Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A04Q0003

LOSS OF SEPARATION

NAV CANADA
MONTRÉAL AREA CONTROL CENTRE –
LA GRANDE SECTOR
LA GRANDE, QUEBEC 160 nm SSW
13 JANUARY 2004

Canada

Aviation Investigation Report

Loss of Separation

NAV CANADA
Montréal Area Control Centre – La Grande Sector
La Grande, Quebec 160 nm SSW
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Report Number A04Q0003

Summary

American Airlines Flight 167, a Boeing 777, en route from John F. Kennedy Airport, New York, United States, to Narita, Japan, was at flight level 350 on a converging track with United Airlines Flight 943, a Boeing 767, at flight level 350 en route from Paris, France, to Chicago, Illinois, United States. Both aircraft received a traffic alert and collision avoidance system resolution advisory, to which they responded. The two aircraft passed each other at 1322 eastern standard time, within 600 feet laterally and 1100 feet vertically of one another, approximately 160 nautical miles (nm) south of La Grande, Quebec, in radar-controlled airspace. The air traffic controllers had not detected the conflict until alerted by the air traffic control conflict alert program. The required separation was 5 nm laterally or 2000 feet vertically.

Ce rapport est également disponible en français.

Other Factual Information

At 1104 eastern standard time,[1] American Airlines Flight 167 (AAL167), with 15 crew and 118 passengers on board, departed John F. Kennedy Airport, New York, United States, on a flight to New Tokyo Airport, Narita, Japan. At 1228, AAL167 entered Canadian radar-controlled airspace northbound at flight level (FL) 350 via Massena into the Montréal, Quebec, area control centre (ACC) South Specialty, Pontiac sector. The flight planned route for AAL167 crossed the main westbound flow coming over the Atlantic Ocean. When AAL167 first contacted the La Grande (GL) sector at 1251:36, a single controller was responsible for the GL combined sector.

At 0633, United Airlines Flight 943 (UAL943), with 12 crew and 107 passengers on board, departed Roissy-Charles-de-Gaulle Airport, Paris, France, on a westbound route to Chicago O'Hare Airport, Chicago, Illinois, United States. At 1259:23, UAL943, at FL 350, contacted the GL sector controller after the handover from the Fontange (FG) sector. At that time, UAL943 and AAL167 were 294 nautical miles (nm) apart on crossing tracks.

Both aircraft were radar identified and in communication with the Manic (MC)/Chibougamau (MT)/La Grande (GL) combined sector within the Montréal ACC, High Level Airspace, North Specialty. These three sectors extend approximately 540 nm north to south and vary 200 to 340 nm east to west. The controller was operating with the range selector set at 599 nm on the radar situation (RSiT) display. The traffic volume was considered moderate with a medium level of complexity. Overall staffing throughout the North Specialty was considered adequate at the time of the occurrence.

There were three main traffic flows through the GL combined sector in the time leading up to the incident: a stream of traffic in the southern part of the MT sector heading southwest into the Pontiac sector; a southwest bound stream (including UAL943) in the southern part of the GL sector heading to the Noranda sector; and a northbound stream (including AAL167) through the western part of the MT and GL sectors heading toward Edmonton, Alberta, ACC controlled airspace (see Appendix A). The aircraft within each individual stream were properly separated.

At approximately 1256, an on-the-job instructor (OJI) and a trainee returned from a break to take over the GL control position. The position handover involved both a review period and a verbal briefing period. During the review period, which lasted approximately four minutes, the OJI and trainee looked over the flight progress board and RSiT and observed the first GL controller accept the control and make initial contact with UAL943. There were no imminent conflicts between UAL943 and other aircraft in the vicinity at the time.

A checklist that includes items to be covered during the position handover is available at each control position in the Montréal ACC. The checklist is designed to lead and direct the handover process so information is not overlooked or forgotten. Section 113.2.B.4 of the *Air Traffic Control Manual of Operations* (ATC MANOPS) states that the relieving controller is to review the checklist prior to the handover briefing. Section 3.3.2 of the North Specialty operations manual, dated 14 November 2003, states that, before leaving his or her position, the outgoing controller is to select the computer visual information display system (CVIDS) transfer of responsibilities page

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[1] All times are eastern standard time (Coordinated Universal Time minus five hours).

to ensure that the handover briefing is complete. The checklist in use in the North Specialty includes, as the third item, a reference to verify any imminent conflicts; there were no imminent conflicts at the time of the handover. The potential conflict between AAL167 and UAL943 (294 nm apart) had not been detected by the controllers and was not mentioned during the handover briefing.

At 1259:43, the GL controller commenced the verbal handover briefing to the OJI and trainee. Although UAL943 had been accepted on the handoff just prior to the position handover, its flight data strip was not annotated or cocked to indicate that further action was required. The ATC MANOPS states that the "cocking" of flight progress strips is an essential control technique and should be used as a reminder to controllers that some type of further action must be performed. A red "W" may be used to mark a strip once a conflict has been detected. Besides cocking a strip, there is no procedure in place to remind controllers that further action is needed. On taking over the combined GL sector, neither the OJI nor the trainee conducted a conflict probe for aircraft flying on crossing tracks at the same altitude within the sector.

At approximately 1301, the OJI took over responsibility of the combined GL sector. The trainee was sitting in front of the RSiT display in the radar position and the OJI was sitting slightly back and to the left of the trainee, in front of the flight progress board. The trainee (operator) was transmitting to the aircraft on the sector frequency using a foot pedal. The foot pedal is active only with the operator jack; it is not active for someone plugged into the instructor jack. The OJI can override the trainee's transmissions and transmit by pressing the press-to-talk (PTT) button connected to his or her headset cord.

Following the position handover, the trainee was busy accepting aircraft approaching the eastern boundary of the combined GL sector and handing off aircraft exiting his airspace to the west. Most of these aircraft were at flight levels between FL 350 and FL 390. The trainee was also occupied with attempting to overcome a communications problem with an aircraft in the southernmost stream.

At 1316:18, the trainee instructed AAL167 to switch to another frequency to ensure continued communication with the aircraft as the aircraft transitioned from the MT sector to the GL sector. At that time, UAL943 and AAL167 had closed to within 6 minutes (72 nm) of the crossing point.

At 1320, the ATC conflict alert program warned the controllers of the potential loss of separation between AAL167 and UAL943. The trainee quickly moved away from the RSiT display, and the OJI moved into the controller position in front of the display. The OJI attempted to issue instructions to AAL167 to descend to FL 340 and UAL943 to climb to FL 360. However, because the OJI, who was plugged into the instructor jack on the console, used the foot pedal to transmit instead of the PTT, the aircraft did not receive the instructions. The OJI's voice was treated as background noise[2] by the automatic gain control (AGC) on the trainee's microphone and, therefore, the OJI's transmissions faded out and were unreadable by the pilots. When the OJI

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[2] The OJI was not transmitting by radio; however, his voice was being captured by the trainee's microphone, and as a result of the automatic gain control (AGC – a noise reducing feature), any "background" noise is automatically cancelled out.

realized that the pilots were not receiving his transmissions, he assumed that there was a frequency problem. The OJI attempted to correct the problem by switching both aircraft to other frequencies, without success.

At 1320:44 and 1320:46, both aircraft advised that they were responding to a traffic alert and collision avoidance system (TCAS) resolution advisory; AAL167 climbed to FL 355 and UAL943 descended to FL 344, resulting in 1100 feet vertical spacing by the time their flight paths crossed. Once each aircraft's TCAS indicated clear of the conflict, AAL167 returned to FL 350 and UAL943 was cleared to remain at FL 340 until after exiting the GL sector.

After the conflict alert program had first sounded, another controller (relief controller) on the operations floor walked over to the sector to see if the controllers needed assistance. This relief controller let the OJI continue handling the emergency but watched over the other traffic in the sector to ensure there were no additional problems.

At 1324:18, the relief controller took over the position, replacing the OJI and trainee. The relief controller plugged his headset into the console's operator jack and used the foot pedal; he was able to transmit clearly to the aircraft. Both aircraft were then handed off to the next control agency and continued without further incident.

The first controller and the OJI were licensed as per existing regulations. The OJI is fully responsible for the position while performing his instructor duties. The OJI had previous experience instructing while working as a flight service specialist. He completed the required five-day On-the-Job Instructor Skills Course (OJISC) training in May 2002. This is the only course required to carry on operational training while on the job. The emphasis on the OJISC course is mainly on the interpersonal skills and teaching techniques involved in instructing. The course does not provide information or best practices on how to plan for taking over from a student if required.

The two aircraft involved in this occurrence were registered in the United States where TCAS is mandatory for passenger aircraft. TCAS served as a last defence against a mid-air collision. At present, all major Canadian airlines have TCAS equipment installed in their aircraft because of flight routing through the United States. However, many smaller Canadian carriers flying within Canada or large cargo aircraft are not TCAS equipped. New Canadian regulations on the mandatory installation and use of TCAS are still under review. The TSB issued a recommendation for the mandatory use of TCAS in July 1996 (Recommendation A96-07).

The Northern Airspace Display System (NADS) assists the controller in ensuring the required separation of en route aircraft in non-radar airspace is maintained. The NADS provides controllers with conflict probe capability, flight path projection, determines estimates for route of flight, and prints flight progress strips. Since the NADS is limited in the amount of data it can hold, flight plan data for aircraft operating in radar-controlled airspace are deleted by the controller approximately 10 minutes after the aircraft enters radar coverage.

UAL943 flight plan data were initially in the NADS, because it came from non-radar, oceanic airspace, but were deleted from the NADS, in accordance with local procedures, once the flight was established in radar-controlled airspace. Information on AAL167 was entered into and

remained in the NADS because its route of flight was northbound from radar into non-radar airspace. Both Eurocontrol and NAV CANADA are working on the development of a medium-term conflict detection system for use in radar-controlled airspace.

The flight progress board at the GL sector is organized by sector exit points. As a result of this type of board layout, the flight data strips for UAL943 (exiting west) and AAL167 (exiting north) were widely separated on the board. The ATC MANOPS allows flight progress boards to be organized by fix or altitude designator, the objective being "post each strip depicting the aircraft's route of flight under the most appropriate fix designator, so that potential conflicts can be more easily recognized and accurately assessed."[3] It has been determined that there may be a declining reliance on flight data strips in the radar-controlled environment as a primary conflict detection tool.

Flight data strip marking procedures, contained in Part 9 of the ATC MANOPS, require controllers to highlight potential conflicts in specific ways. The RSiT provides controllers with a number of tools for manually detecting potential conflicts or highlighting aircraft of concern. Some of these tools are the following:

- the projected track line (PTL)
- the range bearing line (RBL);
- the projected intercept vector (PIV); and
- a "halo" placed on the aircraft's target to make it stand out.

Although some of the above tools were used by the trainee, he did not use them to determine if there was a conflict between AAL167 or UAL943 on converging paths. Unlike the flight data strip marking procedures, the use of these tools is optional.

In May 2003, the ground-based conflict alert program became operational in Montréal ACC high-level, controlled airspace. This program provides controllers with two RSiT display warning levels. The first warning, appearing 60 seconds before a predicted loss of separation, is timed to allow a controller to take action to prevent the loss of separation from occurring. The second warning level appears after a loss of separation has occurred. During the investigation, it was discovered that some controllers misunderstood the conflict alert parameters, leading them to believe that they have less time to take action to resolve a conflict than they actually have. All controllers at the Montréal ACC received classroom training on the conflict alert program. NAV CANADA does not provide controllers with hands-on simulated training on the conflict alert program.

Analysis

A number of procedures and tools have been developed or made available to controllers to assist in detecting in-flight conflicts. In a radar-controlled environment, controllers tend to work more at a tactical level rather than a longer term strategic level. Potential conflicts 10 or 20 minutes in

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[3] NAV CANADA, *Air Traffic Control Manual of Operations* (ATC MANOPS), Part 9, Paragraph 901.3, Note.

the future do not normally require immediate attention. However, the earlier a controller becomes aware of a conflict, the better he or she is able to devise a solution to resolve the conflict without having to resort to drastic measures.

Although AAL167 was crossing a predominantly westbound flow at an altitude that potentially conflicted with a number of aircraft also at FL 350, no special action was taken by the controllers to highlight either the flight data strip or the aircraft radar target on the RSiT. Similarly, the controllers did not use the information contained on the flight data strips or any of the tools provided by the RSiT to detect the potential conflict between UAL943 and AAL167.

Flight data strips are, at times, being used as record keeping devices rather than as conflict detection resources. In this occurrence, the organization of the flight data board was not conducive to detecting conflict because the flight data strips for the two concerned aircraft were widely spaced. As a result, the conflict remained undetected for the 20 minutes the two flights were operating in the sector.

Current procedures and practices for the handover of a control position may not ensure that all pertinent information is relayed from the outgoing to the incoming controller. The position handover checklist guides controllers toward consideration of immediate conflicts and does not specifically address potential longer term conflicts. The traffic picture that was accepted by the OJI at the end of the position handover was that the sector was free of immediate conflicts. This may have lulled the OJI and the trainee into a false sense of security, and as a result, they did not reconfirm that the aircraft within the sector, including UAL943 and AAL167, were free of conflict for their respective routes in the GL sector.

Controllers often develop their own routines and personal work habits. For example, the OJI would normally, after assuming control of a sector and when working by himself, use one of the display functions on the RSiT to reconfirm that there were no conflicts in the sector. With a trainee in the control position, the OJI was not able to directly access the RSiT display functions. Because the trainee did not follow a routine similar to that of the OJI, neither of the two controllers detected the conflict between UAL943 and AAL167. The OJI course does not cover practical aspects of conducting on-the-job training, such as how to effectively share the OJI's work knowledge with a trainee or how to quickly take over a control position from a trainee if required. The OJI did not brief the trainee on the process of transferring control of the position from the trainee to the OJI if required.

When the OJI had to suddenly take over the position from the trainee after the conflict alert alarm sounded, he reverted to his normal practice of using the foot pedal to transmit. Therefore, the OJI was unaware that the instructions to resolve the conflict were not transmitted. As this type of situation can introduce a high level of stress, controllers may make inadvertent errors or use improper equipment or techniques to try to resolve the conflict, which can place aircraft into an even more serious risk of collision situation. More realistic and recurring simulated training may help the controllers make more timely and appropriate responses to conflict alert alarms and other emergencies and increase the likelihood that corrective action is effectively communicated to the aircrew. Only the TCAS, as a last defence, alerted the flight crews to take action to prevent a potential collision. Because the TCAS is not mandatory in Canada, there continues to be some unnecessary risk of mid-air collisions within Canadian airspace.

Had flight information on UAL943 been retained in the NADS, it is possible that information on the potential conflict with AAL167 could have been communicated to the GL sector controllers. There is no medium-term conflict probe for radar-controlled airspace to provide an additional backup to the controllers scanning the radar or relying on information on the flight data strips. At present, the ground-based defence against a loss of separation in the event of an operational error is the short-term conflict alert.

Findings as to Causes and Contributing Factors

1. The potential conflict between UAL943 and AAL167 was not detected when UAL943 first contacted the La Grande (GL) sector and no action was taken by the first GL controller to remind the next controller that a conflict probe had not been completed. This allowed a potential conflict to progress to the point of a risk of collision.

2. After accepting the handover of the GL sector, neither the trainee nor the on-the-job instructor (OJI) conducted a review of all aircraft under their control to ensure there were no potential conflicts; the conflict between UAL943 and AAL167 was not detected, which placed them in a potential risk of collision situation.

3. After the air traffic control conflict alert program warned the trainee and the OJI of the impending loss of separation, the OJI was unable to communicate instructions to the involved aircraft because he used the foot pedal instead of the press-to-talk switch to activate the radios. As a result, the aircraft progressed to the point where only the traffic collision avoidance system (TCAS) resolution advisory (RA) prevented a potential collision.

Findings as to Risk

1. There is no medium-term conflict probe for radar-controlled airspace to provide an additional backup to the controllers scanning the radar or relying on information on the flight data strips.

2. The current operational conflict alert system provides minimal warning time for the controller and requires immediate and often drastic action by both controller and aircrew to avoid a mid-air collision.

3. Because the TCAS is not mandatory in Canada, there continues to be an unnecessary risk of mid-air collisions within Canadian airspace.

Other Findings

1. The lack of realistic and recurrent simulation training may have delayed the OJI's quick and efficient recovery from a loss of separation situation, or may have contributed to his inappropriate response to the conflict alert warning.

2. The OJI's training course focussed mainly on the interpersonal aspects of monitoring a trainee. It did not cover practical aspects such as how to effectively share work knowledge and practices with a trainee or how to quickly take over a control position from a trainee when required.

Safety Action

The Montréal area control centre published an Operations Bulletin (04008) containing information to ensure that all controllers involved in on-the-job training know how to operate their communications equipment and to gain immediate access to their frequencies. This operations bulletin was a mandatory verbal briefing item for all controllers.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 02 March 2005.

Appendix A – Aircraft Flight Paths

NOTE: All times in this diagram are Coordinated Universal Time (eastern standard time plus five hours).