.

1.5.2 Air Traffic Controllers

Airport Controller Position	Controller Being Relieved	Relieving Controller
Age	30	48
Licence	VFR[3]	VFR
Medical expiry date	1 August 1997	9 December 1997
Experience		
- as a Controller	10 months	16 years
- as an IFR Controller[4]	N/A	N/A
- in present unit	10 months	14 years
Hours on duty prior to occurrence	1.25	1.25
Hours off duty prior to work period	15	15

1.5.2.1 Relieved Airport Controller

The relieved controller qualified as a VFR Ottawa airport controller on 24 May 1996. He was subsequently involved in two operating irregularities, which prompted management to provide him with additional training. He re-qualified on 17 October 1996. He stated that he was well rested, under no abnormal stresses, and in good health at the time of occurrence. Records show that his performance was satisfactory following his re-qualification.

[3] Visual flight rules

[4] Instrument flight rules

1.5.2.2 Relieving Airport Controller

The relieving controller had 16 years' experience in tower operations. He stated that he was in good health, properly rested, and under no undue stress at the time. He was the tower supervisor at the time of the occurrence. He was also the unit training officer, and in this capacity he was responsible for conducting the tower familiarization course for each new trainee posted to the establishment.

1.5.3 VFR Controller Training Requirements

The tower familiarization course consists of a few days in a classroom, and includes discussion of the material that is on the knowledge verification test (KVT). The Air Traffic Control (ATC) Manual of Operations (MANOPS), Article 119.3, specifies that each air traffic services (ATS) employee who is required to perform operational duties is required to complete the KVT at least once annually. Further, the Air Traffic Services Administrative and Management Manual (ATSAMM), Article 251.8, directs that unit managers ensure that operational personnel under their control demonstrate that they meet the unit operational knowledge requirement by successfully completing the applicable KVT for their operational positions "at least once annually." Annex "C" to that order specifies that failure to achieve a pass mark will normally require removal from operational duties.

The relieving controller stated that he had not completed the KVT for the last three years or more, because during this time period he had been the unit training officer. There were no recent KVT result records found in his file, and there was no unit directive or order found that exempted unit training officers from the requirement to write the KVT. Queries with two other ATS units confirmed that all their operational controllers, including designated instructors and unit training officers, write the KVT.

1.6 Aircraft Information

ACA330 flight was a Canadair Ltd. CL-600 Regional Jet, serial number 7068, registered as C-FSKI. ANU403 flight was a Swearingen Aviation SA-226TC Metro II, serial number TC293 registered as C-GBXX. The respective crews reported that, at the time of the occurrence, there were no aircraft system anomalies that could have affected this occurrence.

1.7 Meteorological Information

The aerodrome forecast (TAF) for the period 0700 to 1000 called for the following: temporarily, ½ statute mile prevailing visibility in light snow, and a vertical visibility of 1,200 feet. No significant meteorological reports(SIGMETs) were reported for the area, although a series of special weather reports (SPECI) were issued at 0724, 0750, 0754, and 0805. Special weather reports issued at such close intervals normally indicate rapidly changing ceiling and/or visibility conditions.
The tower received a pilot report (PIREP) at 0750 from a landing aircraft indicating that the threshold of runway 25 was visible from approximately one mile back. The 0754 SPECI issued four minutes before the occurrence reported ¾ mile prevailing visibility in light snow showers, with a reported vertical visibility of 1,200 feet. By 0805, the snow shower had passed, and that SPECI reported a prevailing visibility of 10 miles.

1.8 Aids to Navigation

There were no reported problems with the aids to navigation within the terminal control area (TCA) for the time of the occurrence, and all of the approach aids to runways 25 and 32 were serviceable.

1.9 Communications

1.9.1 General

There were no communications equipment discrepancies noted or reported that would have contributed to the occurrence, and neither aircraft experienced communications malfunctions or difficulties.

From the time of the transfer of position responsibility until the incident occurred, five aircraft were on the tower frequency. At the time of the occurrence, two had landed, CDN901 and KNX9910, and were on the ground control frequency, and three were on the tower frequency, ANU403, ACA330, and C-GBAF, a light aircraft on the north field.

1.9.2 Regulations Concerning the Use of Both Official Languages

The Ottawa tower is a bilingual unit, required to communicate only in the language initially chosen by the aircraft (MANOPS 754.1), unless:

1. a specific request is received from the aircraft to change to the other language; or,

2. it is considered necessary for safety of flight. A MANOPS note adds that safety of flight may be considered in jeopardy if communications appear to be misunderstood.

Bilingual service is provided as required from all operating positions in the tower. Controllers are required to mark the strip appropriately with a high-lighting marker to indicate that the flight has chosen to use French. The strip for ANU403 was appropriately marked, and on handover from approach control, the airport controller communicated with that aircraft in French. The flight crew of ANU403 were bilingual; the flight crew of ACA330 were unilingual English.

The controller spoke French when he cleared ANU403 to land on runway 25, and the crew of ACA330, on the same frequency, did not understand that communication. Approximately 10 seconds later, the controller asked ACA330 "you're with me and ready, confirm?" ACA330 replied "Yeah, Air Canada three-thirty is in position, ready to go, 25." The controller acknowledged this call and advised ACA330 that there would be a short delay for their departure, as he had another aircraft to land first. The crew of ACA330 assumed that the aircraft referred to was landing on runway 32. The crew of ANU403 did not react to these transmissions by ACA330 and the controller.

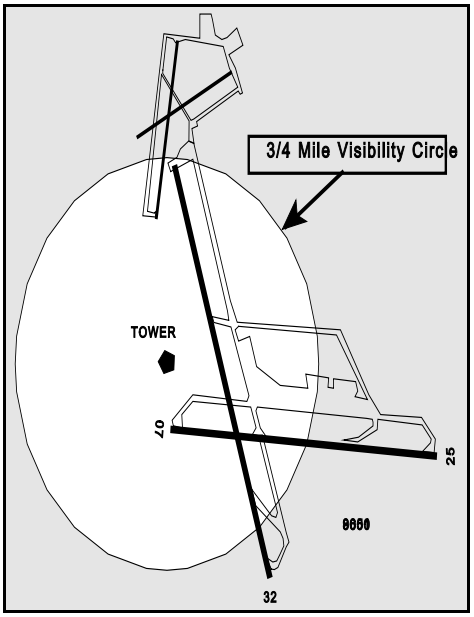
A TSB survey of the three major ATS units in Quebec was conducted to ascertain whether bilingual service in

air-ground-air communications was a factor in any operating irregularities that occurred in that province over the last two years. The survey consisted of a verification of the results of fact-finding boards (FFBs) and operating irregularities reports on file. There was nothing found to indicate that language was a causal factor in any incidents. Therefore, it was concluded that, for the time period covered by the survey, the bilingual issue was seldom, if ever, a factor in air proximity events.

1.10 Aerodrome Information

1.10.1 General

The Ottawa/MacDonald-Cartier International Airport has two main runways, used primarily by commercial carriers, and two secondary runways at the northwest end of the field, used mainly by small aircraft and the resident flying schools. The orientation and length of the major runways are depicted on the accompanying diagram. The distance from the tower to the threshold of runway 25 is approximately 8,100 feet. A visibility of 3/4 mile prevents the airport controller from seeing the threshold and first half of runway 25, as depicted by the shadowed area.



The runways and taxiways were generally covered by a light coat of snow because of a local snow shower at the time of occurrence. The snow blended the airfield surface with that of the surrounding area. Moreover, the upper surface of the Regional Jet was painted white, and the flight crew of ANU403 reported that the white aircraft on the snow-covered threshold was difficult to discern.

1.10.2 ATC Tower

The ATC tower, operated by NAV CANADA, was erected in 1990 and operations began in December of that year. The tower structure and cab are located to the west of the intersection of the two main runways. This location provides a good view of the approaches to runways 25 and 32, weather permitting, and a fair to good view, because of the distance and background, of the north field.

1.10.3 ATC Tower Personnel Manning

The Ottawa tower manning is established for five operating positions: operational support specialist (OSS); clearance delivery; ground control; airport control; and, supervisor. The supervisor is responsible for the safe operation of the shift and replaces any of the four other positions as the need arises, such as during breaks, provided the current and anticipated workload permits. No provision is made to back-up the supervisor when he is required to fill any of the positions during a vacancy, nor is there a procedural requirement to do so. All of the positions can be interchanged during a shift except that of the OSS, as this position is not filled by a qualified controller; however, qualified controllers can fill the OSS position. During light activity periods, two positions can be combined, allowing the supervisor to fulfil his primary supervisory function without having to work a control position. Traffic volume and complexity were respectively assessed as being light and moderate at the time of the occurrence. No positions were combined at the time, therefore the supervisor was required to occupy the airport controller position when the latter went on a break.

1.11 Flight Recorders

Data from the flight recorders were not retrieved because the information was not required for the conduct of this investigation.

1.12 Wreckage and Impact Information

There was no wreckage.

1.13 Medical Information

The medical records for the two ATS specialists were up to date, and indicated that both were in good health at the time of their examinations. Medical records for the flight crew were not verified.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Not applicable.

1.16 Tests and Research

None were conducted.

1.17 Unit Equipment and Procedures

1.17.1 Airfield Surface Detection Equipment (ASDE)

1.17.1.1 General

The Ottawa airport is equipped with an ASDE radar system, which was reportedly functioning properly at the time of the occurrence. The ASDE is specifically designed to detect aircraft and vehicular traffic on the surface of an airport, and to present this image in the control tower, via one or more monitors. The ASDE is designed to detect a target as small as a passenger car anywhere on the displayed surface, and controllers reported that the ASDE monitor accurately reflected airfield traffic at all times. The primary purpose of the ASDE is to augment visual observation by tower personnel of aircraft and/or vehicular movements on runways and taxiways, especially during times of reduced visibility and at night. The radar antenna and its associated rotating structure for the ASDE are mounted on top of the tower cab.

1.17.1.2 ASDE Monitor Location

During the construction of the tower, it was realized that one of the three posts used to support the roof structure of the tower cab obstructed the Airport controller's ability to observe the intersection of the two main runways. As it was no longer possible to move the offending post, the Airport controller's position was shifted approximately eight feet to the right in order to alleviate the situation and to provide optimum visibility. At the time of the occurrence, ASDE information was displayed in the cab on a single monitor, located near the ground controller. A second ASDE monitor was in storage. Because of his distance from the monitor, the airport controller could not easily view the ASDE information.

Reportedly, airport controllers had complained on a number of occasions about the poor positioning of the ASDE monitor. Unit management had also, on a number of occasions, verbally requested that maintenance personnel install the second monitor next to the airport controller's position as a matter of priority.

1.17.1.3 MANOPS Directives and Procedures Pertaining to ASDE

MANOPS 307.1 states that controllers are to use the ASDE to augment visual observation of the manoeuvring areas under the following conditions:

1. at night;
2. when visibility, for any reason, is less than the most distant point of the manoeuvring area; and,
3. at any other time when, in the opinion of the controller, an operational advantage will be gained.

MANOPS 30 7.2 further states that the controller *may* use ASDE derived information to:

1. determine that a runway or taxiway is clear of aircraft, vehicles or obstructions prior to a landing or a take-off;
2. confirm the location of aircraft and vehicles on the displayed airport manoeuvring area;
3. provide directional instruction to pilots and vehicle operators on the displayed manoeuvring area when requested by them, or when deemed necessary by the controller;
4. confirm compliance with control instructions to aircraft or vehicles operating on the displayed manoeuvring area; and,
5. provide directional instruction to crash, fire and rescue vehicles manoeuvring on any displayed area, as necessary.

1.17.1.4 ATSAMM Directives Pertaining to the ASDE

ATSAMM Article 213.3 states that the unit manager shall develop local procedures to enable airport controllers to determine that the runway is clear whenever operating during restricted visibility or at night. Article 214.1 states that the unit manager shall develop local procedures incorporating the direction provided in 213.3 and specify any additional restrictions or operational limitations applicable at their respective sites; there were no such amplifying procedures found in the unit's operations manuals.

1.17.1.5 Action by the Controller

After assuming the airport control position, the relieving controller glanced at the ASDE and saw a radar return on the taxiway adjacent to the threshold of runway 25, where he expected AC330 to be. This radar return was in fact a DC-9 waiting for departure. The controller did not leave his position to obtain a better view of the ASDE monitor and never saw the radar return for ACA330 on the threshold.

1.17.1.6 Past Safety Action Regarding Control Tower Layouts

In its March 1990 special investigation report into Air Traffic Control Services in Canada, the Canadian Aviation Safety Board (CASB) concluded that "the current lack of integration of information required airport controllers to monitor several displays and information sources to make critical decisions." It was noted in one Transport Canada Fact Finding Board (FFB) report that the controller had to move 15 feet from his work station to visually check the ASDE display. In view of the inefficiencies in the layout of airport controller's information displays, the CASB recommended that:

> The Department of Transport accelerate the improvement of control tower layouts with a view to implementing an ergonomically efficient configuration.
>
> (CASB 90-07)

The Minister of Transport responded by stating that implementation was ongoing. Transport Canada Publication TP210, *Control Tower Site and Design Standards*, had been updated and would be re-issued by December 1990. Through the Transportation Development Centre, the Department of Transport would determine how technology and ergonomics could best be applied and integrated in control tower workstations, and that a study was underway to determine the optimum presentation of radar information in control towers. Transport Canada Publication TP210 was re-issued one year later than planned. At the time of the occurrence, the TSB was not aware of any changes to ergonomic presentations as a result of the Transportation Development Centre study.

1.17.2 Unit Procedures

1.17.2.1 Transfer of Position Responsibility Procedures

MANOPS 113.2 directs that the relieving controller perform the following actions during the pre-relief monitoring process:

- observe operational situations and equipment;
- listen to communications;
- observe current and pending aircraft and vehicular traffic;
- verify the position relief checklist;
- correlate information; and
- indicate to the controller being relieved that the position has been previewed and you are ready to begin the verbal briefing.

After the briefing, the relieving controller makes a statement, or otherwise indicates to the controller being relieved, that position responsibility has been transferred. MANOPS 113.3 states that after the transfer, the controller being relieved shall remain for monitoring
purposes jointly with the relieving controller. During this time, the relieved controller is to reinforce the position relief briefing and assist the relieving controller in becoming familiarized with the position. MANOPS 113.4 states that the pre-relief and post-relief overlap time requirement shall be based on traffic volume and complexity, and that each controller is to use his best judgment in evaluating the situation and taking the

appropriate time to effect a complete change of information. The survey of other ATS units showed that, although each transfer is unique and must be treated separately, a monitoring time of two minutes is considered the maximum amount of time a relieved controller would normally remain behind to monitor the position during periods of light traffic.

In this occurrence, the relieving controller indicated to the controller being relieved that the position responsibility had been transferred by unplugging the latter's headset from the communications jack, and plugging his own headset in – extra jacks are available for additional headsets to be plugged in as required. The relieved controller, believing the relieving controller now had the whole picture, left the tower cab without delay, not verifying that his colleague now had the complete airfield traffic picture.

Management personnel at Dorval, Mirabel, and Quebec City airports stated that when an aircraft has been cleared into position on an active runway by a controller about to be relieved, the transfer of responsibility is not normally effected until that aircraft has been cleared for take-off. During occasions where the transfer must occur while an aircraft is holding position on the active runway, the relieved controller would monitor until that aircraft has been cleared for take-off. The Montréal/Dorval tower has specific written guidance to this effect in their unit operations manual, in accordance with ATSAMM Articles 203.3 and 203.4. No such guidance was contained in the Ottawa ATC operations manual.

1.17.2.2 Use of a Transfer of Position Responsibility Checklist

ATSAMM Article 203.3 states that the "Regional Director, ATS (RDATS) shall ensure that unit guidelines are developed, which provide direction for controllers and specialists to follow, at the time of transfer of position responsibility." Article 203.4 also provides the same direction to unit managers, and further states that unit managers shall develop a checklist for each operational position, to be used at the time of transfer of position responsibility. The note to this Article states that the following items may be included in the checklist, as appropriate:

- potential conflicts, arrival and departure information, and traffic patterns;
- status of NAVAIDs and communications, etc.;
- flow restrictions;
- special use airspace;
- NOTAMs;
- PIREPs;
- airport status, RSC/JBI, NOTAMs, etc.; and
- weather (impact on traffic).

A checklist incorporating the above items was available at the console for the OSS, ground control, and clearance delivery positions, but none was found at the airport control position. During the visit to the tower by the investigation staff, where airport control transfer of position briefings were observed, the checklist was not being consulted. When queried as to the location of the checklist for that position, none of the controllers remembered seeing it in the recent past, and it was remarked that the checklist had likely been missing for quite some time. The investigation could not clearly establish whether the transfer of position responsibility checklist

was in place or not at the time of the September 1996 unit evaluation; however, Officers who conducted the Ottawa unit 1996 evaluation clearly stated that the transfer of position checklist was at the airport controller's console at that time.

Within the unit, it was felt by some individuals that the decision to require the use the checklist was likely a "knee-jerk" reaction to a previous operation irregularity. Some controllers stated that each has his own way or sequence of ensuring that essential items are covered during transfer of position briefings, and that a checklist may not work best for everyone.

In another recent TSB investigation, A95A0046, the Board found that sub-standard work practices can result from not taking advantage of mandatory tools or aids, like a checklist. The report on that occurrence stated that checklists can be useful tools to promote both efficiency and safety, especially in circumstances where a series of critical actions must be routinely carried out. To fulfil their aim, checklists must be designed and located so as to be useful to the user.

1.17.2.3 Handover Procedure

During the investigation it was determined that neither controller was happy with the handover procedure. The handover was characterised as "sloppy," there was some preoccupation with the intensity of the approach lighting on runway 32, and there were assumptions made regarding each other's knowledge of the situation. Both controllers later noted that the use of the checklist would have reduced the likelihood of the occurrence.

1.17.2.4 Use of Headsets by Controllers During Transfer of Position

The Ottawa tower communications setup allows controllers to listen to incoming radio communications on personal headsets or via a common speaker system. Most controllers prefer to use headsets, as it reduces distractions and background noise.

At the time of the occurrence, the controllers were communicating with aircraft using headsets. Only those who wear a headset and who are plugged into the appropriate communications jack can therefore listen to incoming communications, although one can generally listen to outgoing communications when standing close to the controller on duty. Relieving controllers are required to listen to communications during the pre-relief period. As stated previously, there are extra plug-in jacks available.

The relieving controller did not have his headset plugged in during the pre-relief period; therefore, it was not possible for him to hear ACA330 request the clearance for takeoff. Although he was standing behind his colleague, he did not hear him clear the aircraft to position on runway 25. He was also considering a request from a local light aircraft on the north part of the field for special VFR authorisation. In any case, he was not aware that ACA330 had been cleared to position on runway 25.

The MANOPS directives pertaining to radio communications during transfer of position responsibility stipulate that the relieving controller shall, among other requirements, observe the operational situation during the pre-relief monitoring period, and listen to communications. A review of procedures in use at this and other

towers revealed that it was uncommon for relieving controllers to plug in their headsets during the pre-relief period, unless traffic volume and complexity were high. A number of airport control handovers were observed by the investigators during a visit to the tower. The relieving controllers were not observed plugging their headsets in during the pre-relief monitoring period. The intent of the MANOPS directive to listen to communications during the pre-relief monitoring period was, thus, not always heeded at this and at other units.

1.17.2.5 Flight Progress Strips

In work situations where safety critical information must be remembered and acted upon, special procedures are often devised. A performance aid, or job aid, is any device that a person uses to ensure completion of an activity. It is designed for immediate use, and can assume a wide variety of physical forms, or may be written or computer-based. A performance aid helps by reducing the cognitive processing requirements of an activity; thus, it serves as an aid to memory, it improves efficiency and reliability of performance, and it improves safety. Performance aids provide the most benefits where completion of the task is critical, and where the consequence of error can be serious. They are also most effective when normal verification methods or sensory perception is not available, or is reduced.[5] A performance aid that provides a single message can easily be used by many individuals.

Errors can still happen when a standardized performance aid is used; however, it is important to note that when an error is made with the same performance aid used by all, the error is more likely to be captured because all the individuals in the group understand the implications of the performance aid. Conversely, when different individuals use their own, unique performance aids for a particular activity, the potential for teamwork is compromised.

[5] R.W. Bailey, *Human performance engineering: Using human factors/ergonomics to achieve computer system usability* (Englewood Cliffs, N.J.: Prentice Hall, 1989).

MANOPS provides specific direction to IFR controllers with respect to flight progress strip manipulation and marking. One of these directions concerns "strip-cocking," a method which involves lifting the corner of the strip holder out of the strip bay. This reminds the controller that further action has yet to be performed regarding a particular aircraft under his control. There are no specific rules or guidelines that apply to strip-cocking in VFR operations. Some airport controllers cock the strip as a reminder that an aircraft is on an active runway without a take-off clearance. Some controllers never cock the strips, while others use different mnemonic methods. The relieved controller had cocked the strip for ACA330 to remind himself that he had cleared the aircraft to position on runway 25, and that the aircraft was now obstructing that runway. The relieving controller never used this method, and he did not notice the cocked strip cue as he took over from the other controller. Discussions during the investigation revealed that the majority of airport controllers do not feel that a standard is required in this respect, rather that each controller should be allowed to use whatever works best for him or her; management supports this view.

On 1 February 1991, two aircraft collided on the runway at Los Angeles Airport. The National Transportation Safety Board (NTSB) of the United States investigated this catastrophic accident, and their report on the collision contained the following: "The Safety Board believes that there is no existing automated monitoring system on which a tower can rely to ensure that human performance errors will always be detected." The report also states that local and ground controllers must rely almost totally on their eyes, ears and memory to perform their duties. The NTSB believed that "any job aids and procedures, such as strip marking and flight strip forwarding, which are designed to improve each airport controller's performance, should be adopted and emphasized, repeatedly, until other independent, automated systems become available."

1.18 Organizational and Management Information

1.18.1 TC's ATS Standards Division Audit and Inspection Responsibilities

Prior to 1 November 1996, NAV CANADA prepared for the transfer by Transport Canada (TC) of the air navigation services and its existing ATS operational units. The privatization process included an application for an ATS Operations Certificate to meet the regulatory requirements to operate air traffic control units and flight service stations across Canada, starting 1 November 1996. All 136 ATS units were transferred and certified in time for the privatization, with the understanding that NAV CANADA's operational units would be the subject of an "Air Traffic Services audit" by ANS Inspectors under a ministerial delegation of authority.

On 1 November 1996, the Government of Canada sold the assets and transferred the responsibility for the operation of Canada's civil air navigation system to NAV CANADA. Since then, TC's role in this regard has changed from that of owner, operator and regulator to that of

regulator alone. Concurrent with the privatization of the air navigation services, TC's Air Traffic Services Standards Division of the Air Navigation Services and Airspace (ANS&A) Branch became, in part, responsible for overseeing the ATS provider's compliance with Part VIII of Canadian Aviation Regulations.

Initial ATS audits are conducted, in the form of a site manual verification by ANS Inspectors, following the Minister's approval of an ATS Operations Certificate, or following the addition of an operational unit to be listed on the same ATS Operations Certificate. Other ATS audits are conducted as required. ATS inspections are the subject of separate activities.

In order to ensure the continued safe operation of the Canadian air navigation system, TC has created the Office of Air Navigation Services and Airspace Safety Oversight, tasked with the custody of the air navigation and airspace safety oversight policy and program. The goal of the safety oversight function is to advance safety by:

- continuously monitoring the national civil air navigation system and environment;
- reducing the likelihood of accidents and incidents; and
- discouraging non-compliant behaviour or practices.

TC Audit results are forwarded to NAV CANADA for information and corrective action, as required.

1.18.2 Unit Management Supervision and Turnover

The unit manager of the Ottawa Tower/Terminal Control Unit (TCU) had been in the position for two years. Since January 1992, there had been four different unit managers and six different operations managers in the unit.

1.18.3 NAV CANADA's ATS Audit Organisation and Evaluations

The Director, ATS, is the functional specialist responsible for the ATS function in Canada and the integrity of the National system. The Chief, ATS Monitoring and Evaluations, is the functional specialist charged with the responsibility of assessing the integrity and effectiveness of ATS operations, including the extent of adherence to, and appropriateness of, existing policies, standards and procedures. The Chief authorizes headquarters ATS evaluations officers to conduct, on an ongoing basis, the evaluation of all ATS units. The evaluations division comprises the Manager, a Superintendent ATC, seven ATC inspectors, a Superintendent FSS, three FSS inspectors, one clerk, one secretary and a statistical systems analyst.

General direction and information by which the ATS evaluations division conducts its activities is contained in ATSAMM Section 260, Unit Evaluations. This direction is amplified in ANS Policy Document 100.204.2. The evaluations division also uses document NP7993, ATS Evaluation Guidelines, in the conduct of unit audits. Evaluations of ATS units are to ensure that provision of service is maintained at the highest standard; and that all units and personnel apply in an approved manner the policies, standards, rules, procedures and separation minima.

ATSAMM 263 directs that routine evaluations of ATS units shall be conducted at least every three years, and

an interim evaluation at each major location and other selected units shall also be carried out when necessary. During evaluations, identified problems or deficiencies are reported as "Items of Consequence." This term defines a practice which has an impact on the system, or is a deviation from the standard or approved procedure. Corrective action is required for all identified items of consequence. ATSAMM 266.5 requires that each Regional Director, ATS, advise the Chief, ATS Monitoring and Evaluations, of the status of action taken with respect to identified problems within 60 days of receipt of an evaluation report, and at 90-day intervals until all outstanding items have been resolved. Follow-up evaluations are carried out, normally within 12 months, when a unit is found to not meet the standard.

The Evaluation Guideline states that evaluation officers will, among other activities, monitor operations by whatever means are appropriate. No amplifying details of this general directive are found in the available documentation, other than in ATSAMM 262.2, which gives a general overview of the scope of evaluations. In the absence of specific procedures, there is scope for variation from evaluator to evaluator, with the consequent possibility of a safety item being overlooked.

1.18.4 Ottawa ATS Routine Evaluations

There was an evaluation of the Ottawa ATS in 1992 and a subsequent evaluation in September 1996. The second evaluation occurred two months prior to the transfer by TC of the air navigation services and its existing ATS operational units to NAV CANADA. Although the responsibility for the follow-up action to this latter TC evaluation became that of NAV CANADA, it should be noted that the personnel performing both functions remained essentially the same.

One observation in the 1992 evaluation was that only one ASDE monitor was in place in the tower, and that a second one in storage should be installed by the airport controller's console. The 1996 evaluation report identified the failure to install the second ASDE monitor in the cab as a deficiency to be corrected. The report further commented that this deficiency had also been reported in the 1992 unit evaluation, and had thus remained uncorrected for more than four years. At the time of this occurrence the second monitor was not installed. No paper work was found indicating that any follow-up action on this deficiency had been taken in the intervening years between the two evaluations, and no documentation could be found in the unit files pertaining to the requirement that the second ASDE monitor be installed without delay.

The 1996 review of management contained the following observation: "The lack of management continuity has had a detrimental influence on morale and unit administration." The review also uncovered two items of consequence directly associated with supervision by management. The first one, rated as a major deficiency, was that there were no apparent controls in place to ensure that operational personnel demonstrated proficiency. The second observation, assigned a regular category, indicated that there was no position responsible to verify licence validation certificates for supervisors.

A review of the1996 evaluation revealed that the following procedural deviations, uncovered during the course of this occurrence investigation, were missed during that evaluation:

- the relieving controller's KVT annual exam had not been completed for at least three years;
- no unit documentation could be found on the amplifying guidelines the unit manager is required to provide to enable airport controllers to determine that the runway is clear whenever operating during restricted visibility or at night, including any additional restrictions or operational limitations applicable at his site; and
- no unit documentation could be found on the amplifying guidelines the regional and unit managers are required to provide with respect to the transfer of position responsibility.

In all, the 1996 evaluation identified 12 items of consequence requiring a response from the Regional Director, ATS, by 29 November 1996. A verification with NAV CANADA on 30 April 1997 revealed that the required response had not yet been sent to the Chief, Evaluations. Further, there was no indication that the evaluations division had queried the lack of response.

1.18.5 Past Safety Action

The 1990 special investigation CASB report into Air Traffic Control Services in Canada concluded that:

> the current staffing crisis [in 1990], the frequency of serious ATC operating irregularities, the forthcoming implementation of significant equipment enhancements, forecast traffic growth for the next decade, and anticipated high staff turnover, all suggest a need for an extraordinary effort to ensure the maintenance of quality control. Therefore, the CASB recommended that, during this highly dynamic period:
>
> > The Department of Transport increase its efforts for monitoring ATC operations through unit evaluations to ensure consistent application of prescribed standards and procedures.(CASB 90-48)

Transport Canada responded to this recommendation as follows: "All efforts will be made to maintain the unit evaluation cycle. When resources permit, the cycle will be increased to ensure compliance with national policies and to ensure the consistent application of prescribed standards and procedures." It is worth noting that although an *increase* in monitoring levels was recommended, the TC response stated that efforts would be made to *maintain* the cycle, and that it would be increased when resources permitted. The TSB was recently provided with documentation from the former Transport Canada ATS Evaluations Branch, dated January 1993, which proposed downsizing the unit evaluation program for all units. This proposal was submitted to the then-Director ATS for his approval. This approval was reportedly granted. During the period 1991 to the present, ATSAMM 263 has not been amended to reflect the changes that occurred to the evaluation cycle policy during that time frame. NAV CANADA stated that, effective September 1997, it has modified the ATS unit evaluation cycle to a two- or three-year cycle, depending on the unit, and that the Ottawa tower/TCU is now on a two-year evaluation cycle.

2.0 Analysis

2.1 General

The information gathered during the investigation indicates that both controllers met medical fitness requirements, were rested and under no significant stress at the time. There were no indications that the performance of the flight crews or of the aircraft systems contributed to the incident. The appropriate navigation aids and communication frequencies were also all serviceable. The communications between the flight crews of both aircraft and the tower were normal, and the flight crews followed ATC instructions as directed. The weather conditions were such that the controllers could not see the threshold of runway 25.

The analysis will concentrate on the interactions between the two controllers, their actions and the procedures used during the transfer of position sequence, and the impact of the location of the ASDE monitor on this event. The analysis will also cover the adherence to directives and procedures at the unit's supervisory and management levels, and the audit practices, procedures and tracking within NAV CANADA's Monitoring and Evaluations Division.

2.2 Handover Coordination

2.2.1 Pre-relief Procedures

The handover procedure was characterised as having been generally sloppy. Based on the two controllers' descriptions of what transpired, there were problems with both how the information was transferred by the out-going controller and how it was received by the relieving controller. The result was that the relieving controller did not develop an appropriate awareness of the whole situation, which led to his final unsafe act of clearing an aircraft to land on a runway occupied by another aircraft.

The sequence of events leading to the occurrence was initiated by the relieving controller who did not actively listen to incoming communications during the pre-relief period. The sequence was continued by the relieved controller, who omitted to pass on the position of ACA330 to his colleague during the relief briefing. Although MANOPS clearly states that the above actions are requirements during handover procedures, and both individual controllers recognize the importance of passing the information, because of assumptions and distractions, safety information was not passed. Because the required job aid, the checklist, was not being used, an opportunity to catch the error was lost.

2.2.2 Post-relief Procedures

Once a transfer of position is effected, the relieved controller is no longer responsible for the position. In accordance with MANOPS, a relieved controller, following a transfer of position, is required to remain at the position for an appropriate period of time. Because of the varying volume and complexity of traffic that can be experienced at handover time, the length of the monitoring period is left to the discretion of the relieved controller. The word *appropriate* is understood by controllers to include "no monitoring time at all" when traffic conditions and circumstances permit.

The following factors influenced the relieved controller's decision to not remain behind following the handover: the traffic density was light at the time; the relieved controller usually worked the same shift as his supervisor and trusted the latter's knowledge and competence; the supervisor was also the unit training officer; and finally, the supervisor pulled the relieved controller's headset communication jack out and plugged his own in, a non-verbal cue that he was now accepting responsibility for the position.

During the investigation, the question was assessed as to whether there should be a mandatory minimum monitor period following every handover. In this occurrence, nearly four minutes elapsed between the time the handover was effected and the first radio communication between the relieving controller and ANU403. Typically, this would constitute an inordinately long time for a relieved controller to remain behind for monitoring purposes during periods of light traffic density. Therefore, staying behind for "an adequate period of time" following handover would have been insufficient for the relieved controller to notice that his colleague had an incorrect picture of ACA330's position. Although the role of the brief period of overlap after the turnover appears not to have been a specific factor in this occurrence, a number of situations could be envisioned when no overlap could create unsafe conditions.

2.2.3 Controller Decision Making

The relieving controller believed that ACA330 was still on the taxiway, and his decision to clear ANU403 to land was the consequence of that belief. The controller's mental model of the situation was faulty because it was based on incomplete information as a result of the inadequate handover carried out by both controllers.

Although the ASDE and the ACA330 crew's position report could have also provided the controller with information about the aircraft's position, neither piece of information was compelling enough to affect the mismatch between the controller's mental picture and the actual situation. The ASDE monitor location did not lend itself to easy viewing from the airport controller's position. The controller stated that he looked at the monitor from his position and noticed the radar return from BRM600 on the taxiway leading to the threshold of runway 25, but he interpreted that information to be the return for ACA330. Although the radar return for ACA330 on the threshold was most likely also displayed, it went unnoticed either because the return was not compelling enough from the controller's viewing position or because the utility of the ASDE as a job aid was not being realized due to the ASDE's problematic location. With

respect to ACA330's position report, the phrase "in position, ready to go, 25" is technically correct, and would normally be interpreted to mean the aircraft was on the runway, but the controller had already concluded that the aircraft was holding on the taxiway, and he did not notice the discrepancy.

2.3 Transfer Procedures

2.3.1 Use of the Transfer of Position Responsibility Checklist

The analysis of the reason(s) why the checklist had not been used for some time revealed that there was an attitude of "too many, not enough, or inappropriate items" on the checklist. The following factors probably led to this attitude: unit guidelines for controllers to follow at the time of transfer of position responsibility were not available; the checklist was not available for the position at the time of the occurrence, and neither the operating controllers, the supervisors, nor unit management were aware that it had been missing for some time; and, the evaluations division did not have specific written procedures to ensure the checklist was both available and utilized, and had therefore not specifically reported on this aspect during the last routine evaluation. It is clear from the above that the lack of adherence to directives pertaining to the use of the checklist had been an accepted practice at the unit's airport control position for some time.

2.3.2 Communications Monitoring

Since the controller being relieved was aware that relieving controller was standing close by and ready to assume control, he incorrectly assumed that the relieving controller had heard him clear ACA330 to position on runway 25. As a result, he did not consider it necessary to remind the relieving controller of this fact. The relieving controller missed the opportunity of listening to the incoming and outgoing communications at the time of the pre-relief monitoring period, and, having unplugged the headset of the controller being relieved, did not learn that ACA330 was on the runway.

2.3.3 Flight Progress Strip Marking

The methods used to ensure key or critical information is retained by the individual, and transferred properly to others (e.g., the cocking of strips to identify that further work is required, and how it is both transferred, received and acknowledged), are not standardized by procedures for VFR controllers. Without standardization, the style and method of noting critical actions that require further action can vary and create opportunities for misunderstanding, as was the case in this incident. Interviewed controllers stated that they did not believe a standard method to indicate that an aircraft was on a runway without a take-off clearance was required.

2.4 Location of the ASDE Monitor

The ASDE is a tool to aid the controller in identifying aircraft and vehicle position on the ground, especially at night and in conditions of poor visibility. Since the ASDE was not located in a "user-friendly" viewing position for the airport controller, its usefulness as a system defence was diminished, which may have contributed to the relief controller's lack of situational awareness. In this occurrence, where the controllers could not see the threshold of runway 25, the ASDE information was important and warranted careful consideration.

Reportedly, at this unit, the ASDE was considered more of a useful tool to the ground controller than to the airport controller. The lack of additional unit guidelines on the use of the ASDE did not reinforce the requirement for the airport controller to pay close attention to the ASDE monitor. Management's verbal requests to maintenance to install a second monitor by the airport controller's console were not carried out. To properly interpret the ASDE information, the airport controller had to get up from his console area and walk over to the monitor. The above factors likely combined to decrease the perceived usefulness of the ASDE by the airport controllers.

2.5 Language of Communications

When the relieving controller cleared, in French, ANU403 to land on runway 25, the crew of ACA330, on the runway, did not appreciate the impending unsafe condition. The capability of both flight crews to understand the clearance would have provided an additional defence mechanism by which the controller error could have been detected.

Ten seconds after ANU403 was cleared to land, the airport controller asked ACA330 to confirm that they were ready, to which ACA330 replied "Yeah, Air Canada three-thirty is in position, ready to go, 25." The controller told ACA330 that there was an aircraft two miles out on final and they would go after he was down. Neither of the ANU flight crew remembered hearing the last exchange between the controller and ACA330, 40 seconds before the risk of collision occurred; ANU403 had already been cleared to land. It is possible that the flight crew of ANU403 were concentrating on their final approach and on the acquisition of the runway environment at the time to the point where they did not hear the transmission, particularly because it was not in the language they had been using with ATC.

There were exchanges, in French, between ATC and ANU403 that referred to their landing on runway 25. These exchanges, if understood by the Air Canada flight crew, would have provided an opportunity to avoid the risk of collision. Canada opted for the two-language operation at many of its ATC units to avoid the risks of mis-communication associated with crews having to operate in their second language. That leaves the alternate risk of some important information not being understood because it is in the other language. These risks were identified and offset by special procedures such as the highlighting of the relevant controller's "strips". During the TSB survey of two years of operations of the three major ATS units in Québec, nothing was found to indicate that bilingual air traffic control is a factor in air proximity events. There was nothing to indicate that the bilingual service problem in this event was the result of a systemic deficiency.

2.6 Unit Management

The lack of continuity in both the unit and operations managers' positions had a detrimental effect on the capability of these two offices to provide effective guidance with regard to the directives and to monitor compliance with the standards. A lack of management oversight in the following areas of the tower operation was noted: the unresolved problem of the location of the ASDE monitor; controls to ensure that operational personnel demonstrate proficiency; the availability and use of handover checklists; monitoring of supervisors' qualifications; and the unit training officer not writing the required KVT exam.

2.7 NAV CANADA Audit Procedures and Tracking

CASB Recommendation 90-48 urged the Department of Transport to increase its efforts for monitoring ATC operations through unit evaluations to ensure consistent application of prescribed standards and procedures. At that time, the standard for unit evaluation cycles was two years for major units, and three years for smaller ones. Despite the CASB Recommendation 90-48, TC increased the cycle to three, four, or five years in June 1993. In September 1996, the NAV CANADA Monitoring and Evaluation Division was required to conduct an evaluation of the Ottawa tower at least once every four years. The four-and-a-half-year interval between the last two Ottawa evaluations indicates that the Monitoring and Evaluation Division was still not meeting its stated requirement, and had in fact decreased its monitoring activities in the period between the predecessor Board's 1990 recommendation and the September 1997 change.

At the time of the occurrence, the NAV CANADA Monitoring and Evaluation Division did not have a defined set of audit verification points established to verify that ATS units were complying with standard practices and procedures. Division auditors did not detect that there were no amplifying guidelines in the unit's operations manual, as required, and they did not verify that operational personnel were properly certificated, all of which demonstrate a deficiency in compliance verification. As a consequence, safety items, such as the requirement to use the checklist, were missed. Finally, the NAV CANADA Monitoring and Evaluation Division, because of its methodology, did not detect tardy unit responses to deficiencies identified during audits, and unresolved deficiencies previously identified are not being eliminated through systematic follow-up.

Canada's air traffic system is presently in a period of great change, the air industry is growing rapidly, and its personnel turnover is high; the conditions are probably just as dynamic as those which existed at the time of the CASB's 1990 special investigation into ATC Services. The CASB report on its investigation suggested that there was "a need for an extraordinary effort to ensure the maintenance of quality control." It is the Board's opinion that effective monitoring of the system is, now, more important than ever. However, this investigation has shown that the low frequency and lack of thoroughness of the Ottawa tower's evaluation has impeded NAV CANADA's ability to detect, and therefore correct, unsafe practices at that unit.

3.0 Conclusions

3.1 Findings

1. The control tower was staffed in accordance with unit policy at the time of occurrence.

2. The relieving controller had not completed the required KVT in the last three years.

3. The prevailing visibility at the time of the occurrence precluded controllers from seeing the threshold of runway 25.

4. The relieved controller did not advise the relieving controller that he had cleared ACA330 to position on runway 25.

5. There was no ASDE monitor available at the airport controller's console; this had been identified as a deficiency in the two previous audits.

6. The airport controller could not adequately view the ASDE monitor from his console position.

7. ANU403 was cleared to land on runway 25 by the relieving controller while ACA330 was holding in position on the threshold of the same runway.

8. The relieved controller used the strip-cocking method to remind himself that an aircraft was on an active runway, but the relieving controller did not use this method and did not notice the cocked strip after he took over.

9. There is no standard method of ensuring that VFR controllers remember that they have cleared an aircraft to position on a runway but have not cleared it for take-off.

10. The relieving controller did not monitor incoming radio communications during the pre-relief period.

11. The transfer of position responsibility checklist was not available at the airport controller's position at the time of the occurrence, and had reportedly been missing for some time.

12. Unit management personnel were not aware that the checklist was not available at the airport controller's console.

13. The flight crew of ACA330 did not understand the radio transmission clearing ANU403 to land on runway 25, because the clearance was in French.

14. Unit management did not provide the required amplified guidance with respect to the transfer of position responsibility, nor with respect to the use of the ASDE at night and during periods of reduced visibility.

15. Unit management did not ensure all operational controllers complied with the requirement to write the KVT annually.

16. The NAV CANADA Monitoring and Evaluation Division did not have a defined set of audit verification points established to verify that ATS units were complying with standard practices and procedures.

17. The NAV CANADA Monitoring and Evaluation Division, because of its methodology, did not detect tardy unit responses to deficiencies identified during the Ottawa unit audit, and unresolved deficiencies previously identified were not being eliminated through systematic follow-up.

18. Transport Canada's ATS monitoring and evaluations division conducted the last two routine evaluations of the Ottawa ATS unit over a time span of four and one half years, when the stated requirement is to conduct an evaluation at least every four years.

3.2 Causes

A risk of collision occurred as the result of an ineffective controller handover procedure. Contributing to this occurrence were the following: no method other than memory was used to ensure the completeness of the handover briefing; the relieving controller did not adequately monitor incoming communications; the location of the airport surface detection equipment monitor was inadequate for airport controller use; there was no standard method by which controllers kept track of uncompleted critical actions; there were deficiencies in the management and supervision of the unit; and, NAV CANADA audit procedures of the unit were inadequate.

4.0 Safety Action

4.1 Action Taken

4.1.1 ASDE Location

The airport controller could not adequately view the ASDE monitor from his console position. The ASDE monitor was replaced by a larger one by the end of March 1997 as a temporary measure until a second monitor was installed at the airport controller's position in April 1997.

4.1.2 Transfer of Position Responsibility Checklist

The transfer of position responsibility checklist was not available at the airport controller's position at the time of the occurrence, and had reportedly been missing for some time. The checklist has since been made available at the position, and the Unit Manager has taken action to ensure direction to control staff is in place for the use of the checklist at the time of position responsibility transfer.

4.1.3 Follow-up to Items of Consequence

The NAV CANADA Monitoring and Evaluation Division, because of its methodology, did not detect tardy unit responses to deficiencies identified during the Ottawa unit audit, and unresolved deficiencies previously identified were not being eliminated through systematic follow-up. NAV CANADA has indicated that, since January 1997, a systematic process has been in place to facilitate timely follow-up to items of consequence identified during unit evaluations.

4.1.4 Use of Checklists During Unit Evaluations

The NAV CANADA Monitoring and Evaluation Division did not have a defined set of audit verification points established to verify that ATS units were complying with standard practices and procedures. NAV CANADA is currently evaluating the use of checklists as an integral part of the unit evaluation process.

4.1.5 Unit Management's Implementation of ATSAMM Directives and Guidelines

Unit management did not provide the required amplified guidance with respect to the transfer of position responsibility, nor with respect to the use of the ASDE at night and during periods of reduced visibility. NAV CANADA reports that the Ottawa Unit Manager has now provided such guidance.

4.1.6 Annual Knowledge Verification Test Requirements

The NAV CANADA Monitoring and Evaluation Division did not have a formal procedure to verify the currency of knowledge verification tests for each operational controller during unit evaluations. The Monitoring and Evaluations Division is currently evaluating a checklist to be used during unit evaluations. This checklist includes a specific directive for Evaluations Officers to ensure a current copy of the KVT is on file for each operational controller.

4.1.7 Implementation of Ergonomic Presentation of Equipment in Tower Cabs

NAV CANADA reports that in August 1997, NAV CANADA'S ATS System and Equipment Requirements Division tabled initiatives to address the ergonomics for the integration of current and future equipment into tower cabs.

4.1.8 Frequency of Unit Evaluations

Transport Canada's ATS Monitoring and Evaluations Division conducted the last two routine evaluations of the Ottawa ATS unit over a time span of four and one half years, when the stated requirement is to conduct an evaluation at least every four years. NAV CANADA has recently implemented a two- or three-year evaluation cycle, depending on the size of the unit. Furthermore, a Safety Management program has been implemented which aims to integrate sound risk management standards, methodologies and tools into company policies and practices.

4.2 Action Required

4.2.1 Control Tower Performance Aid

The controller being relieved cocked the flight progress strip of the aircraft that had been cleared to position. The relieving controller did not attend to the cocked flight progress strip left by the relieved controller because he did not use this memory aid. Currently, some controllers use the strip-cocking method, whereas others use a different performance aid or simply rely on their memory. In tower operations, there is presently no requirement for a standard method to be used by airport controllers to remind themselves or others that they have cleared an aircraft into position on a runway without having issued a take-off clearance.

As a result of the aircraft runway collision at Los Angeles Airport on 1 February 1991, the NTSB recommended that any job aids and procedures, such as strip marking and flight strip forwarding, which are designed to improve each airport controller's performance, should be adopted and emphasized, repeatedly, until other independent, automated systems become available. In Canada, the lack of standard methods for reminding controllers of critical actions that must be performed was identified in another occurrence (A96O0196), and is also an issue being looked at in a broader context in the ongoing investigations A97H0007 and A97P0133. An ATS Information Bulletin (ATSI-8709) was issued on 14 December 1987 stating that: "the cocking of flight progress strips is a long established control technique to remind controllers (VFR or IFR) that some type of action must be performed." Although the procedure is mandatory for IFR operations, it is not a requirement in

tower operations.

Without some form of accepted standardization in tower operations, the style and method of noting critical activities which require further action by an airport controller could vary and create opportunities for misunderstandings. Because misunderstandings between controllers could result in accidents, the Board recommends that:

> NAV CANADA institute without delay a standard method to remind airport controllers of critical actions that have not been completed.

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4.3 Safety Concerns

4.3.1 Unit Guidelines, Rules and Directives

The NAV CANADA Monitoring and Evaluation Division did not have a defined set of audit verification points established to verify that ATS units were complying with standard practices and procedures. During the Ottawa routine evaluation in 1996, important procedural deviations were not identified and it is possible that, since similar evaluation methods were in place during previous inspections of other units, the same or similar omissions may have occurred at those facilities.

NAV CANADA is evaluating a formal checklist methodology for use in unit evaluations. This approach should, in the long term, facilitate a comprehensive verification of the applicable standards of service. Nevertheless, the Board is concerned that, in the short term, existing deficiencies may continue to go undetected until all units have been evaluated in accordance with the new verification methodology.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 12 August 1998.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Report was completed:

LP 41/97 ATC Tape Transcript

This report is available upon request from the Transportation Safety Board of Canada.

Appendix B - Glossary

ANS	Air Navigation Services
ASDE	Airport Surface Detection Equipment
agl	above ground level
ATC	air traffic control
ATS	Air Traffic Services
ATSAMM	Air Traffic Services Administrative and Management Manual
CASB	Canadian Aviation Safety Board
EST	eastern standard time
hr	hour(s)
IFR	instrument flight rules
KVT	knowledge verification test
LOC BC	Back Course localizer for non-precision approach procedures
MANOPS	Manual of ATS Operations
NTSB	National Transportation Safety Board (United States)
OSS	Operational Support Specialist
PIREP	pilot report of weather conditions in flight
RDATS	Regional Director, ATS
SPECI	special weather report
TAF	Aerodrome Forecast
TC	Transport Canada
TCA	Terminal Control Area
TCU	Terminal Control Unit
TSB	Transportation Safety Board of Canada
UTC	coordinated universal time
VFR	visual flight rules