

AVIATION OCCURRENCE REPORT

**LOSS OF SEPARATION
BETWEEN**

**NORTHWEST TERRITORIAL AIRWAYS
BOEING 737-210C C-GNWI**

AND

**NORTHWEST AIRLINES
BOEING 747-451 N666US
WINNIPEG, MANITOBA 160 NM NE
01 JUNE 1996**

REPORT NUMBER A96C0081

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.

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Summary

Northwest Territorial 962 (NWT962), a Boeing 737-210, was en route from Rankin Inlet, Northwest Territories, on an instrument flight rules (IFR) flight at flight level (FL) 310 via Churchill, Manitoba, direct to Winnipeg. Northwest 69 (NW69), a Boeing 747-451, was en route from Detroit, USA, also on an IFR flight at FL310, via Red Lake, Ontario, and airway NCA20 to Kansai, Japan. (See Appendix A.) As NWT962 approached the southern boundary of the Winnipeg North High (North) sector, the radar controller observed an unidentified target converging with NWT962's track. The controller identified the target as NW69, and at 1455:19 central daylight saving time (CDT), re-cleared NWT962 to FL290. NWT962 commenced descent from FL310 at 1455:58 CDT with 9.5 nautical miles (nm) horizontal separation from NW69, and levelled at FL290 at 1456:32 CDT with about 3 nm horizontal separation. The minimum required separation in the Class A airspace where the incident occurred is 5 nm horizontal or 2,000 feet vertical separation.

Ce rapport est également disponible en français.

Other Factual Information

Air traffic control (ATC) in the area of the occurrence is provided by the Winnipeg Area Control Centre (ACC). The two flight paths crossed about 160 nm northeast of Winnipeg at 1456:48 CDT, about 6 nm north of the boundary between the North sector and the Winnipeg East (East) sector. At that point, the two aircraft had about 500 feet horizontal and 2,000 feet vertical separation. NW69 crossed from the East sector into the North sector, but the East controller had not yet handed off the flight to the North radar controller.

The East sector controllers have two methods of determining an aircraft's position: the flight progress strips, and the radar display. There was no posted time estimate for a co-located position for the two flights. To recognize the conflict between NWT962 and NW69, it would have been necessary to use NWT962's Gimli estimate to calculate the time of its crossing of NCA 20, NW69's route of flight. Neither the East data controller nor the radar controller recognized the conflict between NWT962 and NW69 from an examination of the flight progress strips. Both were aware of the procedure for calculating the separation between the flights. The East sector was operated by a radar controller and a data controller until 1449 CDT, when the data controller left for a rest break and the radar controller assumed both positions. Traffic in the sector was judged to be light at that time. The East controller was taking a position estimate by telephone when the North controller indicated that he was descending NWT962 and that NW69 should be left at FL310.

The East controller had planned to hand off NW69 to the North controller at or immediately before the aircraft reached the sector boundary. However, the East controller usually did not hand off most aircraft on NCA20 to the North sector before the sector boundary because of potential communications difficulties, as the next remote communications outlet (RCO) near that route is located at The Pas. Flights attempting to use the RCO at The Pas from a position in the East sector often find The Pas RCO to be out of range. Such flights could be assigned to the other available RCO frequency at Island Lake, but they would be out of range of Island Lake several minutes later, and the North controller would then be required to switch the flights to the RCO at The Pas. The East controller considered it desirable to reduce unnecessary workload on aircraft crews and controllers in other sectors by delaying the hand-off of aircraft entering the North sector until the aircraft were within communications range of The Pas.

The North radar controller's instruction to NWT962 at 1455:22 CDT was: "Territorial nine six two maintain flight level two nine zero. Start descent now." NWT962 replied: "Territorial 962 we're leaving three one zero." At 1455:52 CDT, NWT962 asked: "Centre it's nine sixty two. Do you want us to start our descent now?" The North radar controller replied: "Territorial nine six two affirmative. Two nine zero right now please." At the time they received the first message from the controller, the NWT962 crew was not expecting a new clearance from the controller, and discussed the situation in the ensuing 30 seconds.

During that time, the two aircraft closed from a horizontal separation of 19 nm to 12 nm. Neither crew member recalled hearing the clearance limit of FL290 or the urgency of the instruction to descend.

Pilots and controllers form "mental pictures" of the relative positions of aircraft and reporting points to assist them in understanding the overall traffic situation. Pilots and controllers who are involved in a communication exchange usually process the received information using mental expectations that seem most appropriate for the activity that they are performing at the time of the communication. If the message is unexpected or unusual, then the mental expectation held by the information receiver may hinder the understanding of the message, and could delay the response to the new information. At the time that the radio transmissions were made, the crew of NWT962 was in cruise flight conditions approximately 160 nm from their destination. They were not aware of any impending traffic conflict, had not requested a descent, and were not anticipating a descent clearance from that point.

The *Air Traffic Control Manual of Operations* (ATC MANOPS), section 507.1 instructs controllers to, "Issue a safety alert to traffic if you are aware that the aircraft is at an altitude which...places it in unsafe proximity to...another aircraft." The phraseology to be used in such a situation is, "Traffic alert (position of traffic if time permits)...climb/descend (specific altitude if appropriate) immediately." The procedure set out in this section is reportedly used mostly in connection with mixed IFR/visual flight rules (VFR) traffic.

The North radar controller set his indicator module (IM) to show only the data blocks of the aircraft under his control. On this setting, his IM showed only an octagonal "present position symbol," but no data tag, for aircraft controlled by the North Low sector or by an adjacent sector such as East. At the time of the occurrence, the North IM was set on 256 nm scale, the maximum available setting. The North sector is geographically larger than most other sectors controlled by the Winnipeg ACC, and even at the 256 nm setting, the sector depiction occupies most of the space available on an IM. However, if the North sector is centred on the IM display, part of the East sector airspace will be displayed in the lower left corner of the IM.

NWT962's track was about 190 degrees magnetic (°) at the time of the occurrence. The flight crew had been in radar contact with Winnipeg ACC controllers since entering the North sector near Churchill. NW69's track was about 310°, and the flight had been in radar contact with Winnipeg ACC controllers in the Marathon and Dryden sectors before entering the East sector about 40 nm northwest of Red Lake. Above FL290, aircraft on tracks from 180° to 359° are assigned cruising altitudes at 4,000 foot intervals, beginning at FL310.

At the time of the occurrence, the Winnipeg North specialty, comprising the data and radar controller positions in the Winnipeg High, Winnipeg Low, and Trout Lake sectors, was staffed with three

controllers and two supervisors. No controllers from the other specialties were qualified in the Winnipeg North specialty. One of the two supervisors was working the Trout Lake sector, and the other was on a break.

At 1422 CDT, the two controllers working the North Low sector observed that the single controller working the North sector was experiencing a period of heavy workload. One of the North Low controllers then moved to the North radar position to assist that controller, who then assumed the North data position. The incoming controller received no status briefing on assuming the North radar position; the incumbent North controller was reportedly too busy to provide one. A status briefing is to apprise an incoming controller of the existing and expected traffic in a sector and of any anticipated conflicts. On the morning of the occurrence, staffing in the North sector was judged by the ACC shift manager to be sufficient for the day's traffic requirements.

The controllers in the Winnipeg North specialty have three methods of determining an aircraft's position: the flight progress strips, the radar display, and the Northern Airspace Display System (NADS). The NADS is a computer-driven, representational display system which plots position estimates and crossing points for aircraft beyond the range of radar coverage. NADS helps controllers to recognize and avoid traffic conflicts at crossing points. The system depends on timely and accurate input of aircraft positions. The first estimate for NWT962's position abeam Gimli was 1519 CDT, based on that flight's departure time and estimated time en route. NADS issued a track crossing warning for NWT962 and NW69 based on this original estimate, and indicated that the two aircraft would cross with six minutes separation. ATC MANOPS directs controllers to post red "W" warning indications on flight progress strips to identify conflicts with other aircraft. Neither North controller marked a warning indication on either aircraft's flight progress strip. Both North controllers believed that a crossing with six minutes separation could be monitored on radar, without the need to change the clearances of the aircraft. After NWT962 came into radar contact and its position and speed could be determined more accurately, the North radar controller calculated that the flight would be abeam Gimli at 1513 CDT. He marked the revised estimate on the North sector's flight progress strip and passed it to the East data controller, who marked it on the East sector's NWT962 flight progress strip. The North data controller then continued updating NADS but did not enter the revised time estimate into NADS before the occurrence. There was no posted time estimate for a co-located position for the two flights. As in the East sector, to recognize the conflict between NWT962 and NW69, the North sector controllers would be required to use NWT962's Gimli estimate to calculate the time of its crossing of airway NCA 20, NW69's route of flight. Neither North controller could recall performing this calculation.

Both aircraft were equipped with traffic and collision avoidance systems (TCAS), although TCAS systems are not required by Canadian

regulation. The TCAS system in NWT962 reportedly activated when that aircraft was descending through 29,200 feet, at a range of 5 nm from NW69, with a time to closest point of approach (CPA) of about 35 seconds. The system issued an aural traffic alert, along with position and altitude information on NW69. The TCAS system in NW69 reportedly issued an aural traffic alert about 40 seconds before the CPA between the two aircraft, and when the crew selected the TCAS screen on their navigation display, it indicated the position and altitude of NWT962. In both cases the TCAS indications preceded and corresponded with the visual sighting of the aircraft traffic by the crews.

The radar modernization project (RAMP) radar system in use at the Winnipeg ACC is not capable of conflict advisory or resolution. A conflict advisory system was developed after the commissioning of the RAMP radar system. The system compared aircraft tracks and altitudes and issued conflict advisories to controllers when it determined that separation standards were likely to be compromised. When the system was tested, deficiencies were identified that required corrective action. Developmental work on a replacement system is reportedly in progress.

Analysis

Both aircraft were at the appropriate altitude for their direction of flight. They were converging at a relative angle of 120° when a loss of separation occurred between NW69 at FL310 and NWT962, which was descending from FL310 to FL290.

Although both the East radar and East data controllers had NWT962's revised estimate for a position abeam Gimli available to them, neither controller recognized that flight's conflict with NW69. Estimates for NW69 and NWT 962 were not posted for a co-located point and the required mental calculation necessary to correlate the estimates made it harder for the East controllers to recognize a conflict between the flights.

Because of the difficulty in communications that might have resulted if the aircraft were handed off early, the East radar controller delayed transferring control of NW69 for as long as possible; the controller then became preoccupied with data work rather than radar monitoring as NW69 left the sector.

Because the workload in the North sector was high, the incoming North radar controller was not given a status briefing when he assumed that position. The data controller was updating the information in the NADS system, but, because he had not yet completed the update, the NADS system was operating on outdated information. Although the NADS conflict warning indicated a six minute crossing time separation between NWT962 and NW69, NWT962 was six minutes early; therefore, the time separation decreased to nil. Although both North controllers were aware of the new estimate, they did not compare NWT962's revised strip with that of NW69 to update their mental picture of the

separation between the aircraft. Formulation of an accurate mental picture was made more difficult by the lack of a co-located time estimate for the two flights. By concentrating on the NADS system, the North controllers relied more on the NADS separation calculation to detect conflicts than on their analyses of the flight progress strips.

The North radar controller's IM setting helped him avoid screen clutter by deleting the data tags of targets not under his control. However, the deletion of the data tags of the targets controlled by the sectors geographically adjoining the North sector decreased his ability to detect information about the incoming NW69, for which he had not yet accepted control.

Although one of the crew members of NWT962 responded that they were leaving FL310 when the North radar controller first issued an instruction to NWT962 to descend, a period of about 40 seconds passed before the crew commenced the descent from FL310. Because the crew members were not expecting a descent clearance, they did not fully understand the message or the reason for it, and initially took no action. During this time, the separation between the two aircraft decreased by 7 nm, and the situation was only resolved when the crew asked for clarification. This confusion might have been averted if the controller had used phraseology such as that in MANOPS 507.1, which incorporates the reason for the controller's instruction. Although section 507.1 is mainly used in mixed IFR/VFR traffic, its use in IFR/IFR traffic could improve pilots' understanding of the meaning and urgency of ATC messages.

The TCAS system in NWT962 issued a traffic advisory after the conflict with NW69 was already recognized by ATC and NWT962 was descending. The TCAS system in NW69 activated in the absence of an ATC traffic advisory and helped that crew monitor the position and altitude of NWT962. Although the TCAS systems were not needed to resolve the conflict between the two flights, they helped the crews visually acquire and monitor their aircraft traffic.

There was no radar system conflict advisory system available to alert the controllers to the impending loss of separation.

Findings

1. A loss of separation occurred about 160 nm NE of Winnipeg between NW69 at FL310 and NWT 962, which was descending from FL310 to FL290.
2. Neither the East nor the North sector flight progress strips displayed co-located position estimates for NW69 and NWT962.
3. The required mental calculation necessary to correlate the position estimates of the two flights made it more difficult for the North and East controllers to recognize the conflict between

the flights.

4. The East controller delayed NW69's hand-off to the North sector in an attempt to avoid potential communications problems in the North sector.
5. The East controller became preoccupied with data functions and did not hand off NW69 before it left the East sector.
6. The North data controller's workload prevented him from providing the incoming North radar controller with a status briefing.
7. The NADS system listed an incorrect separation warning at the time of the occurrence, based on an outdated time estimate for NWT962.
8. The North controllers relied more on the NADS separation calculation to detect conflicts than on their analyses of the flight progress strips.
9. The North radar controller's IM setting prevented him from receiving information about aircraft not under his control.
10. The North radar controller's descent instruction to the NWT962 crew did not use MANOPS 507.1 phraseology, and did not convey the desired sense of urgency to that crew.
11. Both aircraft TCAS systems helped the respective crews visually acquire the other aircraft and monitor the situation.
12. No radar system conflict advisory system was available to alert the controllers to the impending loss of separation.

Causes and Contributing Factors

A loss of separation occurred because the North and East controllers did not recognize the potential conflict after NWT962's estimate was updated. Contributing to the occurrence were the high workload in the North sector, the North controllers' reliance on outdated NADS information, and the East controller's delayed hand-off of NW69.

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 05 March 1997.

APPENDIX A

