Department of Transport and Communications

Bureau of Air Safety Investigation

An Investigation of Systemic Factors Underlying Air Safety Occurrences in the Brisbane Area Approach Control Centre

PRELIMINARY REPORT
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BASI
Bureau of Air Safety Investigation

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When the Bureau makes recommendations as a result of its investigations or research, safety, (in accordance with our charter), is our primary consideration. However, the Bureau fully recognises that the implementation of recommendations arising from its investigations will in some cases incur a cost to the industry. Consequently, the Bureau always attempts to ensure that common sense applies whenever recommendations are formulated.

BASI does not have the resources to carry out a full cost-benefit analysis of every recommendation. The cost of any recommendation must always be balanced against its benefits to safety, and aviation safety involves the whole community. Such analysis is a matter for the CAA and the industry.

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This report was produced by the Bureau of Air Safety Investigation (BASI), PO Box 967, Civic Square ACT 2608.

AN INVESTIGATION OF SYSTEMIC FACTORS UNDERLYING AIR SAFETY OCCURRENCES IN THE BRISBANE AREA APPROACH CONTROL CENTRE

CHAPTER 1

BACKGROUND

1.1 INTRODUCTION

During 1993 there has been a number of air safety incidents involving the Brisbane Area Approach Control Centre (AACC). Recent incidents involved breakdowns in coordination, loss of separation standards, incorrect annotation on flight strips, and failing to obtain level readbacks. In its investigation of the occurrences at the time, BASI found little commonality regarding the causal factors.

Following a suggestion by the Manager Brisbane AACC and consultation with Air Traffic Services Northern District Office and Central Office management, it was agreed that there could be significant benefit in BASI establishing a small team to undertake a systemic examination of factors underlying the air safety incidents which had occurred in the Brisbane AACC.

This report outlines the methodology used in the investigation and contains interim recommendations based information obtained from interviews conducted with controllers from the AACC in the period 21 to 23 September 1993. At this time, training for the (now deferred) ICAO airspace changes and "teams" was under way, enroute sectors were being consolidated to the Brisbane AACC, and the Northern District was acquiring responsibility for more airspace.

The interim recommendations address both national and local issues.

1.2 SCOPE

This investigation concerns issues related to the current work practices and equipment installed in the Brisbane AACC. The present route surveillance radar will be replaced in 1994 by labelled displays. Attention during the investigation

was directed at enhancing the safety net as it relates to the current displays.

1.3 OBJECTIVES

The objectives of the investigation were:

1. To determine whether there were any underlying organisational factors which had not been identified in the investigations of the occurrences involving the Brisbane AACC;

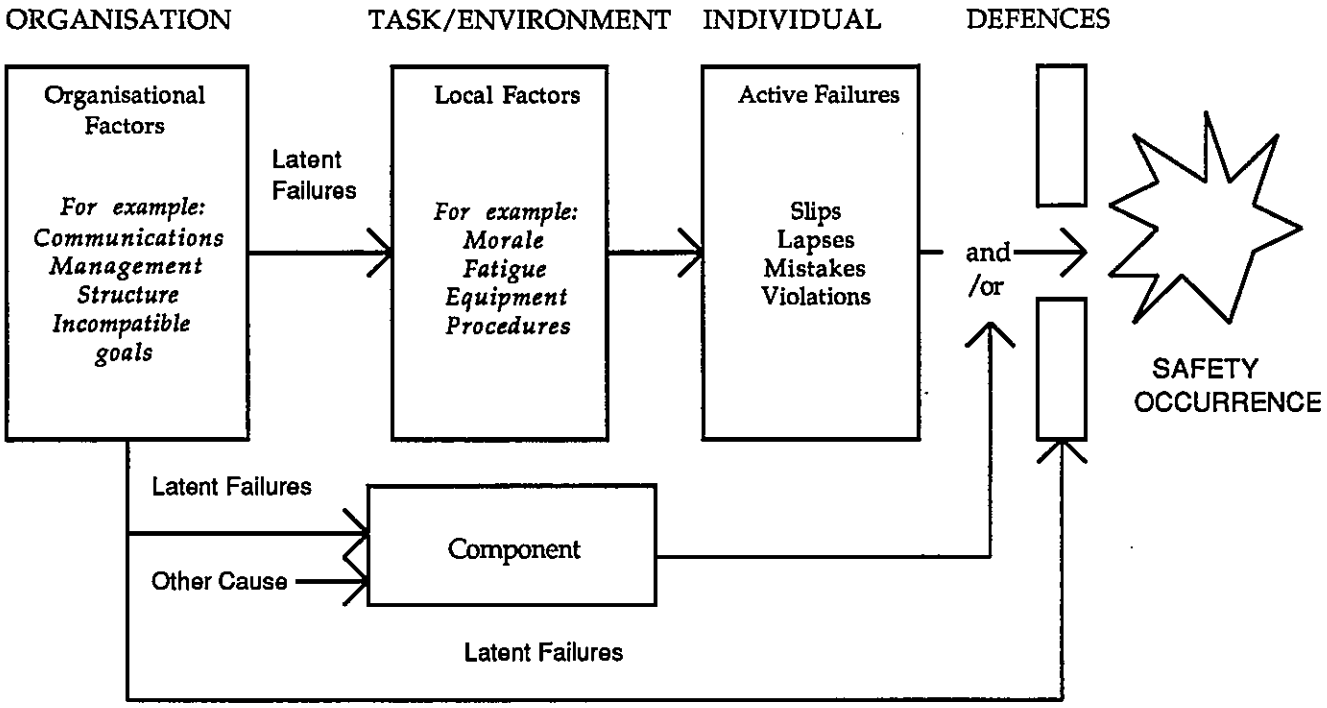
2. To examine ways of improving the "safety net" within the Brisbane AACC;

3. To identify areas for possible human performance assistance to Brisbane ATS; and

4. To make remedial recommendations as appropriate.

1.4 ANALYTICAL FRAMEWORK

The analytical framework of the examination was that developed by James Reason and recommended for adoption by ICAO at the AIG Divisional Meeting in Montreal, February 1992. This framework distinguishes between organisational factors, local factors and active failures. The basic model is presented below.



The main points of the model are:

1. People, by their very nature, will always make errors. Reason has called these errors **Active Failures.**

2. Complex systems (such as air traffic control systems) contain defences to protect them against human error. However, there will always be loopholes or **Latent Failures** in the system which may have been present long before they are seen in an occurrence.

3. Research shows that it is impossible to control or accurately predict the likelihood of a person making an error. However, situations and environments, or properties of the workplace, which increase the probability of error can be identified. These conditions, which include issues such as fatigue and low morale, are termed **Local Factors.**

4. Similarly, it may also be possible to identify latent failures in the organisation **(Organisational Factors),** such as communications, to which the presence of **Local Factors** can be attributed.

In *accounting* for an air safety incident, it may be sufficient to identify the active failures ("the controller did not correctly annotate the flight strip"). To prevent a

recurrence of the incident, however, this is probably the least useful aspect to identify, since it pertains to the least controllable element - the human. It is of more use to identify:

1. Whether there were any prevailing local factors which could have contributed to the mistake.

2. Any latent failures which contributed to the presence of local factors.

3. Any latent failures in the design of the system.

1.5 METHODOLOGY

The aim of the investigation was to collect information from three basic sources which align with the individual, task/environment and organisational components of Reason's model as follows:

Individual (Active Failures). An examination of recent incidents from the OASIS database provided details of the types of active failures which had been identified, ie slips, lapses, mistakes, violations.

Task/Environment (local Factors). Local factors associated with the Air traffic Control task and the AACC environment would be identified from:

1. Information from air safety occurrences which have occurred in 1993.

2. Interviews with controllers.

3. Interviews with Divisional ATS Management.

Organisational Factors. Organisational factors would be identified from:

1. Interviews with Divisional ATS Management; and

2. Interviews with Central Office ATS management

From this information, assessments would be made regarding improvements which could be applied to the defences of the ATS system in Brisbane. Additional information considered included the recent ATS QA report on Brisbane AACC.

Sample. The initial plan was to interview 30 controllers over a three day period. However, early in the exercise, it became apparent that, if each interview was to be properly completed, only about half that number of persons could be interviewed. In the event, a total of 17 controllers from Brisbane AACC, including controllers from Sectors 1, 2, 3 and 5, Approach, Arrivals, Check Controllers, and Senior Area Approach Controllers were interviewed. The high level of consistency in responses across the sample was such that the group was considered a statistically valid representation of the 200 controllers at the AACC.

CHAPTER 2

BRISBANE AACC EVALUATION

2.1 INDIVIDUAL (ACTIVE FAILURES)

Active failures identified from investigations of air safety occurrences included:

1. Failure to correctly indicate an amended flight level on a flight strip;

2. Failure to coordinate an amended flight level with the next sector;

3. Failure to confirm an assigned level.

4. Clearing traffic on a track and at or to a level which resulted in confliction with other traffic.

2.2 TASK/ENVIRONMENT (LOCAL FACTORS)

Local factors identified during interviews with controllers from the Brisbane AACC covered four main areas - procedures, environment, culture, and equipment. Information obtained with respect to these areas was as follows.

2.2.1 Procedures

Controllers felt that there had been considerable on-going effort towards monitoring the route structure and procedures, and developing improvements. Areas which were considered in need of further examination are outlined below.

IFR Aircraft to/from Archerfield. There has been one incident in 1993 and others in previous years which arose when IFR aircraft northbound from Archerfield, having been cleared into controlled airspace, conflicted with traffic into or out of Brisbane. Controllers

were asked their views on any difficulties that existed with respect to Archerfield and improvements which might be considered. Comments included:

1. Controllers at Archerfield appeared to not fully appreciate the Brisbane Approach environment and the pressures under which it operated. Start clearances were not always adhered to. This resulted in controllers being placed under pressure to issue clearances to ex-Archerfield aircraft, sometimes under conditions of high traffic workload.

2. There was a need for an Archerfield standard instrument departure (SID) which took aircraft well away from the Brisbane runway 01/19 centreline prior to them entering controlled airspace.

3. Similarly, the publishing of standard routes into Archerfield would also improve traffic flow. For example, two possible routes were Kilcoy-Amberley-Archerfield from the north, and Laravale-Archerfield (at a particular level) from the south.

VFR Aircraft Operating in Terminal CTA. Senior controllers felt that VFR aircraft operating within the terminal airspace and aircraft transiting that airspace substantially increased the air traffic control workload, primarily because a labelled radar display was not available. It was felt that, as an interim solution pending introduction of the labelled radar displays, there could be merit in introducing periods of restricted VFR access, standard visual routes to designated entry/exit points etc., so as to better control the impact these aircraft had on the sector workload.

Comment. In one of the 1993 incidents, the air traffic picture in Approach North airspace included a VFR aircraft operating to the north-west of Brisbane and a military helicopter transiting to the south of the airport. Analysis of the AVR tape recording covering the 15 minutes prior to the occurrence showed that 81 seconds of transmission time was solely devoted to obtaining the present levels of aircraft. Of this total, 50 seconds was occupied by the VFR aircraft and the helicopter. The remaining 31 seconds covered four IFR aircraft operating either to or from Brisbane. In the same period, 22 seconds of transmission time was devoted to obtaining the levels of four aircraft on Approach South and 33 seconds for two aircraft on Arrivals. Only IFR aircraft to/from Brisbane were operating on these latter two sectors. This analysis indicates the disproportionate affect on controller workload which itinerant aircraft on "one-off" tracks can have and highlights the need for careful evaluation of workload impact before such aircraft are cleared for operations in terminal airspace.

Flow Control. A common view, particularly from controllers operating the enroute sectors, was that the flow control of traffic outbound from Brisbane should be considered especially where traffic is destined for a procedural sector. (Sydney, for example, operates a system of controlled departures.)

Controllers on the enroute sectors indicated that they frequently experienced problems in gaining the attention of the flow controller when he was on the opposite side of the control

room. This involved standing up from their positions and calling across the room - thereby increasing individual workload and the noise level in the control room. It was suggested by some that equipping the flow controller with a mobile intercom system could be considered. However, others held the view that such a device would be too distracting.

Air Route Structure. The air route structure in some of the sectors was complex in places. Changes were being developed which should improve traffic flow at some 'bottlenecks'. Controllers were aware that ongoing monitoring and development was continuing.

2.2.2 Environment

Physical Environment. The recent changes in the physical environment of the AACC, particularly the training annex, the tea room, and the control room itself, were acknowledged and appreciated. However, controllers indicated that there remained a number of areas which, in their view, warranted further attention. These included:

1. Airconditioning. This was described as a long-standing problem which was thought to be due to not enough fresh air being provided in the building. This resulted in what was described as a general stuffiness in the room, and headaches and bronchial problems for some controllers.

2. Rest Areas. There was no quiet area available for relaxing or studying. The amenities room was somewhat noisy, close to the control room, and generally not conducive to relaxation or study. With the longer shift periods associated with the introduction of teams, there would be a greater call for such an area. The suggestion was also made that an outside sitting area would be a most welcome addition to the environment.

3. Exercise Facilities. A number of suggestions were made concerning exercise facilities such as a gymnasium for the AACC. As indicated above, longer shift periods would increase the demand for such facilities.

4. Controllers' Chairs. Some of those interviewed indicated that not all controllers chairs were maintained in a high state of repair. There were 'good' and 'bad' chairs from a comfort aspect.

5. Fire Escape. It was reported that the AACC was equipped with only one fire escape, whereas there should be two.

6. New AACC Building. Some controllers were unsure as to whether the new AACC Centre was going to be built. They were keen to be kept abreast of development plans.

7. The AACC Library. Comment was received that the AACC library was poorly displayed and located. This reduced its accessibility for controllers.

Discussion. Depending on the timing of the proposed new AACC building, there is obviously a limit to the resources which can be devoted to improving the current building. However, consultation with the controllers as a group might be an appropriate means of allocating priorities in this regard.

2.3 ORGANISATION

Organisational factors which were highlighted in interviews included the following.

2.3.1 The Service Ethos

There was a common view amongst the less experienced controllers that, when an aircraft requested a change to its cleared level or route, every effort should be made to comply with the request. The perception was that it was difficult to say no to such requests, as the provision of a 'service' was an integral part of their role. Aircraft crews commonly sought reasons if requests were not granted. This put pressure on the controllers to approve requests.

Controllers on procedural sectors indicated that they would not grant track shortening (as this was against procedures), but would endeavour to comply with level change requests, including the use of non-standard levels. The more experienced controllers indicated that they would carefully assess the workload impact before amending a clearance. However, the overall view expressed was that the provision of a service to aircraft was an important aspect of air traffic control.

Discussion. In his 1992 Review of the Australian Air Traffic Services System, Ratner noted that "ATS officers have been able to cater to ad hoc user requests under most circumstances and provide a highly personalised service. Their understanding of current industry economic difficulties, interpretation of CAA's mission to "serve the users", pressure from aircrews for direct clearances and preferred altitudes, and an industrial focus on compensation rather than working conditions all tend to reinforce this culture of individual ATS officers providing individualised service to aircraft. This culture begins to conflict with safety when traffic grows to capacity levels and this capacity is not acknowledged. ATS officer decision making workload grows disproportionately near (workload) capacity, with greater exposure to the risk of human error.

The ATS authorities of Europe and North America have responded to this situation by regularising ATS operational procedures so as to handle similar situations similarly, that is, to regularise and standardise the way successive aircraft are handled on major flow paths across airspace sectors, and to design clearances so these flow paths are regularly used. It is appropriate for Australian ATS to move in this direction by integrating and regularising ATS procedures and route structures within and between facility jurisdictions. Such a scheme , termed traffic management by its proponents and "running the system on rails" by its opponents, aids ATS officers' decision making reliability at high workloads, reduces

coordination and conflict resolution workload, and increases capacity where workload is the limiting factor. Both safety and efficiency are served, and necessary flexibility is not compromised. In addition to building understanding and acceptance among ATS officers, achieving an effective traffic management system will involve building industry understanding of the greater overall efficiencies to be gained.

Ratner Recommendation 9 Traffic Management Expedite the move to a system on traffic management whereby regular flow paths are established for major intercity and terminal movements to regularise traffic handling. This will involve consideration of preferred routes, STARs, SIDs, and airspace sector redesign."

The investigation noted that Recommendation 9 is being progressed by ATS both locally and at Central Office. However, the active failures highlighted at paragraph 2.1 of this report followed controllers agreeing to requests from aircraft or from other sectors. It would be appropriate for team leaders to place increased emphasis on the "service" aspect during training and checks.

2.3.2 Human Factors Awareness

There was minimal awareness among those interviewed of human performance limitations. For example, controllers were generally not aware of the effects of workload (high or low) on performance, or how to recognise and cope with these situations.

Discussion. In his 1992 Review of the Australian Air Traffic Services System, Ratner noted that"ATS officers need to acquire a better understanding of human performance limitations and mental processes. This understanding itself can be expected to reduce errors associated with human performance limitations, but not eliminate them; a safety net of backup procedures or systems is still necessary."

Recommendation 16 ATS Training Teach ... in-service training programs for ATS officers, principles and findings regarding human performance limitations and mental processes in ATS and appropriate practices to minimise incidents associated with those factors. Include specifically the following topics:

- *The capacity of airspace sectors and ATS officer performance near capacity.*
- *Maintaining vigilance in low workload situations.*
- *Risks associated with plans contingent on future attention requirements.*
- *Expectation errors, and the readback/hearback problem.*
- *Time-critical decision making and effective decision making in abnormal or emergency situations.*
- *Separation assurance as distinct from achieving separation.*

2.3.3 AACC/Control Tower Relationship

There was consensus among the more senior controllers that the relationship between the

AACC and the Control Tower needed improvement. It was felt that the Tower sometimes 'fired aircraft off' in rapid succession without fully appreciating the workload implications this could have on the Approach and Arrivals Sectors. A further problem involved international flights departing from runway 01 when runway 19 was the duty runway. It was suggested that Tower controllers should visit the AACC, and vice versa, to facilitate better understanding between the two units. Also, there were current procedures which allowed a regulated traffic flow to be achieved, and perhaps these were not being utilised properly.

2.3.4 Change and Training. There was an almost unanimous view amongst those interviewed that the AACC and its operation were having to cope with too many changes, and undergo too much training, in too short a time frame. Changes which were under way at the time included:

- Consolidation of en-route sectors to Brisbane - ongoing.

- Assuming responsibility for more airspace associated with the Northern District - ongoing.

- Implementing staffing restructures associated with the transition to the ATS Teams structure on 4 October 1993.

- Training for the transition to ICAO airspace classifications on 11 November 1993.

Preparation for the changes was reportedly placing considerable pressure on both the training system, and individual controllers. Without question, however, the change which was causing most concern was the introduction of the ICAO airspace classifications. Training for this change was described as being rushed and inadequate. Interviewees expressed a low level of confidence in being adequately prepared for the introduction of the new procedures.

Comment. Of all the issues raised during the interviews, it was this which arose as the major area of concern to controllers. Deferral of the ICAO airspace changes has probably temporarily relieved this concern. However, the areas of change and training require more complete examination before a meaningful assessment can be made.

2.3.5 Communications to and from Management

There was a general perception evident during the interviews that controllers viewed communications to and from management as deficient. Controllers indicated a desire to receive more frequent and detailed communications from management on developments within Air Traffic Services - on both national and local issues. A frequent comment was that they did not understand the reasons for changes and decisions from above. (For example, few were aware of the reason why 'teams' were being introduced.) In some respects, this manifested itself in a level of cynicism towards management.

Comment. In his 1992 Review of the Australian Air Traffic Services System, Ratner , in commenting on management communications, noted the following: "Management communications between Central Office and field facility personnel are perceived by the field as inadequate. It would be most unusual if in a period of rapid change such as exists today there were not such feelings, especially in view of the organisational restructuring and review of resource levels that have occurred. The perceived inadequacy contributes to low morale in the field and low morale, while most difficult to pin down as a contributory factor in operational errors, is probably an underlying contributory factor in distraction and inadequate planning incidents to some extent. Real change in staff attitudes depends on improved first line management, and the team concept is the best hope for that."

Given the recent introduction of teams at the Brisbane AACC , the mechanism is now in place, through the team leaders, for improved information flow, both from and to management.

2.3.6 Accessibility

The unanimous view of those interviewed was that the Manager AACC should have his office at the AACC complex, rather than be based remotely. This would enhance communications to and from management.

2.3.7 Gripe Book

A 'Gripe Book' is kept within the AACC library. It allows controllers to express their comments on any matter relating to the AACC. The management reply to these comments is then placed in the book for the perusal of all. Not all controllers knew of the existence of the 'Gripe Book'. Of those who did, few looked at it and knew little of its content. (See also comments on the AACC library)

Comment. The question arises as to whether there should be a formal system established to ensure that all controllers are aware of entries in the book.

2.3.8 Stand-Downs Following Incidents

About half of those interviewed (predominantly the more junior controllers) were not aware of the procedure which would apply should they be involved in an air safety incident. There seemed a lack of appreciation as to why controllers were stood down following an incident.

There was common agreement that counselling should be available to those involved in an incident as soon as possible after it occurred. In this context, counselling was available through Interlock by appointment which usually meant some delay. However, the controller's friend network was viewed as the preferred counselling source as it was immediately available and involved counselling from persons who were themselves

controllers.

The suggestion was made that the controller's friend network should be formalised. At a minimum, each team leader should undergo the three day controller's friend training course which was, in essence, a post trauma stress counselling course tailored to air traffic control. It was further suggested that all controllers would benefit by undergoing such a course.

CHAPTER 3

SUMMARY

The air traffic control safety net fails when human errors go undetected and/or uncorrected. These operational errors are generally more likely to occur in circumstances such as very high (or very low) workload environments, or situations involving complex coordination. Predisposing or underlying factors in, and relating to, the AACC operational environment can influence the frequency and results of operational errors. System safety can be improved by the identification of these predisposing factors and the reduction of their influence through change.

The controller interviews summarised in this report identified a number of underlying factors which, singly or in concert, could potentially contribute to operational errors. The interim recommendations contained below are aimed at addressing these underlying factors.

Shortly after the series of interviews with controllers was completed, the airspace changes scheduled for introduction on 11 November 1993 were deferred. On 4 October 1993, teams were introduced into the Brisbane AACC. The effect these events might have on interviewee responses is not known. BASI proposes, therefore, to conduct follow-up interviews with the same group of controllers in March 1994, after 'teams' has been in operation for 6 months.

CHAPTER 4

INTERIM RECOMMENDATIONS

The following interim recommendations (BS/930154) are presented for consideration by the CAA:

Task/Environment (Local Factors)

1. That the feasibility of developing a Standard Instrument Departure (SID), and standard arrival routes, for Archerfield be investigated.

2. That a program be undertaken to expose Archerfield Tower controllers and appropriate personnel from the Brisbane AACC to the operation of each facility, and the relevant problem areas.

3. That a program be undertaken to expose Brisbane Tower controllers and appropriate personnel from the Brisbane AACC to the operation of each facility, and the relevant problem areas.

4. That consideration be given to the flow control of outbound traffic.

5. That the feasibility of equipping the Flow Controller with an intercom system be evaluated.

6. That improvements continue to be made to the physical environment of the Brisbane AACC, including upgrading air conditioning and rest and exercise facilities.

7. That the AACC library be relocated to provide greater accessibility for controllers.

Organisation

8. That the potential risks in catering to requests from pilots and other controllers for clearance amendments be emphasised to all controllers and receive increased attention by team leaders in their everyday supervisory and monitoring roles.

9. That a protocol be published covering the procedures followed by the CAA in the event of a controller being involved in an air safety incident.

10. That the controllers friend network be formally established as part of the AACC operation and continue to be developed.

11. That all controllers undergo a post-trauma stress counselling course.

12. That the office of the Manager Brisbane AACC be relocated to the Brisbane AACC as a matter of priority.

13. That both management and the AACC controllers make maximum use of team leaders to facilitate effective and efficient two-way communications.

14. That all controllers undergo human factors training , emphasising the performance limitations of the individual.