Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Investigation –200701982

Final

Breakdown of separation
22 km south-west of Sydney Airport, NSW
4 April 2007

VH-VON

Boeing Company 737-8FE

B-HLW

Airbus A330-300

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Abstract

On 4 April 2007 at about 0809 Eastern Standard Time a Boeing Aircraft Company 737-8FE registered VH-VON was inbound to Sydney, NSW from Melbourne, Vic. on descent to 6,000 ft and an Airbus A330-342X, registered B-HLW was departing Sydney for Hong Kong on climb to 7,000 ft. The distance between the aircraft reduced to 1.9 NM horizontal and 600 ft vertical separation. Separation standards as specified in the Manual of Air Traffic Services (MATS) required the provision of either 3 NM horizontal or 1,000 ft vertical separation between the aircraft. There was a breakdown of separation.

The loss of separation occurred as a result of the separation that was planned by the air traffic control officer being based on an incorrect cleared flight level (CFL) that had been entered into the controller's air situation display (ASD). The investigation concluded that this data entry error occurred within 2 minutes of the air traffic controller assuming responsibility for the control position, and that the reconfiguration of the in-use console by the controller during that time increased the risk of the controller being distracted from the traffic separation task.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances in order to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau prefers to report positive safety action in its final reports rather than making formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

FACTUAL INFORMATION

History of the Flight

On 4 April 2007 at about 0809 Eastern Standard Time[1] a Boeing Company 737-8FE (B737) registered VH-VON was inbound to Sydney, NSW from Melbourne, Vic. on descent to 6,000 ft above mean sea level (AMSL). An Airbus A330-300 (A330), registered B-HLW was departing Sydney for Hong Kong, on climb to 7,000 ft. The distance between the aircraft reduced to 1.9 NM horizontal and 600 ft vertical separation. The separation standard as specified in the Manual of Air Traffic Services (MATS) required the provision of either 3 NM horizontal or 1,000 ft vertical separation between the aircraft. There was a breakdown of separation.

Controller handover activities

At about 0800, a change of controllers commenced at the Sydney Approach South (SAS) radar controller position. That handover procedure was carried out in accordance with the MATS.[2] As part of the procedure, the outgoing controller provided advice to the oncoming controller including that:

- four aircraft were operating on the SAS frequency
- due to hazardous weather in the vicinity of the aerodrome, traffic diversions were affecting the SAS airspace
- a confliction existed between two arriving aircraft that were parallel to each other and subject to descent restrictions. Those restrictions were imposed as a result of departing aircraft having to avoid weather within the airspace being managed by the Sydney Departures South (SDS) radar controller. The restrictions kept the two arriving aircraft higher than the normal standard arrival route (STAR) profile.

At 0800:45, the oncoming controller accepted responsibility for the SAS position and, approximately 20 seconds later, commenced reconfiguring the air situation display (ASD) and console to reflect that controller's personal operating preferences. The reconfiguration process was completed at about 0803.

Traffic management activities

The arriving aircraft traffic confliction that formed part of the handover briefing involved an arriving SAAB Aircraft AB SF- 340B (SAAB 340B) and a B737 that was inbound from Melbourne.

Additional traffic management included an A330 that was about to depart from Sydney.

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1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time, as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

2 Part 6, Section 5, 6.5.26, p 6 to 49 (effective 08 June 2006).

Arriving SAAB 340B

The SAAB 340B was on descent to 6,000 ft, with a requirement to reach 8,000 ft by 20 NM from Sydney airport and a second requirement to descend to 6,000 ft by the Glenfield (GLF) non-directional beacon (NDB), which is located 10 NM south-west of Sydney airport. In support of that descent, the outgoing controller had inserted a memory prompt[3] of '080X' into the ASD radar data tag to indicate the initial descent requirement affecting the aircraft.

The SAAB 340B passed 8,000 ft on descent at 0801:33, and the '080X' memory prompt contained within the SAAB 340B radar data tag was deleted at 0802:08.

Arriving B737

At 0801:47, some 14 seconds after the insertion of the 8,000 ft memory prompt for the SAAB 340B, the flight crew of the inbound B737, when approximately 65 NM south-west of Sydney, contacted the SAS controller by radio. That radio contact included advice that they were on descent to 10,000 ft.

The SAS controller provided the pilots of the B737 with a clearance for further descent to 6,000 ft at time 0801:52, and issued approach expectations. A standard descent altitude is not prescribed for this arrival route; however the descent clearance given in this case contrasted with the reported normal approach radar practice of providing jet aircraft with a descent to 8,000 ft.

As a result of SAS controller input, the B737 ASD radar data tag changed to indicate a CFL of 8,000 ft at 0802:04. This contravened the requirements of the MATS,[4] which required the CFL to be amended on assignment of the 6,000 ft altitude clearance.

The pilot of the B737 correctly read back the descent clearance of 6,000 ft at 0802:06. The disparity between the B737 ASD CFL and the B737 pilot read back was not questioned by the controller as required by the MATS.[5]

Departing A330

Shortly after, an A330 aircraft departed Sydney for Hong Kong, on climb to 5,000 ft and was being radar vectored to avoid weather. The flight crew of the A330 were communicating with, and being controlled by, the SDS controller.

Development of the breakdown of separation

Verbal coordination between the SDS and SAS controllers, which was based on the incorrect ASD CFL of 8,000 ft for the inbound B737, occurred at 0808:26. That

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3 A Memory prompt is a free text insert placed in the aircraft radar data tag by the controller to highlight an important action or requirement that is not readily discernable from normal radar data tag information. In this case, the prompt was to remind the controller of the issued requirement to reach 8,000 ft by 20 NM because the ASD-Cleared Flight Level (CFL) level was indicating a cleared level of 6,000 ft.

4 Part 8, Section 2, 8.2.1f, p 8 to 7 (effective 31 August 2006).

5 Part 6, Section 1, 6.1.12, p 6 to 13 (effective 7 June 2007).

coordination permitted the SDS controller to process the outbound A330 through the SAS airspace at 7,000 ft, with an expectation of vertical separation with the inbound B737.

At 0808:59, when the B737 was about 15 NM south-west of Sydney, the SAS controller observed the B737 descending below the ASD radar data tag CFL of 8,000 ft. Realising that a potential infringement of separation existed, the controller requested the flight crew of the B737 to confirm their assigned altitude. The pilots advised that they were on descent to 6,000 ft.

Prior to the SAS controller being able to clarify the discrepancy between the ASD radar data tag CFL and the pilot-advised assigned altitude, a short-term conflict alert (STCA) activated on the SAS and SDS controllers' ASDs. That alert indicated that a loss of separation had or was about to occur. On receipt of the STCA, both controllers responded in accordance with the MATS.[6]

Additional Information

Situational Awareness

Situational awareness (SA) with respect to the provision of air traffic services is defined in the MATS as: [7]

> The perception and integration of external data inputs, the comprehension of their impact on the air situation, and the consideration of their effect on the provision of an effective air traffic management service.

Situational awareness is a key concept in aviation human factors research and in any domain where the effects of ever-increasing technological and situational complexity on the human decision-maker are a concern. Having complete, accurate and up-to-the-minute SA is considered to be essential for anyone who is in control of complex, dynamic systems and high-risk situations, such as air traffic controllers and pilots.[8] The lack of, or inadequate SA, has consistently been identified as one of the primary factors in accidents attributed to human error.

A radar controller obtains SA primarily from the ASD. Within the ASD, controllers must gather information from a variety of sources and, depending on the location of the scanned airborne traffic, identify critical characteristics in order to determine an appropriate course of action. A serious impediment to the maintenance of SA, and therefore, safety, occurs when the controller cannot efficiently process this information. That can be as a result of the distraction of the controller by non-separation tasks, or because their attention is tunnelled[9] to a single task. Any non-separation task, such as console set-up, places an additional burden on a

6 Part 2, section 10, 2.10.3, p 2 to 68 (effective 16 March 2007).

7 Part 10, section 1, p 10 to 21 (effective 31 August 2006).

8 Hopkins, V. David (1995*). Human factors in air traffic control*. London: Taylor & Francis Ltd.

9 Primary or concentrated focus on one task, to the detriment of another.

controller's short-term cognitive abilities which, in some cases, can lead to tunnelled attention.

US Federal Aviation Administration - strategies for reducing operational errors

The US Federal Aviation Administration (FAA) undertook an analysis of air traffic controller (ATC) Operational Errors (OE) between 1997 and 2000.[10] That analysis found that 35% of all ATC OE occurred within 20 minutes of a controller assuming control of a position.

In response to that error rate, the FAA established a number of initiatives including the need for an appropriate controller overlap period following the completion of the control position's transfer checklist. During the overlap period, the relieved controller is required to remain at the operational position, and is responsible for monitoring the activities of the new controller to ensure:

- the complete transfer of responsibilities between the affected controllers
- that the required level of SA is achieved by the oncoming controller.

The MATS does not have a similar overlap requirement.

Setting of personal console preferences

The setting up of personal console preferences does not form part of the handover procedure as detailed in the MATS and is undertaken on an opportunity basis after the oncoming controller has assumed normal separation activities.

The SAS controller advised that he did not feel mentally comfortable until the ASD was set to reflect his personal preferences. An analysis of the controller's input trace indicated that six console changes were made to the ASD settings prior to 8,000 ft being entered in the B737's radar data tag CFL, and that a further 13 console display setting changes were made after that CFL entry. The reconfiguration of the ASD occurred between 0801:08 and 0803:01.

A sample of five other controller input traces was carried out to ascertain the average time taken by those controllers to configure a console to reflect their personal preferences, and the average number of inputs during that time. The results of that examination are contained in Table 1.

10 Pounds, J and Ferrante, A.S. (2003). *FAA strategies for reducing operational error casual factors*; (DOT/FAA/AM-03/19). Washington, DC: FAA.

Table 1: Console set-up data

Controller	Time taken to configure console	Number of controller inputs	Number of aircraft on frequency
Controller 1	1 minute 56 seconds	13	2
Controller 2	1 minute 53 seconds	19	4
Controller 3	1 minute 03 seconds	12	3
Controller 4	1 minute 01 seconds	18	6
Controller 5	1 minute 12 seconds	15	4
Average	1 minute 25 seconds	15.4	3.8

ANALYSIS

The Sydney Approach South (SAS) radar controller detected that a potential conflict existed between the B737 and the A330 before being alerted by a short-term conflict alert (STCA). Following the STCA, all controllers reacted correctly to reinstate the required separation standards. This analysis examines those factors that may have contributed to the occurrence.

The incorrect cleared flight level (CFL) radar data tag of 8,000 ft that was applied to the B737 adversely affected the situational awareness (SA) of the SAS and Sydney Departures South (SDS) radar controllers. The result was that the SAS and SDS controllers agreed to climb the departing A330 through the verbally-assigned level of the inbound B737.

The late change of the CFL by the SAS controller when issuing the descent altitude, and the omission of a crosscheck of the pilot's altitude read back with the CFL display, resulted in the ineffective application of the prescribed system safety mitigators.

The investigation was unable to positively determine why the SAS controller cleared the B737 to 6,000 ft while amending its CFL to 8,000 ft. However the controller's input trace appeared to indicate that distraction from the primary air traffic control task was a factor. The monitoring by the controller of the descent requirements of the SAAB 340B, and the subsequent air situation display (ASD) interaction, may have increased the risk for that distraction to have occurred. That risk was increased further by the workload associated with the controller's self-imposed priority to quickly set his personal preferences on the ASD.

The results of the examination of a sample of controllers' ASD set-up inputs suggested that the actions of the SAS controller to conduct console configuration activities while performing separation actions, was not an isolated occurrence.

The US Federal Aviation Administration (FAA) overlap process highlights the obligations and safety accountability of an outgoing controller to ensure that the oncoming controller is familiarised with the air traffic situation, and operating in a safe and efficient manner, prior to leaving the operational position. There is the potential that the adoption of control position transfer overlap requirements during the normal takeover process, similar to those stipulated by the FAA, could reduce the likelihood of future similar occurrences. Those requirements could include the personalisation of the configuration of a controller's ASD.

FINDINGS

Contributing safety factors

- The displayed cleared flight level (CFL) differed from the level assigned to the B737 by the controller. That assigned level was being used for separation by another air traffic controller.
- The requirements of the Manual of Air Traffic Services (MATS) were not applied by the controller when inserting the CFL into the air situation display (ASD) radar data tag.
- The read back requirements of the MATS were not applied effectively by the controller.

Other safety factors

- The reconfiguration of the ASD by the controller increased the risk of the controller being distracted from the traffic separation task. [*safety issue*]
- There was no formalised control position transfer overlap requirement similar to that stipulated by the US Federal Aviation Administration (FAA). [*safety issue*]

Other key finding

- Once identified, the breakdown of separation was resolved in accordance with the MATS.

SAFETY ACTIONS

Airservices Australia

Airservices Australia (Airservices) advised the Australian Transport Safety Bureau (ATSB) that they had conducted a Normal Operations Safety Survey (NOSS) trial and that, following this occurrence and the results of that trial, the control position handover–takeover process warranted further examination.

Airservices is reviewing the handover-takeover process in respect to its level of detail, the appropriateness of the current checklists and the level of post-handover-takeover support. In addition, Airservices has commenced the development of a methodology and review program to determine areas of specific threat within the handover-takeover process and to identify relevant controls to mitigate any risks.

As part of its action plan, Airservices plans to review:

- its incident reports and investigations where handover-takeover events were considered to be a significant factor
- its NOSS findings in relation to the identified handover-takeover factors
- the available overseas literature in relation to handover-takeover threats identified in that literature.

The review will:

- include, but not be limited to the consideration of:
  - overlap periods associated with controller handover-takeovers
  - potential distracters from traffic management, including workstation reconfiguration by controllers.
- primarily engage the ATC Group, but would also involve the telecommunications and Airfield Rescue and Fire Fighting Services sections to provide subject matter expertise during the conduct and write-up phases.