Aviation Safety Investigation Report 199603722

Boeing Co
B737
Boeing Co
B747

14 November 1996

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Aviation Safety Investigation Report

199603722

Occurrence Number: 199603722 **Occurrence Type:** Incident
Location: 50km S Hamilton Island, VOR
State: QLD **Inv Category:** 3
Date: Thursday 14 November 1996
Time: 1124 hours **Time Zone** EST
Highest Injury Level: None

Aircraft Manufacturer: Boeing Co
Aircraft Model: 737-33A
Aircraft Registration: VH-CZU **Serial Number:** 27267
Type of Operation: Air Transport High Capacity Passenger
Damage to Aircraft: Nil
Departure Point: Cairns QLD
Departure Time: 1044 EST
Destination: Brisbane QLD

Aircraft Manufacturer: Boeing Co
Aircraft Model: 747-312
Aircraft Registration: VH-INJ **Serial Number:** 23029
Type of Operation: Air Transport High Capacity Passenger
Damage to Aircraft: Nil
Departure Point: Sydney NSW
Departure Time: 0941 EST
Destination: Osaka Japan

Approved for Release: Wednesday, November 26, 1997

FACTUAL INFORMATION

History of the flight

A Boeing 747 (B747) was en route from Sydney to Osaka, tracking via Narrabri, Hamilton Island and Port Moresby. The crew had originally planned at flight level (FL) 310 with the intention of climbing to FL350 prior to entering Papua New Guinea airspace. After departing Sydney, the crew calculated that the aircraft could immediately climb to FL330 and requested a change to that level. This was a non-standard level for the planned track. As the B747 flight was to be conducted under radar control while in Australian airspace, the controller granted approval for the crew to operate at FL330. Subsequently, the change to a non-standard level, for the track being flown, was co-ordinated with all other controllers responsible for the Australian airspace through which the B747 would pass.

A Boeing 737 (B737) had departed from Cairns on a flight to Brisbane and was tracking direct to Mackay at FL330. This aircraft was operating at a standard level for the intended track.

The B747 entered the airspace under the jurisdiction of the Brisbane Sector 7S radar controller as the aircraft passed 75 NM to the west of Rockhampton. To ensure adequate coverage of the sector, the controller was using the 180-NM scale on the radar display. Within the sector, the track of the B747 was to cross five other routes which either converged or intersected. Aircraft using these other routes could operate at standard and non-standard levels relative to the track of the B747.

Sector 7 had two radar positions - Sector 7S and Sector 7V. Additionally, there was a planner position located between these radar positions. The planner controller was assisting the Sector 7V controller and not the Sector 7S controller.

The actual time the B737 entered the Sector 7S area, south of Townsville, was not determined. However, based on groundspeed calculations made by the investigation team, the B737 was estimated to have entered the sector approximately 5 - 10 minutes after the B747. The controller was busy at the time and satisfied with the overall traffic situation but did not appreciate the possibility of the two aircraft coming into conflict. The B747 was at FL330 as it approached Hamilton Island from the south. The tracks for the two aircraft crossed 33 NM south-south-east of Hamilton Island. As the aircraft approached the crossing point, the radar controller was required to coordinate and separate a number of departures from Mackay and Hamilton Island airports.

The horizontal separation between the B747 and the B737 aircraft had reduced to 5.5 NM before the controller observed the proximity of the two aircraft on the radar display. The controller instructed the crew of the B737 to turn right to pass behind the B747.

The crew of the B737 sighted the B747 as the controller issued the avoidance instructions. The crew had previously observed the B747 in the distance, but had not perceived it as an aircraft. They were about to request clarification from the controller about a possible aircraft approaching them, when they were advised to turn right. The B737 crew complied with and acknowledged the instruction. The controller subsequently issued traffic information on the B747 to the crew of the B737.

The crew of the B747 received a Traffic Advisory (TA) warning on the aircraft's Traffic Alert and Collision Avoidance System (TCAS), which indicated traffic at the 10-o'clock position at 4 NM. The crew looked for the traffic but did not sight the B737.

The two aircraft passed with a horizontal separation of approximately 2.4 NM and at the same level. The minimum separation standard required was 5 NM horizontally or 2,000 ft vertically. There was a breakdown of separation.

Aircraft cruising levels

Normally, aircraft are approved to operate at flight levels in accordance with the instrument flight rules (IFR) cruising level table. The table used provided standard vertical separation between aircraft which were flying on easterly (example levels are FL330, FL370 and FL410) and westerly (example levels are FL310, FL350 and FL390) magnetic tracks. Approval to operate at other than standard levels could be granted by an air traffic controller when traffic or other circumstances required a change in level assignment. In order to assign a non-standard level, controllers are required to consider the implications on workload and coordination, and the effect on other aircraft which were operating at standard levels. These aspects were considered prior to the B747 crew receiving approval to operate at a non-standard level.

Sector 7S

The Sector 7S controller was responsible for the provision of en-route control services for transiting aircraft as well as arrival and departure control services for aircraft inbound/outbound from airports within the sector which covers a large portion of the Queensland central coast. Additionally, the controller was responsible for the provision of a radar advisory service (RAS) and a search-and-rescue (SAR) alerting service for aircraft operating in non-controlled airspace within radar coverage in the eastern portion of the sector.

Controllers were aware of the potential problems with the crossing routes on this sector, and similar situations were practised in the simulator and encountered on a regular basis when operating the position.

Sector 7S controller

The controller had two and a half years experience in air traffic control and had recently passed a proficiency assessment. He had worked the same shift period the previous day and was adequately rested.

He had been on duty in the position for approximately 50 minutes prior to the occurrence, during which there had been a steady increase in traffic. He appreciated the level and complexity of the traffic situation at the time and felt comfortable with his control performance. He had not considered requesting assistance from the planner controller.

Sector 7 planner

The Sector 7 roster had recently been amended to facilitate staffing of the planner position during nominated times. These times covered anticipated busy periods when the planner controller would be of assistance to the two radar positions. The planner controller conducted coordination with other air traffic service (ATS) agencies on behalf of both radar controllers. This enabled the radar controllers to concentrate on the separation and management of traffic within their respective areas of responsibility.

When all three positions were staffed, the planner and radar controllers shared a communication line to a number of approach control centres serving airports within the two radar sectors. When this line was being used by any of the Sector 7 positions for coordination, it could not be used by either of the other two positions. Consequently, coordination to and from other ATS agencies was often delayed until the line became available. Also, the planner position had facilities to enable a controller to monitor the air-ground-air program of the two radar positions. The planner controller could monitor both radar positions concurrently.

Subject to workload, the planner controller could observe the performance of the radar controllers and provide some assistance to separate traffic if required. The planner controller was required to manage the assistance provided to any one radar controller to ensure it was not to the detriment of the other radar controller.

Traffic situation

The tracks and levels of the departing aircraft from the Mackay and Hamilton Island airports required, the Sector 7S controller to employ step-climb procedures. Subsequently, he spent some time ensuring separation between a number of aircraft in the area to the immediate south of Mackay. At the same time, he was monitoring another radio frequency expecting a transmission from the pilot of an aircraft which was due to arrive at Shute Harbour. The controller also had a number of other aircraft throughout the sector operating on both the control and RAS frequencies.

ANALYSIS

Flight routes and cruising levels

Generally, the operation of aircraft at levels in accordance with the IFR cruising level table would have provided the standard vertical separation of 2,000 ft between the two aircraft. However, because the route of the B747 intersected a number of north and southbound air routes, it would have conflicted with one of the routes, no matter what level was maintained. Action to separate aircraft on the various crossing routes was required on a regular basis. This required one aircraft to operate at a non-standard level or to be radar vectored until the situation was resolved.

As the B747 was to cross a number of routes which may have other aircraft at the same level, the safety net provided by the use of the cruising table levels was not available.

Sector 7 radar controller

The B747 and the B737 entered the sector at itssouthern and northern extremities respectively. The distance between these entry points (approximately 160 NM on the radar display), possibly made it difficult for the controller to appreciate the future potential for conflict between the aircraft. Also, the controller was dealing with a number of aircraft in the area south of Mackay and was distracted from regularly scanning the full display. These aspects combined to create a situation where the controller did not develop an awareness of the potential conflict.

The provision of assistance from the planner controller may have reduced some of the workload and enabled the radar controller to widen his scan of the sector. This may have enabled him to recognise the pending conflict between the B747 and the B737. Alternatively, the planner controller may have recognised the potential conflict and alerted the radar controller prior to the horizontal separation reducing to the minimum. However, because the planner controller was assisting the Sector 7V controller, she was unable to assist the Sector 7S controller or monitor his display. The radar controller thought he was coping adequately with the situation, and consequently did not request any assistance.

After resolving the situation near Mackay, the radar controller turned his attention to other areas of the sector. He quickly realised the situation and provided instructions to the crew of the B737 to avoid the B747. Generally, when there is a breakdown in separation, the provision of traffic information to the crews of the aircraft involved has priority. However, in this incident the priority was to have the B737 crew turn their aircraft away from the B747. Under the circumstances, the radar controller's momentary pause to receive an acknowledgment from the crew of the B737 prior to issuing traffic information was judicious. By this action, he was able to assure himself that the B737 crew had received the essential avoidance instructions before transmitting the traffic information.

The large scale and the variety of aviation activities occurring within the Sector 7S area made management of the sector difficult at times. The sector controller was required to resolve a number of conflicts within the sector concurrently. This resulted in the controller's attention being focused on one particular area of the display while separation action was being implemented. Consequently, other areas of the display did not receive adequate monitoring.

Human factors considerations

The controller was required to provide en-route control services to high-level transiting aircraft, an arrival/departure control service to aircraft operating to and from the underlying airports, and a RAS and SAR alerting service. The first two services are similar in implementation but generally cover different height bands. However, the provision of a RAS and a SAR alerting service represents significantly different types of tasks in cognitive terms compared to the other services. A study of United States Federal Aviation Authority air route traffic control centres (Bruce and colleagues,1993) indicated that a controller's task load is not solely related to increasing traffic, but is also very much conditional upon the degree of change in complexity of the overall traffic situation. Such was the case in the leadup to this incident.

A controller needs to be able to recognise the change in task complexity as well as an increase in traffic activity to manage the overall task better. Training for controllers to develop a specific awareness of when they are approaching task saturation would be a defence for future incidents. Also, resources should be readily available to provide assistance when controllers recognise that they are approaching task saturation.

For most of the time the controller may have been capable of readily providing all the required services concurrently. However, the differences in the types of the services provided and the spread of the traffic in the vertical and lateral planes across the sector, resulted in the controller requiring a complex management plan to be able to adequately manage the task. Consequently, because of this complexity, the total task load increased to the point where the controller may have become task-saturated.

Sector 7 planner

During busy periods, the planner controller could only provide limited assistance to the two radar controllers. This was mainly due to the limitations of the single available communications line to some of the other ATS agencies. The mode of operation of the communication line reduced the flexibility for the planner and the radar controllers to conduct timely coordination. Often when the line was available, the controllers were busy communicating with aircraft or conducting coordination with other Brisbane ATS positions. Provision of separate communication lines to the two radar and the planner positions would enable all three to conduct coordination concurrently. This would provide more options to reduce the task load.

The planner controller was the only immediate "safety valve" available to either radar controller should the latter approach an overload situation. Modification of the planner position to enable another controller to assist at the position may be warranted. This would ensure that assistance was readily available to either radar position which in turn would limit the possibility of future controller task saturation.

SIGNIFICANT FACTORS

1. The planned route of the B747 crossed a number of other routes which could have other traffic at the same level.

2. The controller was responsible for the provision of different services within a sector in which a number of areas required close monitoring concurrently.

3. The controller's attention was focused on separating traffic located immediately to the south of Mackay to the detriment of maintaining a regular scan throughout the total area of his responsibility.

4. The controller believed he was coping with the situation and did not consider requesting assistance from the planner controller.

5. The planner controller was assisting the Sector 7V controller and was unable to assist the Sector 7S controller.

SAFETY ACTION

This investigation identified specific safety deficiencies associated with the provision of ATC services in Brisbane Sector 7. The deficiencies were related to the complexity and workload of the Sector 7 radar controller, to the provision of only one planner controller to assist the two radar controllers and the limited communication facilities for the planner to assist the radar controllers.

The complexity and workload issues were compounded by the Sector 7 radar controller being responsible for a RAS as well as an en-route ATC service. This issue has been addressed by IR960009 which was issued on the 14 August 1997. The Interim Recommendation stated:

"The Bureau of Air Safety Investigation recommends that Airservices Australia re-assess the safety implications of providing a radar advisory service in conjunction with a radar control service."

On 15 September 1997, Airservices Australia responded to the draft occurrence report and advised that they had reviewed the implications of providing a radar advisory service in conjunction with a radar control service and were satisfied with the service currently provided in this sector.

Airservices Australia also advised that team leaders were rostered from 0600 to 2000 hours daily who were able to monitor the workload and complexity of each position and were able to take appropriate action to maintain the integrity of the positions.

The provision of additional facilities was addressed by Safety Advisory Notice (SAN) 970130 which was issued on the 17 September 1997 to Airservices Australia and the Royal Australian Air Force. The SAN was related to this and a number of other occurrences and identified the following safety deficiency:

"Aircraft movement coordination between Brisbane Sector 7 and Townsville ATC operator positions is constrained at times by the single inter-communication line."

Airservices Australia have informally advised that they intend to modify the two Sector 7 radar consoles to provide independent satellite communication facilities in late 1997 in conjunction with other scheduled engineering modifications.

The overall aspects of the ATC task methodology and human performance will be examined in a detailed study by the Bureau of Air Safety Investigation.