

AVIATION OCCURRENCE REPORT

A97H0012

LOSS OF SEPARATION

BETWEEN

CANADAIR CL-600-2B16 CHALLENGER N8MC

AND

BRITISH AIRWAYS BOEING 747-400 G-BNLK
IQALUIT, NORTHWEST TERRITORIES 40 nm NW

20 SEPTEMBER 1997

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 Occurrence Report

Loss of Separation

Between

Canadair CL-600-2B16 Challenger N8MC
and

British Airways Boeing 747-400 G-BNLK
Iqaluit, Northwest Territories 40 nm NW
20 September 1997

Report Number A97H0012

Summary

The CL-600-2B16, N8MC, serial number 5329, departed Iqaluit, Northwest Territories, en route to Seattle, Washington, and was initially cleared direct to the geographic point of latitude 63 degrees north (N) and longitude 080 degrees west (W) at flight level (FL) 240, and then subsequently to FL 350. British Airways Flight 279 (BAW279), a Boeing 747-400, G-BNLK, was en route from London-Heathrow, United Kingdom, to Los Angeles, United States, via Iqaluit at FL 350. To ensure the required spacing between the two aircraft, N8MC was to be re-routed via 64°N 070°W, then to 63°N 080°W, with a restriction to remain at FL 330 or below until reaching 64°N 070°W. By the time this change in routing and the restriction was actually given to the pilots of N8MC, they had already flown past 070°W and were intercepting the amended outbound track. In order to determine the impact of the routing change on other traffic, the data controller working at the Montreal Area Control Centre (ACC), Nuvillek sector, used the radar data processing system (RDPS) to display the track for N8MC on a nearby radar display. However, in entering the new route, the data controller inadvertently entered the wrong coordinates for the second point along the route and was thereby convinced that N8MC's position was much farther north in relation to BAW279 than it was in reality. This error was not detected by the controller. As a consequence, the altitude restriction to remain below FL 330 was cancelled. Lateral spacing between BAW279 and N8MC was reduced to approximately 9 nautical miles (nm) laterally and 1,500 feet vertically, where 20 nm or 2,000 feet was required.

Ce rapport est également disponible en français.

Other Factual Information

The Montreal ACC is made up of four specialties, East, North, South and Terminal, each of which is further divided into a number of sectors. The North specialty is a high-level specialty which controls air traffic FL 290 and above for most of the province of Quebec as well as the north-eastern approaches into Canadian airspace from the oceanic control areas. The East specialty is a low-level specialty responsible for controlling most of the province of Quebec north of 47°N latitude, with the exception of Québec City areas. Individual sectors within a specialty may be controlled individually or combined, depending on operational requirements on a particular day.

The East specialty of Montreal ACC is composed of five sectors. On the morning of the occurrence, these five sectors had been combined into two, one of which was comprised of James Bay, Hydro, and Nuvilik sectors. This was a normal and accepted procedure for a Sunday morning. Iqaluit Airport lies within the Nuvilik sector. The combined Nuvilik/James Bay/Hydro sector extends up to and including FL 280. These three sectors have partial radar coverage. Non-radar control procedures are utilized where radar coverage is not available. The airspace in which this occurrence took place was beyond radar coverage.

The Brevoort sector is one of the sectors within the North specialty of Montreal ACC, and controls the airspace overlying the northern part of the Nuvilik sector from FL 290 and above, as well as the oceanic approaches to northern Canada. Radar coverage in the Brevoort sector is available from the sector's eastern boundary to a few miles west of Iqaluit. The North specialty is equipped with the Northern Airspace Display System (NADS), which provides a visual display of the estimated and/or confirmed positions of aircraft flying within the sector and provides conflict prediction.

Staffing in the East and North specialties of the Montreal ACC at the time of the occurrence was in accordance with unit policies and was reported to be compatible with the workload. The traffic volume and complexity were assessed as moderate. The combined Nuvilik/James Bay/Hydro position was staffed with a data controller and a radio controller who was monitoring a trainee in the radio position. It is the radio position that was in direct contact with the aircraft and was responsible for initiating control actions to separate aircraft. The data controller maintains the data board and coordinates flight information with other sectors and units. The supervisor for the East specialty was working another control position at the time of the occurrence. The supervisor for the North specialty was standing back and assisting with coordination of flight information as required within his own specialty.

At the time the North specialty controller issued the revised route and altitude restriction to N8MC, the East specialty Nuvilik/James Bay/Hydro sector radio controller, a trainee monitored by an on-the-job instructor (OJI), was busy with other traffic in the southern part of the combined sector and was using the Chibougamau radar to provide radar control services there. It is the role of the OJI to provide the trainee with on-the-job experience while at the same time ensuring compliance with all applicable rules and regulations pertaining to the provision of air traffic control services. The OJI must be able to monitor closely all air traffic control (ATC) communications and take over the position from the trainee without requiring a briefing from the trainee. The OJI is provided training in instructional, interpersonal, and debriefing techniques in accordance with NAV CANADA-approved training courses. A controller may volunteer to receive initial training to become an OJI.

The Nuvilik radio controller was expecting Air Baffin Flight 200 (BFF200), a Beech 200 aircraft flying from Puvirnituq, Quebec, at FL 250 and estimating Iqaluit at 1415. At 1337, the Nuvilik radio controller issued a clearance to BFF200, through Kuujuaq Flight Service Station (FSS), to fly the 275° radial of the Frobay very high frequency omni-directional range (VOR) inbound to Iqaluit and to maintain FL 250. On initial contact with BFF200, 92 nm south-west of Iqaluit at FL 250, the Nuvilik radio controller cleared BFF200 to maintain 16,000 feet above sea level (asl) (see Appendix A - Sequence of Events).

At the same time, the Brevoort sector in the North specialty was controlling BAW279, which reported to the Brevoort sector controller that it had passed the Frobay VOR, located 2.4 nm south-east of the Iqaluit Airport at 1354, at FL 350, and was estimating BODRA intersection located at 62°17'N 080°W at 1433.

N8MC departed runway 18 at Iqaluit Airport at 1341, with a clearance from Iqaluit direct to a geographic position of 63°N 080°W (see Appendix B - Relative Aircraft Tracks), outbound on the 308° radial of the Frobay VOR, and with a clearance to climb to FL 240. On departure, N8MC was issued a restriction to cross 20 nm from the Frobay VOR, at 15,000 feet asl or below, to ensure the required separation between N8MC and BFF200. Five minutes later, at 1346, N8MC reported crossing 21 nm, upon which the Nuvilik radio controller issued a clearance for N8MC to climb to FL 280 and to report passing FL 240. The North specialty Ungava NADS position accepted the departure time for N8MC from the Nuvilik data controller and subsequently confirmed that FL 350, along with an amended route and an altitude restriction, was acceptable.

At 1349, eight minutes after N8MC departed Iqaluit, one minute after BAW279 had estimated passing overhead the Frobay VOR, the Nuvilik radio controller issued a revised altitude and altitude restriction, received from the Brevoort sector, to N8MC, to climb to FL 350 and to cross 64°N 070°W at FL 330 or below. This position was not on the route initially given to N8MC. Moments later, the radio controller issued a revised route to N8MC to proceed from the aircraft's present position direct 64°N 070°W, then 63°N 080°W, then on the flight-planned route. The controller also reiterated the restriction to remain at FL 330 or below. One and a half minutes later, the pilot of N8MC reported that the aircraft had already passed 64°N 070°W and was turning right to intercept the route to 63°N 080°W. The pilot also asked for confirmation that it was the correct action, to which the radio controller replied in the affirmative and, at 1353, N8MC requested confirmation that a climb to FL 350 was now authorized.

The Nuvilik controller then realized the aircraft had passed 070°W and immediately approved the climb to FL 350. Thirty seconds later, the Nuvilik radio controller asked N8MC if the aircraft was established on the track between 64°N 070°W and 63°N 080°W, to which the pilot responded that he was 12 nm to the east of the track, heading toward it. The Nuvilik radio controller then stated to the pilot that the aircraft must be established on the specified track and to maintain FL 330 or below until established on the track. One minute later, at 1356, the pilot indicated, as a result of a request from the controller, that the aircraft was now 5 nm from the track and was complying with the restriction to remain at FL 330 or below until established on the track. Almost immediately, the data controller advised the radio controller that the high-level sector had cancelled all restrictions for N8MC. The Nuvilik radio controller informed N8MC of the cancellation and requested a report when level at FL 350 and an estimate for 63°N 080°W.

¹ All times are coordinated universal time (eastern daylight time plus four hours) unless otherwise noted.

Three minutes later (at 1358:48), the Nuvilik radio controller advised the pilot of N8MC that the next sector was unable to accept the aircraft at FL 350, and that the flight was to descend to FL 310. The pilot stated that the aircraft was climbing through FL 335 and that he was descending back to FL 310. At 1402, N8MC reported levelling at FL 310, and shortly thereafter, indicated the aircraft was 127 nm from the Frobay VOR. The two aircraft (N8MC and BAW279) came within 9 nm and 1,500 feet of each other while procedures require a lateral separation of 20 nm or vertical separation of 2,000 feet.

At no time did the Nuvilik radio controllers (trainee nor OJI) ascertain the exact position of N8MC, either by requesting a position from the Frobay VOR, or an exact latitude/longitude. There was some discussion between the trainee and the OJI as to the position of this flight relative to the track and the applicability of the altitude restriction, but the OJI did not direct the trainee to specifically confirm the exact position of the flight. Because the trainee and OJI were busy with other traffic in the southern sector under radar control, they were unaware of the efforts of the Nuvilik data controller trying to resolve the conflict between N8MC and BAW279 with the North specialty controllers and supervisor, and thereby allow N8MC to continue the climb without requiring the flight to level off at an intermediate altitude.

The Nuvilik data controller was responsible for coordinating clearances (and other flight information for N8MC) with other sectors in the Montreal ACC. After the Nuvilik data controller received the departure time for N8MC from Iqaluit FSS, he passed the information to the Ungava NADS position. Shortly thereafter, the Ungava NADS controller issued a restriction for N8MC to the Nuvilik data controller. N8MC was to be re-routed via 64°N 070°W, and restricted in altitude to cross that position at FL 330 or below, to provide the required separation with BAW279. This information was placed on the flight progress strip for N8MC by the NADS controller, handed to the Nuvilik data controller who then placed the flight progress strip in the appropriate section of the data board for the radio controller. The data controller was unable to verbally brief the radio controller on the restriction because the sector radio controller was busy with other control duties, but he physically pointed out the strip to the OJI. The trainee radio controller, however, did not pass this restriction until N8MC had climbed above FL 250. He reasoned that, once N8MC was above this altitude, it would be clear of the conflicting inbound traffic, and could then be safely re-routed in any direction as it continued the climb. Neither the trainee nor the OJI perceived that there was a requirement to pass on the restriction quickly because of the proximity of the new coordinate to Iqaluit, nor the rapidity at which N8MC was climbing; the CL600 Challenger executive jet is known by controllers to be capable of a rapid climb to altitude.

Aircraft departing Iqaluit and climbing into the high-level airspace are initially cleared to maintain an altitude of FL 280 or below. Once the flight departs, coordination is initiated with the high-level sectors for route and higher-altitude approval. It is the controller at the NADS position who activates the information on the flight and determines if there are any conflicts with other traffic. The route and altitude approval and any restrictions are then passed to the low-level sector for relay to the aircraft. Once the flight is clear of any conflict in the low-level sector's airspace, control is then passed to the high-level sector. There are normally few delays encountered by departing traffic from Iqaluit with this method of operation, as the traffic levels are normally low.

Controllers working in the low-level Nuvilik sector are generally not as cognizant of where latitude/longitude coordinates are situated in relation to airports, geographic reference points, navigational aids, or the intersections they more normally use in their day-to-day controlling activities. There was no plotting board at the Nuvilik/James Bay sector position; normally there would be one at that position. It is the controller's responsibility to ensure that all required equipment is available. The plotting board includes a chart covering the

controller's area of responsibility and a specialized ruler to determine aircraft tracks between different points and the airspace to be protected for a particular aircraft. It could not be determined, during the investigation, why there was no plotting board at the Nuvilik sector.

Many controllers consider the plotting board a less accurate method of depicting aircraft tracks when compared with using the range bearing line (RBL) function of the RDPS. This function allows controllers to enter two coordinates and display the resulting track between the two points on the radar display. The trainee radio controller was, however, busy with traffic in the southern sector, so the radar display could not be de-centred to the area around Iqaluit without losing the radar information for the southern sector. In an effort to assist, the data controller walked over to another, unused console on the other side of the operations room and entered into the RDPS what he thought were the correct coordinates for the new route N8MC was to fly. There was a perceived urgency by the Nuvilik data controller to complete this action as N8MC was quickly approaching Brevoort sector controlled airspace and would have to be handed over to that sector soon.

The Nuvilik data controller intended to use the RBL to compare the track originally requested by the pilot with the revised track. He correctly typed in the coordinates for the originally cleared track from Iqaluit to 64°N 080°W. For the revised track, however, the data controller incorrectly typed in the second position as 65°N 080°W instead of 63°N 080°W. This resulted in a displayed track which was considerably farther north than the originally requested track, and also farther north than the amended track issued in conjunction with the altitude restriction. The Nuvilik data controller did not detect the error and therefore surmised that N8MC was to the north of the revised track, and so informed the North specialty supervisor. The North specialty supervisor then informed the Nuvilik data controller that the FL 330 altitude restriction was cancelled. This information was then passed by the Nuvilik data controller to the Nuvilik radio controller.

The Nuvilik radio controller kept N8MC on his frequency in order to ensure communication and separation with BFF200 inbound to Iqaluit. The Nuvilik sector serves as a relay for the Brevoort sector, as this sector does not have any communications capability with aircraft departing Iqaluit. If the Brevoort sector has any restrictions or instructions for aircraft climbing to high-level airspace, that information will be relayed via the Nuvilik sector. While serving as a relay, it is not always considered necessary that the Nuvilik controllers have all the traffic information in the high-level airspace. However, Nuvilik controllers are responsible for providing separation for flights within their own area of responsibility up to FL 280. The Nuvilik radio controller, therefore, had to confirm where the revised route would take N8MC and determine how this restriction would affect separation with BFF200. The North specialty controller, on the other hand, was not made aware that the revised routing might affect separation with another aircraft in the Nuvilik sector and thereby result in a delay in passing the restriction to N8MC.

In a restructuring between the East and North specialties, which took place a few years before this occurrence, a number of the more-experienced controllers were moved to the North specialty. As a result, the East was left with reduced controller experience levels. It was generally accepted that the North specialty was a more difficult specialty in which to qualify. It was also perceived by some controllers that it was easier to qualify in the East. This led to somewhat strained communication between the two specialties, which affected the ease with which information was exchanged. As a result, a lack of cooperation and an underlying climate of dissonance had been allowed to fester between the two specialties and, at times, hindered the free flow of communications between the North and the East specialty controllers during this particular shift. For example, the Nuvilik data controller did not ask the North supervisor for more information relating to the revised route for N8MC (which the data controller knew was available on the NADS display) in the North specialty, but

chose instead to add to his own workload by plotting the tracks himself at another console. Communication problems were not evident in other specialties in the ACC. Shortly before this occurrence, a new manager responsible for the East specialty was appointed, and it was reported that communication between the two specialties had improved.

Analysis

There were two issues to be resolved by the Nuvilik radio controller before the restriction issued by the Ungava NADS controller could be issued to the aircraft. The first was the separation problem to be resolved with BFF200 before altering the route of N8MC. Secondly, the Nuvilik radio controller did not have a clear mental picture of where the coordinate 64°N 070°W was in relation to the flight; therefore, he was reluctant to issue this restriction until separation with the inbound BFF200 was assured. The radio controller did not have access to a plotting board as there was none at the sector at the time, and he could not off-centre his radar display because he was controlling traffic in the southern part of the combined sector. As a result, there was a delay in passing the revised clearance to the aircraft.

The North specialty controller would have been aware that the coordinates for the altitude restriction for N8MC were close to Iqaluit, necessitating a quick relay to the aircraft in order to give the crew time to comply with this restriction. The North specialty controller, unaware that the Nuvilik radio controller was busy with other control duties, expected that the restriction would be passed immediately upon receipt. The fact that none of the Nuvilik sector controllers had a clear mental picture of the proximity of the restriction point to the point of departure further delayed the issuing of the information to the aircraft.

The Nuvilik data controller became concerned that the restriction was not being passed, so in an effort to assist the radio controller, he plotted the revised course for N8MC on a vacant radar display and used the RBL function to plot the original and amended tracks for N8MC. In the rush to complete the task, the coordinates for the original track were entered in error, causing an RBL to be displayed that showed a false original track in relation to the amended track.

The data controller did not intentionally plan to enter the wrong coordinates into the RDPS computer, resulting in an unintentional action that did not go as planned. This type of error occurs where actions are based on stored routines and there is little, if any, conscious decision making, as for example the largely automatic procedural routines of entering information to generate an RBL. The pre-conditions to these types of errors are distractions or preoccupations with other than the immediate task. In this case, incorrectly plotting the aircraft's position by the data controller was an error of inattention. As a result of the time pressures felt by the data controller, in that the aircraft was nearing Brevoort controlled airspace, the controller did not adequately check the coordinates he had entered before executing the command to display the RBL.

The North specialty controller had two advantages over the Nuvilik controllers with respect to the altitude restriction as it applied to N8MC. Firstly, the North specialty was equipped with a NADS, which provided a visual display of the track based on the coordinates entered by the controller, as well as data derived from the flight plan. Secondly, the North specialty controllers were used to working with latitude and longitude coordinates on a routine basis, so they were familiar with the impact a change would have on the current track of an aircraft. The NADS is not available to the Nuvilik sector control positions. The North specialty controllers

did not offer additional information to the Nuvilik sector controllers regarding the impact of the restriction on the initial track of N8MC, and the Nuvilik data controller chose to plot out the new track himself rather than ask the North specialty controllers.

Strained communication between the North and East specialties affected the ease with which control information should have been exchanged and was more apparent between certain individuals than others. The Nuvilik data controller did not ask the North supervisor for clarification. The operation of the ATC system is dependant on complete and timely coordination between units in order to provide a safe and efficient environment for users of the system. Supervisors, as the first line of oversight within a particular unit, must be particularly aware of brewing conflicts and take immediate steps to minimize their effects on the operation. A free and open forum rather than a climate of dissonance must be fostered to prevent bottlenecks in the critical flow of information. Although this communication problem did not appear to have an impact on the ACC as a whole, it did affect communications between the North and the East specialties during this particular work shift.

The Nuvilik radio controller was a trainee monitored by an OJI. In order to provide maximum benefit to the trainee under increasingly more difficult and challenging traffic conditions, the OJI is sometimes placed in a delicate position of allowing more and more freedom to the trainee as training progresses. The trainee was working under the authority of the OJI's ATC licence, and it is the OJI who retains the responsibility for ensuring that the requisite minimum separation standards are applied.

When the Nuvilik data controller placed the flight data strip for N8MC containing the altitude restriction on the data board beside the trainee, it was the OJI, standing behind the trainee, who noticed it. The OJI, however, was not concerned that the restriction was not immediately passed, because he knew that the conflict between N8MC and BFF200 had to be solved first. The OJI maintained a stand-back posture although he was not positive of the exact position of the aircraft in relation to the assigned track, even after the altitude restriction for N8MC was cancelled by the trainee. The OJI allowed the situation to deteriorate into the loss of separation by not providing firmer guidance to the trainee to alleviate the uncertainty with respect to the aircraft's position.

This loss of separation occurrence is classified as an air proximity event in which safety was not assured.

Findings

1. Staffing in the Montreal Area Control Centre East specialty met unit standards.
2. The Nuvilik combined sector controllers' workload was assessed as moderate.
3. The East specialty supervisor was working at a control position, and the North specialty supervisor was acting as a stand-back supervisor/coordinator.
4. There was no plotting board at the Nuvilik sector position, requiring the data controller to use a radar display to plot aircraft tracks.
5. Some East specialty controllers are not familiar with latitude and longitude positions in relation to their normally used airports, geographic reference points, navigational aids, or air route intersections.

6. The Nuvilik radio controller was not able to assess routing changes for N8MC without changing the centre of the radar indicator module, which would result in the loss of the radar display for the southern part of the sector.
7. The Nuvilik sector did not have a NADS display to show relative tracks for N8MC and other relevant traffic.
8. The Nuvilik trainee radio controller did not know the exact position of N8MC when the altitude restriction was cancelled, which led to the loss of separation.
9. The OJI did not intervene in a timely manner to prevent the loss of separation when it was apparent to him that the trainee was unsure of the position of N8MC in relation to the aircraft's assigned track.
10. The Nuvilik data controller entered the wrong coordinates when generating an RBL on a vacant radar display, and he did not detect the error. As a result, he advised the North specialty supervisor that N8MC was north of track rather than south of track, the aircraft's actual position.
11. The Nuvilik data controller did not seek clarification from the North specialty controllers regarding the revised track for N8MC when he was unsure where the revised track was in relation to the aircraft's current track. The climate of dissonance that had been allowed to develop between some of the controllers in the East and North specialties contributed to the lack of communication.

Causes and Contributing Factors

The loss of separation occurred when N8MC's altitude restriction was cancelled because the data controller inadvertently entered the wrong coordinates into the RDPS computer, resulting in a misinterpretation of the position of N8MC in relation to BAW279.

Factors contributing to this occurrence were the lack of a plotting board at the Nuvilik sector, the East specialty controllers unfamiliarity with latitude/longitude coordinates in relation to their normally used control techniques, the strained interpersonal communication problems between some controllers in the East and North specialties, confusion among controllers as to how soon after receipt of an amendment the information must be relayed to the aircraft, the Nuvilik sector controller not issuing the revised route and altitude restriction to N8MC in a timely manner, the lack of an appropriate display in the Nuvilik sector to provide a more complete traffic picture for the controllers, and the OJI not intervening when he was unsure of the position of N8MC in relation to the outbound track.

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 28 April 1999.

Appendix A - Sequence of Events

Time (UTC)	Time (min) Before/After Occurrence	Action
1326	-30	BAW279 passes 64°N 060°W, estimating Frobay VOR at 1348
1334	-22	Nuvilik sector controller issues ATC IFR departure clearance through Frobay FSS for N8MC
1341	-15	N8MC departs Iqaluit, departure time passed to Ungava NADS
1343	-13	Nuvilik radio controller issues restriction to N8MC to cross 20 DME of the Frobay VOR at 15,000 feet asl or below
1345	-11	initial radio contact between Nuvilik radio controller and BFF200
1346	-10	N8MC cleared to maintain FL 280 and to report leaving FL 240
1346	-10	N8MC reports 21 DME from Iqaluit
1349	-7	N8MC cleared to maintain FL 350 with a restriction to cross 64°N 070°W at FL 330 or below
1350	-6	Re-routing issued to N8MC to proceed direct 64°N 070°W, then 63°N 080°W, flight planned route, and advised that the restriction to cross 64°N 070°W at FL 330 or below still applies
1352	-4	N8MC advised having already passed 64°N 070°W and was turning to intercept the track between 64°N 070°W and 63°N 080°W
1353	-3	Nuvilik sector controller approves climb to FL 350 once N8MC has passed 070°W
1354	-2	BAW279 passes Frobay VOR at FL 350
1355	-1	N8MC advised 5 nm from track and restricted to FL 330 until on the track
1356	0	N8MC informed that all restrictions were cancelled
1358	2	N8MC advised by Nuvilik sector controller that the next sector is unable to accept the aircraft at FL 350 and issued descent to FL 310
1358	2	N8MC advised at FL 335 and commencing descent to FL 310
1402	6	N8MC advised at FL 310

Appendix B - Relative Aircraft Tracks

