

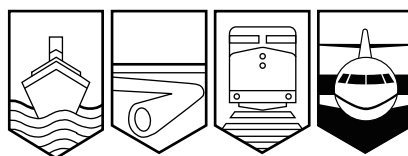
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A99W0064



LOSS OF SEPARATION

BETWEEN

AIR CANADA

AIRBUS INDUSTRIE A320 G-FNNA

AND

CANADIAN AIRLINES INTERNATIONAL

BOEING 737-200 C-GQBH

CALGARY, ALBERTA 6 nm NE

01 MAY 1999

Canada

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

Loss of Separation

Between

Air Canada

Airbus Industrie A320 G-FNNA

and

Canadian Airlines International

Boeing 737-200 C-GQBH

Calgary, Alberta 6 nm NE

01 May 1999

Report Number A99W0064

Synopsis

An Air Canada Airbus A320, flight number 270 (ACA270), was inbound from the north to the Calgary International Airport for an approach to runway 28 with a clearance to descend to 6 000 feet above sea level (asl). A Canadian Airlines Boeing 737, flight number 960 (CDN960), had departed runway 34 at Calgary and was cleared to a heading of 090 degrees and to climb to flight level (FL) 250. When it became apparent that the separation minimum would be breached, the departure controller turned CDN960 to a heading of 110 degrees. At the same time, the arrival controller turned ACA270 onto a parallel heading. At an altitude of about 9 700 feet asl, the aircraft passed within 2 nautical miles (nm) of each other. The required spacing was 3 nm laterally or 1 000 feet vertically.

The Board determined that the departure controller cleared the departing aircraft to an altitude above 9 000 feet prior to establishing that there would be adequate separation from arriving aircraft. He attached a code to the radar data block of the arriving aircraft, removing the restriction for that aircraft to maintain a minimum of 10 000 feet prior to reaching the dump point. The lack of communication and coordination between the departure and arrival controllers contributed to the occurrence. The arrival controller recognized the developing situation but did not take positive action early enough to prevent the loss of separation.

Ce rapport est également disponible en français.

1.0	Factual Information	1
1.1	History of the Flight	1
1.2	Personnel Information	2
1.2.1	Departure Air Traffic Controller	2
1.2.2	Arrival Air Traffic Controller	4
1.3	FMS ATHLO FIVE Arrival	4
1.4	Edmonton ACC Organizational and Management Information	5
1.4.1	Calgary Terminal Control Unit (TCU)	5
1.4.2	Shift Management	5
1.4.2.1	Shift Managers	5
1.4.2.2	Shift Managers—Information Exchange and Documentation	6
1.4.3	Team Supervision	6
1.4.3.1	Team Supervisors	6
1.4.3.2	Team Supervisors—Information Exchange and Documentation	7
1.5	Calgary TCU Separation Procedures	7
1.5.1	Calgary TCU Procedures	7
1.5.2	Separation of Traffic—Departures and Arrivals	8
1.6	Conflict Resolution / Team Training	9
2.0	Analysis	11
2.1	Management and Supervision	11
2.2	The Nine/Ten Split vs. Look and Go	11
2.3	Traffic Separation	11
2.4	Departure Controller	12
3.0	Conclusions	13
3.1	Findings as to Causes and Contributing Factors	13
3.2	Other Findings	13

4.0	Safety Action	15
4.1	Edmonton ACC Management	15
4.1.1	Information Documentation	15
4.1.2	Operating Irregularities	15
4.2	NAV CANADA	15
4.3	Transport Canada	16
5.0	Appendices	
	Appendix A—Glossary	17

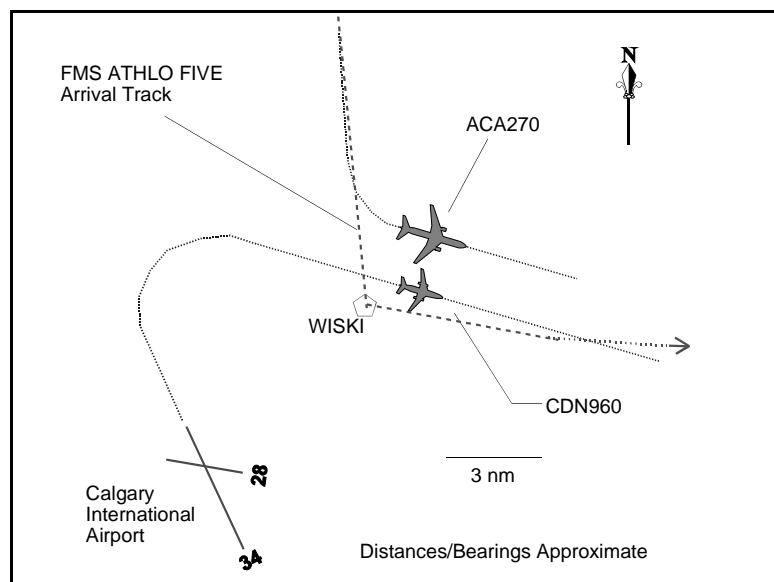
1.0 Factual Information

1.1 History of the Flight

At 0653:00 mountain daylight saving time (MDT),¹ ACA270, inbound from Edmonton, Alberta, contacted Calgary Arrival and advised the controller that the flight had been cleared for an “FMS ATHLO FIVE arrival” and descent to 12 000 feet.² The controller advised ACA270 that it was cleared to descend to and maintain 10 000 feet and that it would be landing on runway 28 (the primary landing runway at the time). During this time, the controller was controlling both the arrival sector and the departure sector of the Calgary Terminal Control Unit (TCU).

Just prior to 0659, a second controller relieved the original controller of his duties at the arrival sector; however, the original controller continued working the departure sector. At about this time, the departure controller attached a special function indicator (SFI) code letter “N” to the ACA270 data block. This code indicates to the arrival controller that he may descend ACA270 below the flight management system (FMS) arrival altitude of 10 000 feet asl prior to the STAR (standard terminal arrival route) dump point.

At 0657:50, CDN960, en route to Toronto, Ontario, contacted Calgary Departure and advised that the flight was off runway 34 and climbing through 5 000 feet for 7 000 feet. The departure controller cleared CDN960 for a right turn to a heading of 090 degrees and to climb to FL 250. Shortly thereafter, the arrival controller informed the departure controller that ACA270 was still at 10 000 feet. About 50 seconds later, the departure controller realized that the radar separation criteria of 1 000 feet vertical or 3 nm lateral might be



ACA270 and CDN960 Flight Tracks

compromised, and he instructed CDN960 to turn right to a heading of 110 degrees and advised that it would be provided vectors to intercept the airway. At 0659:00, the arrival controller cleared ACA270 to descend to 6 000 feet at the pilot’s discretion. The clearance was

¹ All times are MDT (coordinated universal time [UTC] minus six hours).

² All altitudes are asl, and all headings are in degrees magnetic.

acknowledged. Nineteen seconds later, the arrival controller cancelled the STAR and cleared ACA270 to a heading of 110 degrees, parallel to the flight path of CDN960. The two aircraft were then 2 nm apart at the same altitude and had less than the required radar separation. The aircraft flew parallel courses until vertical separation was established. They then received appropriate clearances for the continuation of their flights.

1.2 Personnel Information

1.2.1 Departure Air Traffic Controller

Controller Position	Departure
Age	33
Licence	Terminal Control Rating for Calgary Airport Control Rating for Edmonton and Calgary
Medical Expiry Date	01 December 1999
Experience	
- as a Controller	6 years
- as an IFR Controller	since December 1995
- in Present Unit	since December 1995
Hours on Duty Prior to Occurrence	0.25
Hours Off Duty Prior to Work Period	10.5

The departure controller had 40 months of instrument flight rules (IFR) controller experience, all in the Calgary Terminal Area. Prior to September 1997, the Calgary Terminal Control Centre was located at the Calgary International Airport. It was then moved to and integrated into the Edmonton Area Control Centre (ACC) at the Edmonton International Airport. The departure controller's permanent home was in Calgary, and he commuted to and from the Edmonton ACC, about a two-and-a-half hour commute each way. During short shift changes, the departure controller normally stayed with co-workers who lived in the Edmonton area.

On 30 April 1999, the departure controller was involved in a loss of separation incident (TSB occurrence no. A99W0063). Procedures in place at the Edmonton ACC required the departure controller to maintain separation between aircraft he was controlling and arriving aircraft. During the departure of a northbound aircraft, he vectored that aircraft to cross the path of an arriving aircraft. His scheduled shift that day was from 1345 to 2200; the operating irregularity occurred at about 1715. After a review of that occurrence by the shift manager, the controller was relieved of duty and provided with critical incident stress peer counselling. He was advised by the Edmonton ACC shift manager that he could return to work for his next shift and that two letters, one relieving him of duty and the other reinstating him to duty, would be

completed prior to his return. After completing his report and receiving peer counselling, the controller left the ACC at about 2000. The controller reported that he had a reasonable night's rest and slept well after reviewing, in his mind, the circumstances of the prior incident. He did not feel that the prior day's occurrence had influenced his work on the morning of 01 May 1999.

On 01 May 1999, the controller reported for duty at 0645. He did not report to the on-duty shift manager and had not been requested to do so. His team supervisor was not aware that he had had an incident the previous evening. On relieving the on-duty controller, he was responsible for the combined arrival and departure sectors for Calgary Terminal, as well as for the visual flight rules traffic advisory (VTA) sector. There were no aircraft in the VTA sector.

The departure controller had originally been scheduled for 22 shifts in April but worked 20 shifts. (One shift equals eight hours fifteen minutes.) Of the shifts worked, seven were not originally scheduled and were worked either through agreement with another controller or because of a request by the shift supervisor or shift manager. Seven of the shifts worked were overtime. Five of the original shifts were rescheduled for vacation, and two were rescheduled for days off. Of the shifts scheduled, only five shifts did not have some change associated with them. The original schedule provided for nine days off. By month's end, only two of those scheduled days off were not worked. The remainder of the days scheduled as days off were worked as overtime, except for one.

The controller changed shifts with other Calgary Terminal controllers on a regular basis because he lived in Calgary and commuted to the Edmonton ACC. By changing shifts with other controllers, he was able to maintain a work schedule whereby he could stay in the Edmonton area and not have to commute between Calgary and Edmonton on a frequent basis. On the night of 30 April 1999 he stayed in the Edmonton area, reducing his commute time by about two hours each way. He was off duty on 28 and 29 April 1999.

1.2.2 *Arrival Air Traffic Controller*

Controller Position	Arrival
Age	56
Licence	Terminal Control Rating for Calgary Area Control Rating for Edmonton
Medical Expiry Date	01 November 1999
Experience	
- as a Controller	27 years
- as an IFR Controller	since October 1974
- in Present Unit	since February 1978
Hours on Duty Prior to Occurrence	0.25
Hours Off Duty Prior to Work Period	15.75

The controller reported for duty at 0645 on the day of the incident. On taking up his duty just before 0700, he took over responsibility for the arrival sector.

During the month of April he had worked 24 shifts, of which five were overtime. His most recent scheduled days off were 25 and 26 April 1999. The day prior to the incident, he worked from 0700 to 1500.

Shortly after the departure controller turned CDN960 right and cleared the aircraft to climb to FL 250, the arrival controller recognized that there might be a potential conflict between CDN960 and ACA270. To alert the departure controller of this potential conflict, he advised him that ACA270 was still at 10 000 feet. When he did not receive a response or observe the departure controller change the clearance, he descended ACA270 to 6 000 feet. The arrival controller then watched as the situation developed, and when the departure controller turned CDN960 to a heading of 110 degrees, he turned ACA270 onto the same heading so as to minimize the loss of radar separation minima.

1.3 *FMS ATHLO FIVE Arrival*

Runway 34 was being used for departures, and runway 28 was being used for arrivals. This results in crossing tracks for aircraft arriving from the north and those departing to the east. On initial descent to Calgary, ACA270 was cleared for the FMS ATHLO FIVE arrival procedure with an initial clearance from Calgary Terminal to descend to 12 000 feet. If the procedure is flown without changes directed by air traffic control, the aircraft would not descend below 10 000 feet until after passing the WISKI fix, which is south of the area of the loss of separation.

1.4 *Edmonton ACC Organizational and Management Information*

1.4.1 *Calgary Terminal Control Unit (TCU)*

The Calgary TCU is located in the Edmonton ACC and is responsible for the VTA, Calgary Departure, Calgary Arrival, and the Data positions. The TCU is staffed seven days a week, 24 hours a day, requiring 28 controllers, including supervisors; however, at the time of the occurrence, only 24 controllers were on staff. The number of on-duty controllers varies according to the expected traffic levels. On the morning of 01 May 1999, the traffic level was low and the complexity was low. Three controllers and one supervisor were available for duty. One of the controllers was on a break, one was staffing the arrival sector, one was staffing the departure sector, and the supervisor was setting up the data position.

1.4.2 *Shift Management*

1.4.2.1 *Shift Managers*

The Edmonton ACC utilizes a shift manager system that is staffed from 0600 to 2400 daily. Six managers rotate through the shift manager position. (This changed in late October 1999 to seven managers and the institution of a 24-hour duty cycle.) The shift manager is responsible for the overall operation of the IFR air traffic positions and their functions at the ACC and is responsible for taking appropriate action when an air traffic irregularity occurs. On the day of the loss of separation, the shift manager came on duty at 0600. The handover consisted of a handwritten note from the previous shift manager who had completed his shift just after midnight. From the note, he was made aware that a controller had been removed from duty the preceding day and that this controller was returning to duty, having received the appropriate letters. He did not meet with the controller prior to the controller assuming his duties on the morning of 01 May 1999.

When the loss of separation occurred between ACA270 and CDN960, the team supervisor relieved the departure controller and directed him to report to the shift manager. On reporting to the shift manager, the departure controller completed an incident report. It was the shift manager's responsibility to determine if an irregularity had occurred, its severity, and the course of action that should be followed. The shift manager reviewed the radio audio and the radar data tapes. On determining that a loss of separation had occurred, he met with the controller, advised him that he was relieved of duty, and provided access to a critical incident stress peer counsellor and to a union representative. The arrival controller was assessed by the shift manager as not having contributed to the loss of separation and was not relieved of duty; but was given the choice as to whether or not he would complete his shift. He chose to take the remainder of the shift off. The shift manager then met with the departure controller and, after a

review of the incident and a discussion, it was agreed that the controller would not return to work until 10 May 1999. The shift manager provided the controller with a letter removing him from duty.

1.4.2.2 Shift Managers—Information Exchange and Documentation

The shift managers did not have a formal or permanent method to exchange information about issues that may have arisen during their duty period. Typically, the outgoing manager would verbally debrief the incoming manager, and the manager whose shift ended at 2400 would leave a handwritten note on the duty desk for the 0600 shift manager. These notes were often destroyed after being read; thus, there was no record of the information. Shift managers who were on leave or time off were not always aware of issues that had surfaced during their absence. An historical record, such as a permanent logbook, of the functioning of the ACC from a shift-manager perspective was not available for review.

In the circumstances of the 30 April 1999 occurrence, the shift manager spoke to the controller and determined that he should not return to work on that shift. Based upon his assessment of the controller's reaction to the occurrence, he determined that the controller could return to work for his next scheduled shift. He then prepared the letters of "Removal from Duty" and "Return to Duty", and advised the controller that he could return the next day and both letters would be in his mail slot. The actions taken by the shift manager (for example, the interview process and the review of the incident to reinstate the controller) were not documented. Because his shift ended at midnight, the shift manager left a note on the desk for the 0600 shift manager advising of the incident and of his actions. The 0600 shift manager noted the incident on reading the note but did not take any action since the incident had been resolved by the previous shift manager.

1.4.3 Team Supervision

1.4.3.1 Team Supervisors

The Calgary TCU has four team supervisors. A team supervisor is assigned to duty during the time that the Calgary TCU positions are staffed. The supervisors are counted as part of the required staffing level for the terminal sector and therefore must rotate through the various controller positions. At the time of the occurrence, the team supervisor was setting up the data position and was aware of the irregularity as it occurred. He relieved the departure controller and had the controller report to the shift manager. Although he was aware that an operating irregularity had occurred on the day before, he did not know who had been involved.

The Calgary TCU team supervisors' duties are outlined in the position description as follows:

Under the general supervision of the shift manager, the team supervisor directs the operation of a specific area of responsibility within an IFR Unit, ensures air traffic control service is provided in accordance with approved policies, standards and procedures; participates in the control of air traffic; supervises and evaluates controller performance; identifies training requirements; monitors department; and performs other related duties.

However, based on staff levels and the position staffing requirements, the team supervisors interviewed stated that they performed few of the functions detailed in the position description. Normal routines require that they staff control positions and follow a rotation along with the other air traffic control staff. Limited time is spent on other team supervisory duties.

1.4.3.2 Team Supervisors—Information Exchange and Documentation

The team supervisors did not have a formal or permanent method to exchange information about issues that may have arisen during their duty period. Outgoing supervisors verbally debriefed incoming supervisors. The supervisor whose duty period ended at 2245 did not have a formal method of leaving information for the next supervisor who came on duty at 0600.

On the evening of the 30 April 1999, the 0600 team supervisor contacted the on-duty team supervisor by telephone to obtain an update on issues that might affect him when he came on duty at 0600. At that time he was advised that a controller had had an operating irregularity, but he was not informed that the individual involved would be reporting for duty on his shift at 0645. The next morning, the team supervisor did not meet with the departure controller before he went on duty, nor did he conduct any form of stand-back supervision.

1.5 Calgary TCU Separation Procedures

1.5.1 Calgary TCU Procedures

Operations Letter No. 98/20, dated 30 May 1998, details the Calgary TCU specialty sector procedures. The letter defines the responsibilities and describes the procedures to be used for the control and coordination of flights operating within the airspace assigned to the Calgary Terminal specialty. Paragraphs 404 to 408 deal with the arrival and departure procedures.

Paragraph 405.2 states that the arrival controller shall “[e]nsure aircraft under his control remain on the appropriate arrival route and not descend below 10,000 until the appropriate Dump Point.” For a flight inbound from the north, the dump point is located at approximately the WISKI fix of the FMS ATHLO FIVE arrival. Paragraph 408.9 states that the departure controller shall “[r]estrict IFR departures to 9 000 ASL or below until they are clear of arriving IFR aircraft.”

These procedures, commonly referred to as the nine/ten split, reduce the workload of the controllers by providing departing and arriving aircraft with 1 000 feet of vertical separation. The nine/ten split was implemented in the Calgary TCU in 1982.

During interviews, several Calgary TCU controllers stated that they used the nine/ten altitude split as an exception rather than as a rule. They believed that using the nine/ten split caused unnecessary flight delays for the airlines. Thus, in an attempt to maintain traffic flow and to minimize transits by aircraft at low or intermediate altitudes, the controllers favoured a process referred to as “look and go”. The Operations Letter describes “look and go” as “[a] process used to reduce or eliminate coordination whereby traffic under control of other positions is assessed (RAMP, CADDS, etc.) and further action is taken with respect to that traffic.” This procedure requires that the controller continuously monitor traffic because the separation between departing and arriving aircraft may be vertical or lateral.

During periods of high traffic volume, the “look and go” procedure will increase the workload of both the departure and arrival controllers. The preferred procedure, described by most controllers interviewed, was to turn the departing aircraft toward its outbound track and, traffic permitting, clear the aircraft to its flight planned altitude. On the incident of 01 May 1999, the controller instructed CDN960 to turn right onto a heading of 090 degrees and to climb to FL 250 immediately after the flight crew contacted departure control and while it was on the runway heading.

1.5.2 *Separation of Traffic—Departures and Arrivals*

The Calgary TCU controllers expressed the view that both the arrival and departure controllers have a responsibility to ensure that traffic they are controlling maintains separation from other known traffic. However, it is the departure controller’s responsibility to keep departing aircraft clear of the arrival controller’s aircraft. These responsibilities, although implied in Operations Letter No. 98/20, are not explicit.

The Operations Letter does task the departure controller with the responsibility, traffic permitting, to provide ANTs³ to the arrival controller(s). This requires that the departure controller assess the arriving traffic for conflict resolution and then place the appropriate SFI code “N” to the arriving aircraft data block. The departure controller affixed the SFI code “N” to the data block of ACA270, thus providing the arrival controller the option of descending and/or vectoring ACA270 direct to the final approach of runway 28 without the requirement to bring ACA270 to the STAR dump point.

³ The term giving the arrival controller(s) the option of descending and/or vectoring direct to final approach of the primary runway prior to the STAR dump point, ensuring that radar separation is maintained from the extended centreline of the designated departure runway.

1.6 *Conflict Resolution / Team Training*

During the investigation, controllers interviewed were asked about the types of traffic conflict resolution training they received during initial and annual training. All staff stated that they did not receive training specific to traffic conflict resolution and that their training was oriented towards avoiding traffic conflicts.

2.0 *Analysis*

2.1 *Management and Supervision*

On 30 April 1999, at about 1800, the departure controller was involved in an operating irregularity in which there was a loss of separation. The on-duty shift manager assessed the controller as being capable of returning to work on his next scheduled shift. However, there was no assessment of the controller the following morning by the on-duty shift manager or the team supervisor. It could not be determined if such an assessment would have influenced the decision to have the controller return to duty; however, had such an assessment been required, the team supervisor would have been aware that one of the duty controllers had had an operating irregularity. The team supervisor would then have had the option, as provided for in the statement of duties, of conducting a proficiency check through stand-back supervision during the controller's initial period of return to duty.

2.2 *The Nine/Ten Split vs. Look and Go*

The nine/ten split is a procedure that was established and has been in use for about 17 years in the Calgary TCU. It provides for positive vertical separation when aircraft are in proximity to the airport and manoeuvring to the landing runway or when aircraft are receiving their initial headings to establish themselves on their outbound tracks. When used, this procedure reduces the controller's workload because the need for close monitoring of the traffic is less than that required by the "look and go" method.

2.3 *Traffic Separation*

Aircraft separation from other known IFR or VFR traffic is the responsibility of the controller responsible for that aircraft. In the situation of the arriving ACA270 and departing CDN960, the arrival controller and departure controller shared that responsibility; however, the departure controller has the responsibility of keeping his traffic clear of inbound landing traffic. It is therefore important that the controllers communicate. Communication becomes imperative if one individual is uncertain of the intentions of the other.

In the situation that arose with ACA270 and CDN960, the arrival controller recognized early that the two aircraft might be placed in proximity to each other. He took the initiative by communicating to the departure controller that ACA270 was still at 10 000 feet. When the departure controller did not respond with a verbal acknowledgement, change the altitude clearance limit for CDN960, or cancel the code for ACA270, the arrival controller did not take any further action to ensure that the departure controller was aware of his concerns. Nor did he take positive action at that time to ensure separation between the aircraft he was controlling and CDN960.

2.4 *Departure Controller*

It could not be determined how the prior day's occurrence influenced the departure controller on the morning of 01 May 1999.

The departure controller's schedule for April 1999 showed several changes from the controlled shift schedule. These changes were the result of both his and management's requests. Of the 30 shift possibilities, only five (17 per cent) were unchanged. Scheduled days off were largely exchanged for overtime and, of the eight days off, five were due to the controller taking vacation.

Shift work has the potential to impair an individual's ability to function at peak efficiency. The beneficial effects of controlled shift work, in maintaining an individual's efficiency, however, have been well documented by the scientific community.

3.0 *Conclusions*

3.1 *Findings as to Causes and Contributing Factors*

1. The departure controller cleared the departing aircraft to an altitude above 9 000 feet prior to establishing that there would be adequate separation from arriving aircraft.
2. The departure controller attached a code to the radar data block of the arriving aircraft, removing the restriction for that aircraft to maintain a minimum of 10 000 feet prior to reaching the dump point.
3. The arrival controller recognized that there was a possibility of a conflict between ACA270 and CDN960, but he did not communicate that concern in a manner that was understood by the departure controller, nor did he take positive actions of his own to prevent the loss of separation.
4. The departure controller had the option of using a “nine/ten split” for aircraft separation but chose to employ a “look and go” option that required close monitoring of the inbound and outbound traffic.

3.2 *Other Findings*

1. The Calgary TCU specialty staffing was appropriate for the traffic complexity.
2. The departure controller’s workload was assessed as low with low complexity.
3. The Calgary TCU specialty team supervisor was preparing the data position at the time of the occurrence.
4. The departure controller was involved in a loss of separation the previous day.
5. The Calgary TCU specialty team supervisor was not aware that the departure controller had been involved in an operating irregularity during the previous day.
6. The on-duty shift manager did not meet with the departure controller prior to his resumption of duties on 01 May 1999.
7. In the 30 days prior to the occurrence, the departure controller had worked an irregular shift schedule that had been changed several times at his or management’s request.

4.0 *Safety Action*

4.1 *Edmonton ACC Management*

4.1.1 *Information Documentation*

The management of the Edmonton ACC has instituted a temporary procedure whereby the shift managers provide written documentation to their relief in the form of electronic mail on issues that have arisen during their shift. These electronic messages are accessed by the oncoming shift manager at the beginning of each shift and continue to be supplemented by verbal shift-change briefings. The electronic messages are available to all managers and are maintained so that an historical record is available. The Manager, Area Control Centre Operations is developing a formal shift-manager information database that will replace the electronic mail system.

4.1.2 *Operating Irregularities*

A procedure has been instituted at the Edmonton ACC for handling operating irregularities. The shift manager responsible for removing a controller from duty is now responsible for ensuring that all the appropriate steps are taken to reinstate a controller to duty. This includes the requirement for the controller involved in an operating irregularity to be interviewed by the duty shift manager immediately prior to being returned for duty. The ACC has also instituted a policy whereby all controllers involved in an operating irregularity are required to undergo a proficiency check before being reinstated to duty.

4.2 *NAV CANADA*

NAV CANADA's National Mandatory Air Traffic Control Refresher Training Plan for 1999/2000 and 2000/2001 notes that the Technical Training Division of NAV CANADA is committed to the development and complete delivery by 31 August 2001 of two 1-day human factors training modules on communications and on teamwork. The aim of the communications module is to make participants aware of the danger of poor or confusing communication in the operational environment. The aim of the teamwork module is to make participants aware of how an individual's skill and performance affect collaborative work and decision making.

4.3 *Transport Canada*

Transport Canada is chairing a tripartite working group on controller fatigue. Included in the working group are representatives from NAV CANADA, the Canadian Air Traffic Control Association, and Transport Canada. The related steering committee is chaired by the Assistant Deputy Minister, Safety and Security.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 01 August 2000.

Appendix A—Glossary

ACA	Air Canada
ACC	Area Control Centre
asl	above sea level
CADDS	Calgary Automated Departure Display System
CDN	Canadian Airlines International
FL	flight level
FMS	flight management system
IFR	instrument flight rules
MDT	mountain daylight saving time
NE	north-east
nm	nautical miles
RAMP	radar modernization program
SFI	special function indicator
STAR	standard terminal arrival route
TCU	Terminal Control Unit
TSB	Transportation Safety Board of Canada
UTC	coordinated universal time
VFR	visual flight rules
VTA	visual flight rules traffic advisory