AIRCRAFT ACCIDENT REPORT No 1/89

Air Accidents Investigation Branch

Department of Transport

Report on the Airmiss between the Tristar G-BBAH and the Tupolev 154 LZ-BTE near Lydd on 6 February 1988

LONDON
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2/88	Boeing Vertol BV 234 LR G-BWFC 2.5 miles east of Sumburgh, Shetland Isles, November 1986.	
3/88	Bell Model 222 G-META at Lippitts Hill, Loughton, Essex, May 1987	August 1988
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Department of Transport
Air Accidents Investigation Branch
Royal Aerospace Establishment
Farnborough
Hants GU14 6TD

4 January 1989

The Right Honourable Paul Channon
Secretary of State for Transport

Sir,

I have the honour to submit the report by Mr R C McKinlay, an Inspector of Accidents, on the circumstances of the Airmiss between the Tristar G-BBAH and Tupolev 154 LZ-BTE which occurred near Lydd on 6 February 1988.

I have the honour to be
Sir
Your obedient servant

D A COOPER
Chief Inspector of Accidents

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GLOSSARY

AAIB	Air Accidents Investigation Branch
ABB	Abbeville
ACT	Activate message
ASC	Assistant Sector Controller
ATC	Air Traffic Control
ATCA	Air Traffic Control Assistant
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATFMU	Air Traffic Flow Management Unit
BAA	British Airports Authority
BRS	Bristol
BNE	Boulogne
CAA	Civil Aviation Authority
CAR	Cardiff
CAS	Controlled Airspace
CASOR	Civil Mediator Organisation
CATO	Civil Air Traffic Operations
CCF	Centralised Control Function
CDB	Central Data Bank
CHIRP	Confidential Human Factors Incident Reporting Programme
CLN	Clacton
CORTA	Centre d'Organisation et de Regulation du Trafic Aerien
CSC	Chief Sector Controller
CVR	Cockpit Voice Recorder
DORA	Directorate of Operational Research and Analysis
DTY	Daventry
DVR	Dover
EDDUS	Electronic Data Display and Update
ETA	Estimated Time of Arrival
FDPS	Flight Data Processing System
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
HUR	Hurn

IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
JAS	Joint Airmiss Section
JAWG	Joint Airmiss Working Group
Kts	Knots (nautical miles per hour)
LATCC	London Air Traffic Control Centre
LJAO	London Joint Area Organisation
LTMA	London Terminal Manoeuvring Area
LYD	Lydd
MADAP	Maastricht Automatic Data Processing and Display System
MASOR	Military Mediator Organisation
MATO	Military Air Traffic Operations
MHz	Megahertz
MID	Midhurst
MOR	Mandatory Occurrence Report
NATS	National Air Traffic Services
OACC	Oceanic Area Control Centre
RDPS	Radar Data Processing System
RTF	Radiotelephony
ScATCC	Scottish Air Traffic Control Centre
SDAU	Safety Data and Analysis Unit
SFD	Seaford
STR	Strumble
TMA	Terminal Manoeuvring Area
UIR	Upper Flight Information Region
VFR	Visual Flight Ruled
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omni Range
WOR	Worthing

Air Accidents Investigation Branch

Aircraft Accident/Incident Report No 1/89
(EW/C1060)

Owner and Operator:		(1) British Airways Plc (2) Balkan Bulgarian Airlines
Aircraft (1):	Type: Nationality: Registration:	Lockheed L1011 Tristar British G-BBAH
Aircraft (2):	Type: Nationality: Registration:	Tupolev 154 Bulgarian LZ-BTE
Place of Incident:		18 nautical miles south-south-west of Lydd, Kent. Longitude 50° 42'N Latitude 000° 50'E
Date and Time:		6 February 1988 at 1138.32 hrs

All times in this report are UTC

This report is presented in the standard ICAO format recommended for aircraft accident reports. A glossary of abbreviations and acronyms is included.

SYNOPSIS

This incident, an airmiss, was reported to the Air Accidents Investigation Branch through the standard reporting procedures and was received, by telex, at the AAIB Headquarters at 1351 hrs on 6 February 1988. In response to a request from the Chairman of the Civil Aviation Authority, the Chief Inspector of Accidents ordered an Inspector's Investigation into the circumstances of the airmiss, and the investigation began at 1200 hrs on 8 February 1988. The AAIB team comprised Mr R C McKinlay (Investigator in Charge), Mr A W Skinner (Operations), and Mr P F Sheppard (Flight Data and Radar recording). Mr R A Home, an Air Traffic Control Officer I, was formally appointed to assist in the investigation. Representatives of the Bulgarian State Aeronautical Inspectorate also participated.

At 1135 hrs on 6 February 1988, the British Airways Tristar Flight BAW 305, en route from Paris to London Heathrow, was approaching a position some 12 nautical miles south-south-west of the Lydd radio navigation beacon. At the same time the Balkan Bulgarian Airlines Flight LAZ 967 was leaving the Lydd radio navigation beacon holding pattern having been cleared to descend for an approach to London Gatwick. There had previously been a significant build up of traffic due to a temporary, although pre-planned, closure of runway 26L at Gatwick - between 1056 and 1115 hrs - and an emergency closure of runway 27L at Heathrow at 1126 hrs. As a result there was a complex and unusual traffic situation, and in-bound aircraft to Gatwick were being held at Eastwood and Lydd. As the Tristar was descending to Flight Level (FL) 180 on a radar heading towards Biggin Hill, an airmiss occurred with the Tupolev 154, which was also descending to FL 180 whilst turning onto a radar heading for positioning at Eastwood. The Tristar commander saw the Tupolev 154 aircraft and took violent evasive action to avoid a collision. The Tupolev 154 flight crew were unaware of the confliction as their aircraft, at the time, was in a right hand turn that made visual sighting of the other aircraft virtually impossible. Both aircraft were under positive radar control and both aircraft were being flown in accordance with their flight clearances.

The report concludes that the primary cause of the airmiss was a lack of co-ordination between two experienced Air Traffic Control Officers who were controlling the two aircraft, in the same section of airspace, but on two different radio frequencies. Other causal factors were the lack of sufficient warning of impending traffic peaks, the lack of dual monitoring requirements between controllers, the lack of a conflict alert warning system, and the lack of formulated procedures to co-ordinate pre-planned runway closures with inbound traffic flow.

Thirteen safety recommendations resulted from the investigation.

1 Factual Information

1.1 History of the flights

At 1056 hrs on 6 February 1988 it was necessary to close Runway 26L at Gatwick Airport for repairs to a runway light. The repairs were forecast to take 10 minutes, but unfortunately took longer than expected and the runway remained closed to landing traffic until 1115 hrs. The London Air Traffic Control Centre (LATCC) watch supervisor had been informed of the planned closure at about 0930 hrs, but had not been consulted either about the time of closure or its possible effect on inbound traffic flow. However due to the experience of traffic peaks over previous successive Saturdays, inbound flow restrictions had already been ordered for aircraft routing via Abbeville, Boulogne and Koksy. These restrictions were to be effective from 1100 hrs. At 1126 hrs it was also found necessary to close Runway 27L at Heathrow Airport due to surface damage, and single runway operation was introduced whilst repairs were carried out. This situation prevailed until 1152 hrs, when take-offs were permitted by aircraft not requiring the full take-off distance available, however it was not re-opened for landing traffic until 2119 hrs. As a result, between 1100 and 1200 hrs there was a complex and unusual traffic situation, and inbound aircraft for Gatwick were being held at Eastwood and Lydd whilst inbound traffic for Heathrow was being held when necessary at Biggin Hill.

1.1.1 Bulgarian Airlines Tupolev 154

The Balkan Bulgarian Airlines Tupolev 154 aircraft, callsign LAZ 967, on a flight from Sofia to London Gatwick, entered LATCC airspace on airway UG106 in the Dover/Lydd Sector at 1122 hrs. (Appendix 1/1A). The aircraft was then descending from cruising flight down to FL 280. The initial radiotelephony (RTF) message was passed on the Very High Frequency (VHF) radio frequency 134.9 Megahertz (MHz) and the Dover Sector Controller cleared LAZ 967 to route via the Lydd Very High Frequency Omni- range (VOR) navigational beacon and Eastwood for Gatwick, and then re-cleared the aircraft to descend to FL 200. At 1124 hrs the Dover Sector Controller advised LAZ 967 of delays into Gatwick and instructed the aircraft to maintain FL 200 and enter the Lydd VOR holding pattern. LAZ 967 acknowledged the instruction and, at 1129.30 hrs control was transferred to the Lydd Sector Controller on VHF frequency 127.1 MHz. At 1134.30 hrs all aircraft in the Lydd holding pattern were progressively ordered to re-contact London on VHF frequency 132.45 MHz. LAZ 967 checked in on the new frequency and, at about 1137 hrs was informed by the controller that the Lydd hold was cancelled and the aircraft was cleared to descend to FL 120. LAZ 967 was also instructed to turn onto a heading of 270° to intercept the Mayfield

VOR 132° radial inbound to Eastwood. The aircraft acknowledged the instructions and commenced further descent. At 1138.03 hrs the controller instructed LAZ 967 to stop the descent at FL 180 and shortly afterwards followed this with the instruction to turn immediately, heading 270°, for avoiding action. During this turn, whilst maintaining FL 180, LAZ 967 crossed very close in front of and slightly above the British Airways Tristar, callsign BAW 305, which was also at FL 180 heading towards Biggin Hill. The flight crew of LAZ 967 did not see the Tristar and the aircraft subsequently landed at Gatwick without further incident.

1.1.2 *British Airways Tristar*

The British Airways Tristar, callsign BAW 305, which was on a flight from Paris to London Heathrow entered LATCC controlled airspace on airway A20 at 1129.30 hrs.(Appendix 1/1A). At that time the aircraft was levelling at its cruising altitude, FL 240, and had just crossed over the Abbeville VOR. Initial RTF contact was on the VHF frequency 127.1 MHz, and the Lydd Sector Controller instructed BAW 305 to maintain FL 240 and to route Abbeville, Biggin Hill for landing Heathrow runway 27R. In response to a query concerning the possibility of holding at Biggin Hill, the Sector Controller replied that the "traffic seems to have cleared". At 1136.03 hrs the Lydd Sector Controller cleared BAW 305 to descend to FL 180 and requested an expedited descent, followed immediately by a further instruction for the aircraft to turn onto a heading of 300°. At 1138.11 hrs the Lydd Sector Controller transmitted the callsign "BAW 305", but thereafter did not complete the message. At 1138.25 hrs, with the aircraft flying straight and level at FL 180 and maintaining the radar heading 300°, the commander of BAW 305 saw the Tupolev LAZ 967 to his right, slightly above, and as he subsequently described it "filling the windscreen". He immediately put the aircraft into a steep right hand descending turn and passed extremely close to and just below LAZ 967. In his immediate report of the airmiss by RTF, the commander of BAW 305 quoted a miss distance of within two or three hundred metres. The aircraft landed at Heathrow without further incident where the commander formally filed an airmiss report.

1.1.3 *LATCC Dover/Lydd Sector*

When both LAZ 967 and BAW 305 made their initial RTF calls to the Lydd Sector Controller, (Lydd East), LAZ 967 was descending to FL 200 with instructions to take up the holding pattern at Lydd. This was quickly followed by further inbound traffic for Gatwick to hold at FLs 210, 220, 230, and subsequently at 240 and 250. Meanwhile BAW 305, at FL 240, had passed Abbeville on a direct track for Biggin Hill. The situation was further complicated by a higher than normal proportion of overflights routing north on airway UA2 which had to be co-ordinated with traffic also overflying from the Scandinavian countries to Spain. A proportion of this traffic was following radar headings thus further increasing the sector workload. The Dover/Lydd Chief Sector Controller (CSC1) considered that the Lydd East Controller was rapidly becoming over-loaded, and decided to split the Lydd Sector and transfer some of the load to a second Sector Controller (Lydd West). The controller who was most immediately available and validated to control the Lydd Sector had just completed 90 minutes as Assistant Sector Controller (ASC) on the Dover Sector and had just been relieved in order to take a break. He nevertheless immediately volunteered to operate the Lydd West position, and this was accepted. As Lydd West Controller he was instructed to handle all traffic in the Lydd hold inbound for Gatwick, whilst the Lydd East Controller was instructed to continue to handle all other traffic in the Sector.

At 1134.30 hrs all aircraft in the Lydd VOR hold were progressively transferred to VHF frequency 132.45 MHz, whilst all other Sector traffic remained on VHF frequency 127.1 MHz. At the same time CSC 1 was relieved by another Chief Sector Controller, CSC 2. Lydd East Controller, recognising that the Lydd holding pattern lay across BAW 305's track to Biggin Hill, instructed BAW 305 to descend to FL 180 and, at 1136 hrs, asked for an expedited descent. To make sure that BAW 305 would be safely separated below and abeam the aircraft in the Lydd holding pattern, he also instructed the aircraft to turn onto a heading of 300°. This descent and radar heading was not communicated to Lydd West Controller who, at the same time, had been allocated FL 120 for LAZ 967 at Eastwood.

At 1137 hrs Lydd West Controller, knowing nothing of BAW 305's descent, cleared LAZ 967 to descend to FL 120 and instructed the aircraft to turn right onto a heading of 270° to intercept the Mayfield VOR 132° radial for Eastwood. It was during this turn that the airmiss occurred. At the last moment both controllers realised that there was an impending confliction. Lydd West Controller saw BAW 305's height read out at FL 180 and, believing that this aircraft was further descending towards Biggin Hill, ordered LAZ 967 to stop the descent at FL 180 and to expedite the turn onto 270°. The Lydd East Controller, who thought that he had heard LAZ 967's descent being stopped at FL 190, transmitted BAW 305's callsign, but nothing else. The time interval between the controllers' realisation that there was a confliction and the airmiss itself was very short, and neither aircraft was given traffic information. At the same time CSC 2 was occupied on the telephone, co-ordinating the descent of another Gatwick inbound, and when his attention was brought to the airmiss the two aircraft were about 1 nautical mile apart.

At the time of the airmiss both aircraft were under positive radar control, and there was no unserviceability to any ground radar or radio equipment.

1.2 Injuries to persons

None.

1.3 Damage to aircraft

There was no damage to either aircraft.

1.4 Other damage

There was no other damage.

1.5 Personnel information

1.5.1 Balkan Bulgarian Airlines Tupolev 154

The flight crew of this aircraft consisted of two pilots and a flight engineer. They were all experienced on the aircraft type, and held the appropriate Bulgarian licences.

1.5.2 British Airways Tristar

The flight crew of this aircraft consisted of two pilots and a flight engineer. They were all experienced on the aircraft type, and held the appropriate United Kingdom licences.

1.5.3 LATCC /Dover/Lydd Chief Sector Controller (1)

ATCO I, Male, aged 54 years

Licence first issued 1.6.62, valid until 30.11.88

Arrived LATCC 4.6.62

Validations:

(i) Sector Controller: CLN, DTY, TMA(N), TMA(S), DVR/LYD, SFD/WOR/HUR - since 16.4.63

(ii) Chief Sector Controller: as above since 30.9.81

1.5.4 *LATCC Dover/Lydd Chief Sector Controller (2)*

ATCO II, Male, aged 56 years

Licence first issued 24.1.64 valid until 30.6.88

Arrived LATCC 1.4.64

Validations:

(i) Sector Controller: DVR/LYD, SFD/WOR/HUR, TMA(S) - since 6.8.64

(ii) Chief Sector Controller: DVR/LYD, SFD/WOR/HUR, TMA(S), BRS/STR/20, CAR/23 - since 30.9.81

1.5.5 *LATCC Lydd (East) Sector Controller*

ATCO II, Male, aged 39 years

Licence first issued 30.1.70 valid until 31.12.88

Arrived LATCC 14.1.70

Validations:

(i) Sector Controller: DVR/LYD, SFD/WOR/HUR - since 31.9.74 Lapsed due to illness 1980.

Re-validations:

(ii) Sector Controller: BRS/STR/20, CAR/23- since 6.4.81

SFD/WOR/HUR - since 12.2.82

DVR/LYD - since 12.4.83

1.5.6 *LATCC Lydd (West) Sector Controller*

ATCO II, Male, aged 40 years

Licence first issued 22.11.68 valid until 30.10.88

Arrived LATCC 23.9.68

Validations:

(i) Sector Controller: DVR/LYD, SFD/WOR/HUR - since 30.8.74 BRS/STR/20, CAR/23 - since 23.1.75 TMA(S) - since 13.10.75

(ii) Chief Sector Controller: DVR/LYD, SFD/WOR/HUR - since 24.8.84.

1.6 Aircraft information

1.6.1 *Balkan Bulgarian Airlines Tupolev 154, LZ-BTE*

The aircraft had a valid Bulgarian Certificate of Airworthiness and a current Certificate of Maintenance. Its weight and centre of gravity were within the prescribed limits. The aircraft's navigation and communications equipment systems were fully serviceable and in operation throughout the flight.

1.6.2 *British Airways Tristar G-BBAH*

The aircraft had a valid United Kingdom Certificate of Airworthiness and a current Certificate of Maintenance. Its weight and centre of gravity were within the prescribed limits. The aircraft's navigation and communications systems were fully serviceable and in operation throughout the flight.

1.6.3 ***ATC information***

The Civil Aviation Authority (CAA) was established under the Civil Aviation Act 1971. The principal responsibilities of the CAA are the safety and economic regulation of British civil aviation and the provision of air navigation services. The National Air Traffic Services (NATS) is jointly responsible to the CAA and the Ministry of Defence for the regulation and control of civil and military air traffic over the United Kingdom. The United Kingdom airspace is divided into two Flight Information Regions (FIRs) - 'London' and 'Scottish' - with air traffic control centres at West Drayton in Middlesex (LATCC) and Prestwick in Ayrshire (ScATCC).

1.6.3.1 ***LATCC***

LATCC became fully operational in 1971, and is responsible for the safe separation of all aircraft flying in the airways system within the London FIR, which covers England up to 55° North, Wales, the Isle of Man, the Irish Sea and the surrounding seas up to the airspace of adjacent countries. Within the FIR there are two categories of airspace - 'uncontrolled' and 'controlled'.

(i) Uncontrolled airspace

In uncontrolled airspace aircraft may generally be flown when and where they like and pilots are not required to comply with ATC instructions. However they are required to observe the Rules of the Air, contained in the Air Navigation Order, 1986.

(ii) Controlled airspace

To operate in controlled airspace, aircraft must be fitted with suitable radio and navigation equipment and their pilots must be appropriately qualified. Pilots must comply with Instrument Flight Rules and compliance with ATC instructions is normally mandatory. Controlled airspace is divided into three parts:

(a) Control Zones, which surround and protect major airports.

(b) Terminal Manoeuvring Areas (TMAs), which are established at the confluence of airways in the vicinity of one or more major airports.

(c) Airways, which connect the TMAs and link up with the airways of adjacent countries. Airways are corridors of airspace ten nautical miles wide, usually from a base of between 5000 and 7000 feet up to a height of FL 245. Above FL 245, which is regulated airspace, all aircraft, many of which are overflying the United Kingdom, are subject to a full and mandatory air traffic control service.

1.6.3.2 *Air Traffic Control service*

Civil controllers at the LATCC operations room, West Drayton, are responsible for providing an air traffic control service to maintain internationally agreed safe separation standards between aircraft flying in controlled airspace within the London FIR. This is done either by allocating different heights to aircraft or by arranging minimum horizontal distances between them. The separation distances vary. For example, an aircraft flying along the airways under radar surveillance may not pass within five nautical miles of another if it is at the same height; on the other hand if two aircraft are less than five nautical miles apart horizontally, they must be at least 1000 feet apart vertically. Above FL 290 this vertical separation is increased to 2000 feet. Under certain specified conditions of radar coverage the five nautical mile horizontal separation may be reduced to three nautical miles.

In order to provide this service the London FIR is divided into nine en-route sectors and two London TMA sectors. In addition some controlled airspace in the northwest of the area is delegated to a sub-centre at Manchester Airport. The en-route sectors are known by the approximate geographical area overlaid by the sector airspace, and are responsible for the airways and upper air routes, including aircraft crossing these routes, in their respective areas. Those sectors controlling the London TMAs are known as TMA North and TMA South, and are responsible for aircraft flying to and from Heathrow, Gatwick, Luton and Stansted Airports, and also all other aircraft flying within the TMA below FL 135. Inbound aircraft are regulated and transferred to the destination airport's approach control when they are about 25 nautical miles away. When aircraft cannot immediately be directed to the destination airport's control because of the density of traffic or delays for other reasons, they are directed towards one of several holding 'stacks' and then released in sequence. If the TMA holding stacks become full the aircraft are held at designated holding positions in the en-route sectors.

Each sector is controlled from a radar control suite located in the LATCC operations room. The size of the sector team varies according to the particular airspace requirements and the amount of air traffic needing a control service. A Chief Sector Controller is the team leader and directs the work of all personnel on a suite. He/she is responsible for the inter-sector co-ordination of all traffic entering or leaving the sector airspace. Two or more Sector Radar Controllers control aircraft within each sector airspace, maintaining radar watch and issuing executive instructions to pilots to ensure a separated, orderly flow of traffic. At LATCC the individual RTF instructions issued by controllers to pilots are not normally monitored by any other person, however they are recorded for investigation purposes.

1.6.3.3 *Flight Data Processing System (FDPS)*

The operator of every aircraft intending to fly within controlled airspace has to file a flight plan, listing the essential details of the flight. LATCC operates an IBM 9020D computer which provides Flight Data Processing and Radar Data Processing. It also provides traffic data for statistical and planning purposes. For repetitive scheduled flights the basic flight plans are filed weeks or even months in advance, and the information stored in a computer until needed. The FDPS provides information, in the form of flight progress strips, to each sector along an aircraft's route within the LATCC area of responsibility. The flight progress strips incorporate the call-sign and up-to-date information on timings, flight level, route and radar identification code at selected points along an aircraft's route. This, in itself is a considerable task. For instance during the 24 hour period 0001-2359 hrs on 8 July 1988, there were 3638 aircraft movements within the LATCC area, and this required the printing of 42,299 flight progress strips. This information is then placed on flight progress boards with the strips arranged in geographical and chronological order and displayed in front of the sector controllers and chief sector controllers. As the sector controllers give instructions to pilots, they record these instructions by manually annotating the flight progress strips in a distinctive red ink.

1.6.3.4 *Co-ordination of flights between sectors*

It is fundamental to the principles of LATCC operation that aircraft must not enter the airspace of an adjacent sector without prior co-ordination, and that the offering controller must always comply with any conditions laid down by the receiving sector. Under normal traffic flow conditions, co-ordination is carried out by transferring aircraft to an adjacent sector in accordance with standard procedures published in LATCC control instructions. These instructions lay down agreed levels and positions for the transfer of control. For instance the agreed level of transferring inbound Gatwick traffic from the control of the Lydd sector to LTMA South sector is FL 130. However, when an adjacent sector becomes heavily loaded, these standard agreed levels may be cancelled and the transfer of each aircraft must be separately negotiated by their respective Chief Sector Controllers. These negotiations are usually carried out using the LATCC operations room internal telephone system, and instructions and clearances are thereafter manually annotated on individual aircraft flight progress strips in a distinctive green ink.

1.6.3.5 *The radar environment*

Radar is the primary equipment that ATC uses to determine the position of aircraft, and thereby to control and ensure their safe separation. There are two types - Primary and Secondary. The main function of primary radar is to provide aircraft position; secondary radar gives aircraft position with identity and height information. Secondary radar depends for its action on a transmitter/receiver (transponder) that is a mandatory item of equipment for all aircraft flying within controlled airspace. On these flights, when receiving their flight clearance, pilots are allocated a four-figure code which, when selected on an aircraft's transponder, automatically responds to interrogation from a ground transmitter, and relays both the four-figure code and also the level at which the aircraft is flying.

At LATCC both primary and secondary radar information is processed and displayed at all the sector control suites on 21-inch horizontal radar displays. Each aircraft 'target' is displayed as a 'blip' with a trail of up to five shadows indicating its previous track. Alongside each aircraft return is an 'alpha-numeric' label indicating the aircraft callsign, its route or destination, and its actual flight level to the nearest 100 feet. For aircraft climbing or descending the planned or cleared flight levels cannot be displayed on the radar picture, however they are manually recorded on the flight progress strips.

1.6.3.6 *The Dover/Lydd Sector*

The area of responsibility and route structure of the Dover/Lydd Sector is shown in Appendix 2. The sector airspace is that part of CAS and UAS within the defined area, but excluding the airspace which forms the LTMA at FL 135 and below, and the section of airway A 37 (LYD-DET) from FL 75 to FL 135. At the Chief Sector Controller's discretion the routes within the sector can be sub-divided between controllers operating the Dover, Lydd East, and Lydd West positions as shown in the colour coding at Appendix 2. A joint responsibility exists where routes affect two or more parts of the sector. Responsibility for control and sector splitting procedures, as stated in the Manual of Air Traffic Services, Part II, are as follows:

One position open	-	R3 (Dover, Lydd East, Lydd West)	134.9 MHz
First split	-	Open R1 (Lydd East, Lydd West)	127.1 MHz
The Lydd split	-	Open R2 (Lydd West)	132.45 MHz

Priority for the use of the R2 position is given to military controllers of the London Joint Area Organisation (LJAO). The function of LJAO controllers is to co-ordinate the passage of operational military flights through controlled airspace, thus this position is only necessarily manned when there is a specific military requirement. There is no promulgated split of the Dover sector.

A diagram of the Dover/Lydd sector control suite is included at Appendix 3. Under normal operating conditions with a regular and orderly flow of traffic, the suite is managed by the CSC with two ATCOs, one controlling the Dover sector and the other controlling the Lydd East/Lydd West sector. An ASC operates the Dover wing and an ATCA operates at each wing position. The main feature of the Dover sector is that, although geographically the smaller of the two, a number of busy outbound routes converge at Dover. Standard departure routes from airports within the LTMA for flights to east and southeast Europe as well as aircraft over-flying the LTMA via Midhurst (MID), Compton (CPT) and Lambourne (LAM) to the same destination, all converge at Dover.

The main feature of the Lydd sector is the control of inbound flights via Abbeville (ABB), Boulougne (BNE), and TRACA. By agreement, control of aircraft within French airspace on the routes north of ABB, BNE, and TRACA is also delegated to the Lydd sector. This includes aircraft inbound for destinations within the LTMA as well as aircraft over-flying the LTMA. During normal operation, when both the LATCC 9020D and the Reims/Paris CAUTRA computers are in operation, the flight plan information held by the FDPS is activated by a signal (ACT message) from one computer to the other. At other times 'estimate messages' are passed by telephone and processed manually by the ATCAs. The essential information provided by the ACT signal, or 'estimate message' is the ETA for an aircraft at ABB, BNE, or TRACA, the flight level and transponder code. By agreement between LATCC and Paris ATCC the ACT signals or 'estimate messages' are sent at parameter times prior to the ETA. Currently these parameters are:

From Reims/Paris	-	12 mins before ETA BNE
	-	10 mins before ETA ABB and TRACA
From Maastricht	-	10 mins before KOK

These parameters represent the earliest pre-warning times, that are currently considered acceptable, detailing the actual expected arrival time of aircraft entering UK controlled airspace in the DVR/LYD sector. In practice they are not always achieved. Observations at the Lydd East/West position recorded at intervals over a typical three day period indicate that, even in a moderate flow of traffic, when flight strip printing was not delayed due to any technical unserviceabilities, a significant number of aircraft transferred to the Lydd radio frequency within 3 to 7 minutes of the printing of the ACT flight strip. There were also some isolated occasions when aircraft arrived before their strips had been printed.

Under normal conditions in-bound aircraft with destination airports within the LTMA are descended to standing agreed levels for the transfer of control. The agreed level for aircraft routeing ABB-BIG-Heathrow is FL 130, whilst the agreed level for aircraft routing from KOK to LYD-Eastwood-Gatwick is FL 110 to be level at LYD. CSCs may cancel these agreements at any time that they feel necessary, and in these cases the descent of each aircraft must be co-ordinated individually with the receiving sector CSC.

1.7 Meteorological information

An aftercast of the meteorological conditions prevailing on the morning of 6 February 1988, provided by the Meteorological Office, Bracknell, shows that an unstable airmass of polar maritime origin covered the United Kingdom, with low centres in north Biscay and the northern North Sea. There was a light westerly surface flow over Kent with a west to west-south-westerly flow at 18000 feet. Cloud amounts at low levels were generally small, but there were 7 oktas of layered altocumulus/altostratus between 9000 and 12000 feet. It is probable that there were variable thin layers of cirrus cloud at 17000 feet and above. There was no evidence of any haze between 17000 and 23000 feet where visibility, outside of cloud would have been 20 kilometres or more. The conditions at 18000 feet were not conducive to the generation of condensation trails. The airmiss occurred in Visual Meteorological Conditions (VMC).

1.8 Aids to navigation

The Lydd VOR transmits on frequency 114.05 MHz. On 6 February 1988 there were no reported unserviceabilities to the transmitter, and no pilot reports of poor or unsatisfactory reception.

1.9 Communications

VHF radio communication was satisfactory on all frequencies, and both RTF and LATCC Dover/Lydd Sector desk side recordings were available and transcripts were produced. Radar recordings were also available. There were however, some initial problems in obtaining satisfactory replays of the radar recordings, and the equipment appeared to be somewhat unreliable. There were no facilities that could provide a synchronised replay of the radar recording and the RTF recordings.

1.10 Aerodrome information

1.10.1 London Gatwick

At 1056 hrs Gatwick's runway 26L was closed for repairs to a runway light. At that time it was estimated that it would take 10 minutes to complete the task. The runway closure time had previously been co-ordinated by the British Airports Authority (BAA) duty officer and Gatwick ATC. The LATCC watch manager had also been informed. Unfortunately the repairs to the runway light took longer than expected. The unserviceable light had sunk into the tarmacadam surface, and water-induced suction made extraction very difficult. The runway was re-opened at 1115 hrs, and the first landing was at 1120 hrs.

1.10.2 London Heathrow

At 1126 hrs debris and broken fittings were observed on Heathrow runway 27L. The runway was closed and outside contractors were called in to carry out repairs. The runway was re-opened for departures only, with a reduced take-off distance, at 1152 hrs. It was restored to full operation at 2119 hrs. LATCC applied a restricted flow of 24 inbound aircraft per hour between 1300 hrs and 2100 hrs.

1.11 Flight recorders

1.11.1 Flight data recorders (FDR)

The British Airways Tristar, G-BBAH was fitted with a Davall type 1198 re-cycling wire accident data recorder, which was part of a Teledyne recording system. This recorded a total of 35 parameters plus a further 57 discretes (i.e. switch positions). Also included in the system was a 'quick-access' recorder which recorded a number of additional parameters.

Both recorders were read out by British Airways Flight Recorder Section and copies of the relevant periods were supplied to AAIB. There were no problems with either recorder, successful replays being obtained.

The Balkan Bulgarian Airlines Tupolev 154, LZ-BTE was equipped with a FDR, model MSRP-64, which recorded a total of 39 parameters plus a further 60 discretes. A copy of the readout in graphical form, together with some individual readout points were provided by Balkan Bulgarian Airlines via the Bulgarian Aviation Authorities. The readout appeared to be satisfactory with no problems to any system.

1.11.2 Cockpit voice recorders (CVR)

G-BBAH was equipped with a Fairchild A100 4-track, 30 minute duration Cockpit Voice Recorder. Due to the limited duration of the recorder, information regarding the incident would have been overwritten as the aircraft flew on to Heathrow. No useful information was obtainable from the CVRs.

1.11.3 Other recordings

Secondary radar data was recorded, and information concerning the actual tracks and altitudes flown by both aircraft was obtained from the radar heads at Pease Pottage, Debden and Heathrow. Copies of the relevant ATC RTF and deskside telephone recordings, which included time injection signals, were also obtained.

1.11.4 Synchronisation of recordings

The various recordings were synchronised in time by using the altitude readings and transmit switch operation recorded on the FDRs, the time and transponded altitude from the radar recordings, and the time injection and recorded intelligence on the ATC RTF and deskside telephone recordings. There were no significant discrepancies.

1.11.5 *Presentation of recorded information*

The radar tracks of both aircraft relative to the boundaries of the Dover/Lydd sector are shown in Appendix 1. This also shows a number of radio navigation beacons and reporting points, as well as the relevant planned inbound routes and the Lydd and Eastwood holding patterns. An expanded diagram of the subject aircraft tracks is included at Appendix 1A. This is also annotated with relevant messages derived from ATC recordings together with their timings, and also spot flight levels obtained from encoded secondary radar data. The sequence of events for the period of events immediately preceding the airmiss are described in the following paragraphs.

At 1136.53 hrs, whilst on a heading of 146° (M) and at an airspeed of 226 knots, LAZ 967 was cleared to descend in the hold from FL 200 to FL 120. The descent was initiated and 15 seconds later, the requirement to hold was cancelled, and LAZ 967 was instructed to turn right onto 270° (M). The aircraft then entered a 15° banked turn to the right. Approximately one minute later, at 1138.03 hrs, LAZ 967 was told to maintain FL 180, at which time the aircraft's speed had increased in the descent to 280 knots. The aircraft levelled out and 10 seconds later was told to turn right immediately onto 270° for avoiding action. Bank angle was then increased to 26° and the speed started to decay. At 1139.00 hrs the aircraft rolled out onto a heading of 270° (M) at a speed of 229 knots.

Meanwhile BAW 305, en-route near Abbeville, was cleared to descend to FL 180, and later, at 1136.03 hrs, was instructed to turn left onto 300°. At 1138.08 hrs the aircraft reached FL 180 and levelled out. At 1138.25 hrs, whilst at an airspeed of 321 knots, the aircraft took violent avoiding action by banking 50° to the right and pitching 5° nose down. It lost 200 feet in altitude before recovering to FL 181 some 30 seconds later.

From a calculation of the distance between the subject aircraft at the individual return points from the recorded radar data, it is estimated that the closest distance separating the aircraft was between 70 and 400 metres.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and Research

The tests and research considered necessary to this investigation were confined to two aspects. Firstly the human factors relating to ATCOs in their working environment. This research was carried out by a senior psychologist of the Royal Air Force Institute of Aviation Medicine, and his report is included in full at Appendix 5.

Secondly it was considered desirable to carry out an evaluation of some of the capabilities and capacities of the radar data processing equipment and the current practices and operational procedures that were in use at the time of the incident, and, in parellel, to look at some of the methods and operational techniques used by neighbouring ATC sectors, both domestic and international. To this end it was decided to ask for the co-operation of the authorities at EUROCONTROL Maastricht, the Paris ACC and its associated air traffic flow control organisation CORTA, the Frankfurt ATFM organisation, and ScATCC. Summaries of some of their various equipment capabilities and operational procedures are included as follows.

1.16.1 EUROCONTROL, Maastricht

The Maastricht Upper Area Control Centre (UAC) is responsible for providing air traffic services to General Air Traffic in the upper airspace over Holland (Amsterdam FL 300 and above), Belgium and Luxembourg (Brussels FL 195 and above), as well as the northern part of the Federal Republic of Germany (Hanover FL 245 and above). The ATC environment is characterised by a complicated route structure, high traffic density a large proportion of which is climbing or descending, and a heavily interrelated system of civil/military traffic co-ordination. The essential part of the air traffic control operation is the Maastricht Automatic Data Processing and Display System (MADAP). The basic philosophy of the design of the system has been to make maximum use of automated functions in order to relieve controllers from routine activities, thereby giving them more time to concentrate on their more important tasks, the planning and execution of tactical control decisions.

Automated functions contributing most readily to this aim are:-

- Processing of flight plan data, including the automated data exchange with computers of adjacent centres, automatic management and assignment of discrete secondary radar codes, calculation of flight profiles in the horizontal and vertical plane, printing of flight progress strips, flight plan navigation, and extrapolation of flight legs.

- Automatic initiation of radar tracks and multi-radar tracking, allowing the early identification of radar responses and continuous maintenance of radar identity.

- Correlation of radar and flight plan data, as well as the automatic update of current flight plans by means of actual radar positions, divergence detection and automatic display of potential conflicts where aircraft are diverging beyond defined values.

- Display of specific flight plan data and system information as defined messages on electronic data displays which, according to the functions of the working position, can also be equipped with touch sensitive co-ordination facilities.

- On-line recording of flight plan, radar and system data, as well as the display and print out of relevant information for training and statistical purposes, as well as the investigation of special occurrences.

A team of a 'Planning' and an 'Executive' Controller is responsible for the safe and expeditious control of the traffic within each sector. On the basis of 'Planning Standards', the Planning Controller establishes the overall plan for the flow of traffic within a sector, and specifies the conditions under which traffic must enter or leave the system. The Executive Controller carries out this plan. System functions which contribute most obviously to increasing control capacity appear to be advanced radar data processing, and the presentation of selected, processed data on radar and tabular displays. The presentation of a correlated track in MADAP enables controllers to have displayed alongside an aircraft's position symbol a comprehensive list of information including aircraft identity, actual flight level, aircraft attitude (level, climb or descent), cleared flight level, ground speed, rate of climb or descent, vector leader showing aircraft position in one minute's time, and any differences between an aircraft's planned and actual flight progress.

In practice the data displayed in the label alongside an aircraft's position symbol enables all controllers at every sector to be instantly aware of an aircraft's position, height and speed, plus any imminent changes. For instance when a Planning Controller alters the flight level at which an aircraft is to be cleared by the Executive Controller, the relevant data in the aircraft label is automatically changed. The re-cleared flight level symbol starts blinking for a pre-set time, generally one to two minutes, and, when the aircraft commences the climb or descent, the attitude symbol also changes. As an additional safe-guard the aircraft label includes a short term conflict alert symbol which flashes whenever radar separation standards are infringed, for whatever reason.

1.16.2 Paris ACC and ATFM

The Paris ACC, situated at Orly Airport, has a similar air traffic control profile to LATCC in that it has responsibility for the control of a high density over-flying traffic pattern, together with an equally high density traffic pattern originating from or with destinations at the domestic airports. The Paris FIR is divided into sectors that are generally geographically smaller than the LATCC sectors, and are also sub-divided horizontally. In the western part of the Paris FIR the upper and lower sectors are segregated at FL 195 and the responsibility for the control of these sectors is contained within the Paris ACC. However in the eastern area the division is at FL 245, the lower sectors being the responsibility of Paris and the upper sectors the responsibility of Reims. This sectorisation is the result of a positive effort to minimise over-flying traffic in the Paris TMA, especially below FL 195.

Each radar suite within the Paris ACC is operated by an Executive and a Support Controller. Whilst each have their own defined tasks, a listening watch on the RTF and monitoring responsibility is fundamental to the operation. The layout of sectors at Paris ACC allows for splitting of existing sectors into separate units, each with its own full complement of equipment. An essential part of the operation is the electronic co-ordination system.

Paris ACC is equipped with an electronic co-ordination system which disseminates constantly updated information on all flights to all appropiate sectors. Co-ordination of flights between sectors is accepted on the basis of information displayed by the system. The primary facility of the system is a touch sensitive display and up-date unit at each sector. Thus the receiving sector, with pre-warned digital information already displayed, only needs to take positive action if a conflict is apparent within its own sector. Otherwise silent transfer is acknowledged using the touch sensitive display. Whilst flight progress strips are still printed, they are confined to one per flight and are generally used as an 'aide memoire' as a precaution against the breakdown of the automatic system.

Another important feature of the Paris ACC equipment is the conflict prediction and alerting system, and its associated radar and RTF recording equipment. Due to the difficulties in defining collision risks between manoeuvring traffic in a terminal area, the conflict alert system can activate when there is in fact no real risk of a collision. When separation criteria have been eroded, the system activates although ATCOs may have already given avoidance instructions. This is recognised by the management and controllers are encouraged and trained to regard the conflict alert warning as primarily an 'attention getter', which is never to be ignored, however it may be discounted when the origin of the alert is re-checked and found to be safe. Equally, when the origin of the alert is not immediately apparent, instant reaction to resolve the predicted conflict must be taken. In order to ensure the validity of this philosophy, the system includes a highly sophisticated radar and RTF recording and playback facility. The radar picture from all transmitter/receivers as well as the RTF messages from all sector operating positions are constantly recorded and fed into a single source. When a conflict alert warning occurs an instant playback, in synchronised real time, of both the radar picture in use and the controller's instructions is available. If further investigation is considered necessary, a computer within the system controls a printer output that displays details of the flight paths of both the subject aircraft, and also calculates and displays the closest distances, both in height and azimuth separation, that occurred.

Separate from, but working in close conjunction with, Paris ACC is their ATFM unit, Centre d'Organisation et de Regulation du Trafic Aerien (CORTA) which regulates the flow of air traffic throughout all French controlled airspace. This unit, manned exclusively by experienced ATCOs, is responsible for both the long term strategic planning of the regulated flow of traffic within French controlled airspace, but also the short term tactical flow measures in the day-to-day operations, and this includes the selection and issue of individual slot allocations. Their primary equipment in carrying out these tasks is a computer system which stores previous traffic information and relates this knowledge to forecast future demands. In the short term it is programmed on a weekly basis. For instance the traffic flow count on a particular Monday is stored in the computer and then a forecast for the traffic flow on the following Monday is produced, which also takes into account differences that may occur due to seasonal variations such as public holidays etc. A similar count and forecast is completed for every day of the week and this information is used to formulate the flow control measures that it may be necessary to implement during the following week. It also serves to advise the ATCC management and supervisors of potential traffic peaks, so that manning levels and deployment can be planned accordingly.

1.16.3 *Frankfurt ATFM*

The Frankfurt ATFM unit is responsible for the air traffic flow management of all IFR traffic throughout the Federal Republic of Germany, Switzerland, and Austria. A dedicated ATFM cell, staffed by experienced ATCOs, operates from a separate department within the Frankfurt ATCC. Strategic flow planning derives from a central computer system that has stored information on all domestic flights within the area of responsibility, plus details of all scheduled over-flights that are registered with the Central Data Bank of Air Traffic Demand, an international facility based in Brussels. This information is further refined by daily traffic counts which are used as a basis for forecasting the following day's expected levels.

The daily tactical flow control is dependent on a parallel computer system which, after an activation message, automatically prints flight progress strips which display the ETA of every aircraft at the entry point into the area of responsibility. There are a variety of methods by which this is achieved, however there is one technique that is particularly relevant to forecasting the ETAs at sector boundaries of long range flights. The departure messages, that are routinely transmitted for all aircraft via the AFTN network, and that relate to all aircraft either inbound to or over-flying the Frankfurt ATFM area of responsibility, are fed into a computer. The computer then calculates the ETAs of each aircraft at the first entry point into the area of responsibility. This is achieved by programming the computer to recognise an aircraft type and match it with an associated speed. It is recognised that it is not possible to relate an assumed airspeed with a groundspeed due to the constantly changing upper wind conditions. However the computer derived typical speeds have been produced by taking an average, for each aircraft type, of observed speeds over a prolonged period and then a mean speed has been selected as the norm. Whilst there are acknowledged errors in this system, generally less than 5 minutes, it does provide reasonably accurate forecasts of immediate traffic flow problems and therefore can be used to warn the sectors likely to be involved, or to re-route traffic.

At present the tactical flow measures in operation at Frankfurt are operated by controllers utilising the information supplied by the computer system, but then printed on flight progress strips which are thereafter manually up-dated. A new system is currently under test whereby the total operation will be fully automated, and controllers will have constant video monitors showing actual traffic levels and forecast traffic flow. This system is expected to be operational before the end of 1988.

1.16.4 ScATCC

The Scottish FIR extends from the boundary with the London FIR northwards to 61 N near the Faroe Islands; to the east it reaches 250 nm from the UK mainland to the boundaries with the Norwegian and Danish FIRs; to the west it extends to the Oceanic Control Area boundary, about 150 nm from the mainland, and includes the airspace over Northern Ireland. Its Control Centre is at Prestwick. Also at Prestwick is the Control Centre for the Oceanic Control Area, which covers the eastern part of the North Atlantic and extends from the UK FIR boundaries to 30° West. Whilst the Oceanic Control Centre is not primarily concerned with the control of domestic traffic, it is involved with warning and controlling the flow of inbound Trans-Atlantic traffic.

The Scottish FIR is divided into sectors which vary in size according to the density of its traffic. A single Scottish Terminal Control Area, which protects the airports at Prestwick, Glasgow and Edinburgh, is divided into three sectors to provide for the complex climbing and descending traffic patterns. Each ScATCC sector is controlled from a radar display suite which includes a planning position, equipped to display flight progress strips, and an executive position with two radar displays as well as the associated radio and communications facilities. Air Traffic Control Assistants operate from a central area in the Operations Centre, and handle all flight data information and prepare the necessary flight progress strips for the controllers. They use teleprinters to receive flight plans, stored flight plan data, and printers connected to the LATCC 9020D computer. There are additionally five separate control suites available exclusively for military controllers to exercise control of military aircraft within the Scottish FIR.

When an aircraft is taking off from, or about to enter, the Scottish FIR the Sector Planning Controller will have previously been provided with a flight progress strip that includes the basic details of the flight. The Planning Controller assesses the overall traffic situation, issues the en-route clearances, and co-ordinates the progress of the flights with adjacent Sector Planning Controllers. The Executive Controller, having identified the flight by its associated label on his radar display, will then issue any further instructions that may be necessary to ensure either traffic avoidance or to give it the most expeditious route through the sector. The monitoring between Planning and Executive Controllers is an important part of this system.

A further responsibility at ScATCC is the joint co-ordination and control of traffic in the North Atlantic Region. Responsibility for this region has been divided into five states: Iceland, Canada, USA, Portugal, and the UK. The Oceanic Area Control Centre at Prestwick is responsible for providing ATC services in the eastern section of the North Atlantic region. Due to commercial demands and time zone differences the majority of North Atlantic traffic divides into two major flows - westbound in the morning, eastbound in the evening. In order to provide the best service to the traffic in terms of both safety and economy, a system of organised tracks is constructed by the relevant OACC every 12 hours to accommodate as many aircraft as possible on the most expeditious routes. Prestwick OACC is responsible for the day track system, and Gander OACC at Newfoundland for the night track system.

Each oceanic flight plan received from the departure airports includes the track, flight level, and cruise Mach number requested and this information is used to produce a planning flight progress strip. When an aircraft requests flight clearance, the planning controller attempts to fit the flight into the organised track system according to the requested level, Mach number and boundary estimate. Once the clearance is accepted by the pilot, the information is relayed to the relevant ATC centre and adjacent OACCs. It is then fed into the OACC FDPS which passes the information to a compatible computer at Gander OACC. Aircraft transitting the North Atlantic track system are required to fly at a constant Mach number and report their positions at designated positions, normally at intervals of 10° of longitude, and to give forward estimates of the time at the next position. These position report times and forward estimates are also fed into the computers which are programmed to calculate any potential reductions in separation criteria and warn the controllers of possible conflictions. An important feature of maintaining the minimal longitudinal separation of 15 minutes per aircraft at similar flight levels is the mandatory requirement to fly at constant Mach number. There is no separate ATFM unit at ScATCC as the London ATFMU situated at LATCC is responsible for tactical air traffic flow management for the whole of the United Kingdom and Ireland. When there is a necessity to apply additional flow measures to westbound oceanic flights (usually when the oceanic control computer fails) ScATCC/OACC notify the London ATFMU who carry out the flow control tasks.

1.17 Additional information*

1.17.1 LATCC History and Development

The combined civil/military air traffic system known as "Mediator", first became operational at West Drayton in 1971. At that time, in the civil Mediator Controlled Airspace Operations Room (CASOR) the controlled airspace was divided into sectors, with each sector control suite accommodating two horizontal radar displays and manned by two sector ATCOs headed by a Chief Sector Controller. Each pair of ATCOs was supported by an assistant sector ATCO and on most route sectors by an ATCA. Flights were monitored by the use of flight progress strips which were updated by hand as the ATCOs issued instructions. The military Mediator Middle Airspace Operations Room (MASOR), whilst an integral part of LATCC, differed significantly from CASOR in that control related to particular aircraft rather than to defined areas of airspace. The control suites had vertical radar displays, and MASOR did not use flight progress strips. A flight data processing and electronic data display system incorporating an interactive update facility being introduced in 1972.

It had originally been intended that the flight plan processing system for both the CASOR and MASOR operations at LATCC would be provided by the Myriad computer. However after delivery it was discovered that the Myriad's capacity was insufficient for both tasks, and it was decided to purchase an IBM 9020D computer, the same system as that then being used in the United States of America by the Federal Aviation Administration. Following the decision to purchase the 9020D, in 1972, a development plan was devised which set out to introduce the implementation of its full capabilities in planned steps. The aim was to provide additional capacity to meet traffic demands in the 1980's, and to replace and modernise the operational sector suites, to permit their use by two controllers at each position in both the CAS and MAS operations rooms. A major change planned was to use electronic data displays with update facilities to display flight plan data (EDDUS). EDDUS was to be developed to replace the manually updated flight progress strips and was to be capable of interfacing with the 9020D.

The requirement to use the full capabilities of the 9020D led to the view, in 1973, that a complete redevelopment would be necessary at LATCC. This was to cover the reorganisation of airspace control between the civil and military organisations,

**The information contained within this section refers to the situation as at 6 February 1988. Where procedures have been subsequently modified, or are under review, this is indicated in the text.*

the provision of vertical displays for civil ATCOs and an associated alteration of the manning of the civil suites. However because of a fall in traffic levels in 1973-74 it was decided not to proceed with the full redevelopment plan, and the proposed introduction of EDDUS was postponed until 1981. Work on the radar data processing system (RDPS) continued and, in 1974, an evaluation of RDPS was commissioned. This evaluation confirmed the view, previously expressed in the 1973 plan, that the system could not be fully exploited using the existing horizontal radar displays. The evaluation also recorded that LATCC ATCOs had a preference for vertical radar displays, and that the Mediator system and organisation was incompatible with the ATC system for which the 9020D RDPS was designed. A complete redesign of the sector control suites was recommended.

In 1976 the concept of a complete redevelopment at LATCC was again revived. At the same time it was decided to re-activate the computer update facilities and new proposals were formulated for the development and introduction of EDDUS. This revised planning culminated in the production of a document which drew together the main aspects of earlier plans and evaluations, and suggested a replacement of the entire ATC system at LATCC and the associated Mediator organisation. Three main reasons were put forward in support of this proposal. They were the obsolescence of two Joint Air Traffic Control Radar Units, situated at the Royal Air Force Stations at Watton and North Luffenham which served both military requirements and the civil East/North-East sector, the expected growth of traffic in the 1980s, and the need to resolve some of the shortcomings of the then current ATC facilities at West Drayton which had been disclosed during the evaluations.

The revised plan received financial approval in 1980 and the main contracts were agreed during the period 1980-83. From an early stage in the design, construction and installation process it became apparent that both the LATCC operations' room main power supply and environmental cooling and air conditioning services were inadequate for the proposed modifications. There were further difficulties with certain outside agencies failing to produce design work on time, and the cumulative delays amounted to some 18 months which, consequentially, prevented the installation of other equipment. The revised plan (1979) was therefore not fully implemented.

The next LATCC development plan, as presented by the CAA to The Monopolies and Mergers Commission investigation in 1983, was summarised in the Commission's report as follows:-

"The LATCC development plan contained other arguments to justify the plan arising from problems previously identified. There was the difficulty in using

horizontal radar displays in CASOR, the ATCOs' preference for vertical displays, and an evaluation of the viewing units used by military controllers which had judged them to be inadequate for the display of data from the 9020D processed radar picture.

The plan was based on the following facilities:

- *(a) new NATS radars, (at Debden and Garrowby), to provide the necessary cover of the East/North-East sector;*
- *(b) new operational furniture featuring vertical radar displays with additional processed radar display equipment for the East/North-East;*
- *(c) activation of the full RDPS of the 9020D computer facility;*
- *(d) EDDUS for the handling of essential flight data not displayed on the radar viewing units together with a support information retrieval system;*
- *(e) a new communication system, to provide central telephone and switching and distribution equipment.*

Three stages in the LATCC redevelopment were planned as follows:

STAGE 1. Re-provision of the East/North-East operational facilities which required 30 military and 2 civil operational vertical display suites and re-provision of 9 suites for training purposes;

STAGE 2. Re-provision of the remainder of the existing civilian organisation comprising 24 civil and 2 military units;

STAGE 3. Re-provision of the existing military suited and services. This was expected to require 10 new suites.

An important element in the LATCC development is the plan to move away from the Mediator organisation. The introduction of the new equipment will permit a change in operating techniques for both civil and military controllers and NATS has evolved a concept known as the Executive and Support (E&S) system. The Executive (radar) ATCO will be in overall charge of a sector, sharing his tasks with a support controller of the same grade. The support ATCO will be responsible for the major part of the computer input task, planning sector *operations, co-ordinating with other ATCOs and handling the telephone. The change is expected to result in a small increase in the requirement for ATCOs and a great reduction in the requirement for ATCAs. The major economies in ATCAs are expected when EDDUS replaces flight progress strips."*

Following the publication, in June 1985, of the Airports Policy White Paper (Cmnd 9542) and the governmental decision to further develop Stansted as the third major London Airport, a further change in priorities took place. It was then decided that capacity of the London TMA had become the most critical element in air traffic management in the south-east, and an analysis by the CAA's scientific staff stated that the potential problems that might arise from failure to be able to meet traffic demands in the London TMA were greater than those in the airways' sectors. Therefore following this decision to nominate Stansted as the third major London Airport, the CAA/NATS decided to expedite previous work that had been carried out with a view to further refining and developing the air traffic control system in the London TMA. The (then) new concept is known as the Centralised Control Function (CCF) and, it is claimed by NATS, that it differs radically from current ATC practice by adopting a 'one man/one airspace' philosophy under which each sector of airspace is allocated to one controller, and has a uniform flow of aircraft along its axis. The sectors are to be in the form of 'tunnels' in the sky, that will be outlined on the radar displays, so that controllers will know precisely what airspace they are to be responsible for controlling. The advantages of this system are claimed to be that it minimises the requirement to co-ordinate flights, and increases the capacity of the system as co-ordination currently accounts for a considerable amount of controller workload.

The revised plan was therefore amended as follows:-

(a) East/North-East sector and MASOR re-orientation plans would continue, unchanged.

(b) Civil airways sectors would continue to use the existing suites with such updating of the sector equipment as was possible.

(c) The London TMA would be treated as (b) above until after the East/North-East transfer and MASOR re-equipment was complete and then it would transfer to new suites with vertical radar displays. The Heathrow, Gatwick and Stansted Approach Control functions would be transferred to LATCC and integrated into CCF which would be progressively developed between 1990 and 1995.

A review of the overall plan showed that, by early 1988, the only completed project other than some modifications to existing equipment, was the transfer of the East/North-East sector to LATCC. At this time the current future planning was to be as follows:

(a) Airways sector suites update1987-1990

(b) London TMA update 1986-1988

(c) Transfer of TMA to new vertical radar suites 1990

(d) Transfer of Heathrow, Gatwick and Stansted Approach Control to LATCC 1991-1992

(e) Phased introduction of CCF airspace management and control concept 1992-1995

The CAA have stated that the existing air traffic control system at LATCC is being modernised by the installation of five new radars and up dating the communications facilities. More efficient use of the terminal airspace will follow with the introduction of CCF. However they acknowledge that, in view of the extent to which the existing LATCC equipment has been developed over the last 20 years, there are major problems inherent in further redeveloping an already congested operational unit. It is therefore the intention to plan for a new Centre (LATCC II) to be operational in 1996 and capable of handling the forecast traffic in the year 2000 and beyond. Detailed studies are reported to be taking place.

1.17.2 *LATCC Manning and Deployment*

In 1977, when there were 37 operating positions in use, the LATCC manning establishment was agreed at 80 ATCOs I and 300 ATCOs II/IV. In 1983, the Monopolies and Mergers Commission's report on their review of NATS operations was critical of the rostering and use of staff which was considered to be inefficient. During the period 1983-1988 the number of operating positions normally manned increased to 43. In the same period the number of controllers available for deployment ranged from 331 (ATCO II) in 1983 to 350 in 1985, and back to 301 in 1988. NATS report that the deliberate increase in staff up to 1985 was intended to provide an extra 30 controllers considered necessary to prepare for and implement the Executive and Suport controller (E&S) method of working, (associated with the introduction of EDDUS), and not for the manning of operational positions. During the period 1983-87, and continuing through 1988, there has been a fairly constant increase in the flow of both domestic and international air traffic. The progressive increase in traffic during that period is shown in graphical form at Appendix 4. During the same period, the actual numbers of staff available to operate the required number of positions has not changed in relation to the traffic demands.

The actual numbers of staff available during the years 1983-88 were (as at the 1st of each May):

	ATCOs I	ATCOs II/IV	TOTAL
1983	83	331	414
1984	80	338	418
1985	80	350	430
1986	80	332	412
1987	80	309	389
1988	91	301	392

(These manning totals against traffic levels are shown in Appendix 4)

The total manning available and the deployment of that manning has traditionally been conditioned by negotiation and agreement between NATS management and the trade unions representing the ATCOs. These negotiations include not only the terms and conditions of employment of ATCOs, but also how they should be deployed by rostering to meet operational requirements. In common with other CAA staff, the conditions of employment for ATCOs include a 40 hour gross/5 day week. In practice the majority of operational ATCOs are rostered on a shift basis covering 24 hours per day, 7 days per week, which results in an equivalent gross average of about 35 hours per week. The current arrangement is to divide the established manning complement into a 5 watch system, with the intention of ensuring that sufficient controllers are always available to man an agreed number of operating positions. The agreed number does not necessarily allow for all operating positions to be manned all of the time. In the event that there is, on a particular watch, an unexpected shortfall in properly validated controllers who can continue to work an operational sector, then it is LATCC policy that air traffic flow restrictions should be used to cover the deficiency. Because this is not always necessary, for example during the quiet periods at night, the opposite takes place and controllers surplus to immediate requirements are released and stood down. Further negotiations took place throughout the latter half of 1987 and continued through 1988 in order to attempt to agree changes in the the rostered hours of ATCOs to meet the recent rapid escalation of traffic demands. An interim agreement has been reached concerning the re-rostering of staff to cover peak traffic demand periods, and it is anticipated that final agreement of revised rosters will take effect from 1 November 1988. The final agreement will still retain the 5 watch system, but modified to ensure greater manning at times of forecast high traffic density.

1.17.3 ATCO Training and Licensing

The initial training of ATCOs begins with a Cadetship at the College of Air Traffic Control at Hurn on a course lasting about 2 years. The time during cadetship is equally divided between theoretical training at the college, and practical training at an operational unit. Regular assessments are made whilst at operational units on the cadets' ability to reach validation standard. Flying training is also provided to enable most cadets to reach the standard required to be permitted to fly solo. At the end of the course, when the cadets have achieved the required ratings (i.e. Aerodrome, Approach, and Area Control) they move on to their operational units.

At LATCC the training program starts with an introductory course in the training section followed by 'on the job' training as an Assistant Sector Controller. During this time there is also training on the use of the 9020D computer. After three to four months new controllers are expected to validate as an ASC on two en-route sectors. There then follows a period of consolidation when qualifications are expected to be extended to include validation on another en-route sector or that of an FIR controller. After about six months, radar training begins with a 'Mediator' course. This comprises a two weeks theoretical course in the LATCC training section, followed by 5 weeks (100 hours) simulator training back at the ATC college. Continual assessments of ability are made during this time. On their return to LATCC a further course of structured training is given (120 hours live training in a 2 month period), followed by 'on the job' unstructured training. When assessed as being ready for validation on two sectors the trainees are examined by selected, qualified examiners within the LATCC staff. The total time from commencing cadet training to initial validation as a LATCC controller is generally about 4 years.

An ATCO's licence is valid for 13 months, and must be renewed annually by a medical examination. Validations are maintained by satisfying Licence Competency Examiners (LCEs) that the required standards have been maintained. This is done by continuous assessments carried out by selected LATCC ATCOs, and an oral examination that normally co-incides with the date of the licence renewal. Validations lapse if not exercised for a period of 90 days. Thereafter, to re-validate a controller must undergo a further period of 'on the job' training. There is no ATC simulator at either LATCC or ScATCC that can be used as a back up to 'on the job' training.

The Monopolies and Mergers Commission report (1983) contains the comment that the CAA had advised them that "there was agreement in principle to invest in simulation facilities for LATCC, with installation to follow the completion of the LATCC development". This has yet to be done.

1.17.4 *Air Traffic Flow Management*

Over the last few years traffic levels within Europe have reached proportions such that it has been necessary to apply air traffic flow management restrictions in order to prevent excesses on ATC sectors. This has resulted in the creation of a Central Data Bank of Air Traffic Demand (CDB), based in Brussels, whose information comprising the latest details of the proposed timing and preferred routeings of all pre-notified scheduled traffic is available to all participating nations. The CDB is essentially a store of airline timetables. Both the submission of the details of proposed flights and subsequent notification of any changes are voluntary to all participants. There are currently plans to widen the data base to include more details on actual routes (as opposed to preferred routes) in order to increase its potential contribution towards the strategic planning of flow management.

The recognised necessity to introduce Air Traffic Flow Management (ATFM) measures has resulted in the creation of 12 separate Air Traffic Flow Management Units (ATFMUs), with the object of regulating the flow of international and domestic air traffic movements to ensure full exploitation of available ATC capacity, and the maximum flexibility and orderliness of traffic flow. These are situated at (in alphabetical order) Athens, Benelux (Maastricht), Beograd (Belgrade), Copenhagen, Frankfurt, Istanbul, London, Madrid, Moscow, Paris, Prague and Rome. In the United Kingdom the London ATFMU was created and Airport Scheduling Committees have been introduced. The basic application of these measures are described briefly and simply as follows.

1.17.4.1 *London Air Traffic Flow Management Unit*

The primary task of the London ATFMU is to plan and co-ordinate the flow of air traffic within the London, Scottish and Shannon FIR/UIRs. ATFM planning and co-ordination is carried out in two distinct phases; the strategic phase and the tactical phase. The strategic phase is concerned with the long term planning and organisation of methods designed to ensure the spreading of forecast traffic loading through such measures as Traffic Orientation Schemes. Strategic planning takes place in a time period from several months to about 24 hours before the operation of a flight. Tactical ATFM operations take place from 24 hours ahead up to the actual time of operation of a flight. The tactical phase takes account of the current serviceability of equipments, manning levels, the weather situation and any other factors which may effect the capacity of the ATC system on the day of operation. The strategic element of the London ATFMU is currently situated at the NATS Joint Field Headquarters at Uxbridge, whilst the tactical element operates at LATCC, West Drayton. In addition a contingency tactical cell is retained at Uxbridge to cope with unforeseen circumstances (such as power failure) whilst some strategic planning is also carried out at West Drayton.

1.17.4.2 Runway capacities and Scheduling Committees

The assessment of runway capacity is carried out by the CAA Chief Scientist's Division, in co-operation with NATS operational staff. Runway capacity is presented in movements per hour, where a movement is a landing or a take-off, and is defined as the 'average hourly demand which gives rise to an average delay of no more than 5 minutes over a typical summer day busy period'. For example, for 1988, the declared runway capacity for Gatwick (one runway for both arrivals and departures)is 40 arrivals/departures per hour, and a 6 hour busy period, whilst the declared runway capacity for Heathrow (one runway for arrivals the other for departures) is 35 arrivals plus 37 departures per hour, and a 4 hour busy period. The hourly capacities determined are then used in the planning of schedules by airlines and other operators using the airports. However, given the right conditions, the actual rates can exceed the planned rate, provided there is co-incidentally a favourable mix of aircraft types, departure tracks and airways flight clearances.

The airport's Scheduling Committees' members comprise planning and scheduling representatives of the airlines using the airport. The tasks carried out by the Committees are to co-ordinate the arrival and departure demands for all operators and to refine them to relate to the airport runway and terminal capacity limits. At present the Committees have no legal standing but are considered to be the best way of achieving efficient use of available airport capacity. In effect the user airlines distribute the available slots amongst themselves by mutual agreement, and it is accepted that the longer an operator has been using an airport the higher its priority. In allocating runway slots no consideration is given to a planned geographical separation of departure or arrival routes, and there are no permanent CAA (*ie* ATC) representatives on the Committees.

1.17.4.3 *ATC sector capacities and ATFM measures*

The assessment of ATC sector capacity is measured by a department of the CAA Chief Scientist's Division, the Directorate of Operational Research and Analysis (DORA). The DORA method uses a system whereby a collation of what are called 'busyness' assessments, which are made by experienced ATCO observers, are related to judgements from operational ATC management of what is an acceptable 'busyness' level for a particular sector. In the assessment process the observers examine the workload resulting from such factors as the complexity of the radar picture, the activity level of controllers operating the VHF radio and telephone equipment, together with the manual marking of Flight Progress Strips and liaison with colleagues operating the same or adjacent sectors. Computer simulation is then used to produce a relationship between 'busyness' and an hourly capacity traffic flow rate. In this respect it is pertinent to note that the capacity of an ATC sector must decrease significantly if en-route holding or extended radar vectoring is required.

With the information on forecast air traffic requirements and the current best advice on ATC sector capacities, the LATCC ATFMU prepares the long term strategic Flowplan, and also provides specialist ATFM controllers to co-ordinate day-to-day short term tactical modifications.

1.17.4.4 *LATCC Flowplans 87/88*

The proposed Flowplan 88 was finalised on 11 March 1988 and due to be fully implemented on 5 May 1988. The introduction to the proposed Flowplan 88 document included comments on the operation of Flowplan 87, and the lessons to be learned from it. Amongst these were the observation that although the application of inbound ATFM measures is designed to reduce major peaks in air traffic demand it may, in itself, cause bunching of air traffic due to the current methods of application. Flow restrictions which are stringent to one sector may result in a worse situation arising in an adjacent sector, especially where individual flows come together. The main reasons for this problem were identified as the inadequate exchange of data and liaison between operators, ATFMUs and ATC.

The LATCC Flowplan 88, seeking to alleviate the problems of 1987, postulated further restrictions to the departure, domestic, and inbound flow control regulations than had been previously in operation. Typical reductions, for example, were the proposal to reduce the departure rate via the Dover/Lydd sector from the 1987 rate of 30 per hour (KOK only) to 24 per hour (KOK + TRACA). Non-regulated traffic, and this includes the considerable number of North Atlantic flights departing the UK daily, was to be spread by means of the imposition of Minimum Departure Intervals from the major airports, by delaying ATC en-route clearance until capacity was available within the ATC system.

1.17.5 *Airmiss reporting, investigation, and statistics*

Under the regulations laid down in Article 85 of the Air Navigation Order 1985, there is a statutory requirement for both pilots and licenced air traffic control officers to report any occurrence that they consider may jeopardise the safety of an aircraft. An airmiss is defined, in the Manual of Air Traffic Services Part I, as having taken place 'whenever a pilot considers that his aircraft may have been endangered during flight by the proximity of another aircraft to the extent that a definite risk of collision existed'. Since by definition an airmiss report is initiated by a pilot who believes that there has been a collision risk, only a pilot can file an airmiss. When a potentially hazardous situation is observed by an air traffic control officer, the only statutory method of reporting the occurrence is by submitting a Mandatory Occurrence Report (MOR). There is a further option, available to both pilots and air traffic control officers, whereby they can report situations that they do not wish to be identified with, but nevertheless consider were hazardous or detrimental to flight safety. This is the Confidential Human Factors Incident Reporting Programme (CHIRP).

1.17.5.1 *Airmiss reports*

A pilot initially reports an airmiss either immediately by RTF at the time of the occurrence, or after landing by telephone. Thereafter pilots are required to submit a written report to the Joint Airmiss Section (JAS), a department within NATS. (Since March 1988 OC JAS reports directly to the Chairman CAA and the Chief of the Air Staff in their Offices as Joint Chairmen of the Air Traffic Control Board.) These written reports are submitted in an official format designed to cover the wide range of information required for an investigation. JAS then opens a file on the incident, including pilots' reports, RTF tape transcripts, and relevant photographs from radar recordings. Where one or more ATC controllers may have been involved, a separate investigation is carried out by specialist staff from Civil Air Traffic Operations (CATO) or Military Air Traffic Operations (MATO), or both as appropriate. A report of their investigation is submitted to JAS.

Once all the evidence on an airmiss report has been assembled by JAS it is submitted to the Joint Airmiss Working Group (JAWG). The membership of this working group, which was essentially 'pilot-orientated', comprised a forum of airspace users including representatives from airlines, professional aviation associations, the General Aviation Safety Committee, and military airspace users.

The CATO and MATO investigators are always present (although not members) and give specialist ATC advice. Membership has recently been increased by nominees from the Institute of Professional Civil Servants (ATC Branch) and the Guild of Air Traffic Control Officers (GATCO), while an ATCO from Eurocontrol is also often present. The JAWG committee meets once a month and reviews the evidence from the individual airmiss investigations submitted to them. The declared objectives of this procedure are that the committee should:

(a) Determine the cause of the airmiss.

(b) Assess the degree of collision risk.

(c) Formulate recommendations to prevent recurrence.

(d) Highlight any trends.

In their review of airmiss reports the members of JAWG assess the degree of risk inherent in each occurrence, determine the cause, take note of any remedial action that may have already been taken and, when appropriate, record their comments and recommendations. The degree of risk is assessed, in accordance with ICAO guide lines, and categorised as follows:

Category 'A' - Actual risk of collision.

Category 'B' - Possible risk of collision.

Category 'C' - Other reports with no assessed risk of collision.

The category awarded relates only to the circumstances applicable at the time of the incident; it does not indicate potential risk nor does it necessarily reflect the Group's view of the seriousness of the airmiss.

JAS maintains on computer a database on all airmisses, and after the JAWG assessment each airmiss is coded under a wide range of parameters including aircraft types, the location and geometry of the incidents, passing distance, degree of risk and cause. The database thus enables JAS to establish adverse trends in flight safety, and also provides source material for the airmiss statistics currently published by CAA and NATS.

1.17.5.2 MORs

When a potentially hazardous situation is observed and reported by an ATCO, a MOR is forwarded to the CAA Safety Data and Analysis Unit (SDAU) where it is entered into the database and, if merited, ATC aspects are investigated by HQ CATO specialist staff. The results of these investigations are not submitted to JAWG and therefore, even when an investigation suggests that minimum separation criteria may have been eroded, the details are not included in the JAS database.

The SDAU provided a computer listing of all ATC originated MORs involving the London FIR for the period 1983-1987. A study of these MORs was carried out using the following criteria:-

(i) Public transport aircraft involved.

(ii) Conflict or potential conflict indicated.

(iii) Unauthorised penetrations of regulated airspace by non-public transport aircraft excluded unless the MOR identifies a possible confliction with a public transport aircraft.

(iv) Military/civil conflictions excluded.

(In this context 'conflict or potential conflict' does not necessarily imply that a potential collision risk existed or occurred, but merely that it had been reported)

Based on the above criteria, the annual number of MORs reporting instances when a conflict or potential conflict might have occurred were studied in detail. Unfortunately, due to the subjective nature of the task, it was not possible to derive reliable figures from the data available. Studies were carried out by two separate organisations and the total figures produced differed to an extent that they cannot be considered to be reliable, and therefore are not included. However it must be recorded that both sets of figures showed similar trends, which were rising, and that the largest increase occurred between 1986 and 1987.

The MOR recording system does not include the necessary data to carry out an objective scientific analysis of the reported incidents. In order to improve the present system, with particular reference to ATC reported incidents involving loss of separation, HQ NATS is currently carrying out a study with the intention of introducing new procedures that will provide data in detail comparable with that available from airmisses.

1.17.5.3 CHIRP reports

The Confidential Human Factors Incident Reporting Programme was first introduced in January 1983. The scheme is run by the Royal Air Force Institute of Aviation Medicine, based at the Royal Aerospace Establishment, Farnborough, and is run with the approval of, and on behalf of, the CAA. When first introduced the scheme was opened as a confidential method whereby pilots, or other flight deck crew members, could anonymously report potentially hazardous incidents that they considered were caused by human error, and thus might have had a bearing on flight safety. The response has been such that from the beginning of the scheme in January 1983 until April 1988 there have been 952 reports received from flight deck crew members.

In August 1986, CHIRP was widened to include reports from ATCOs. From August 1986 until April 1988 a total of 136 CHIRP reports have been received from ATCOs, and of this number 45 have reported instances where prescribed separation standards have been eroded. Due to the anonymity and confidentiality of the scheme it is not practicable either to investigate fully the circumstances of each occurrence, or to determine how many of these reported conflictions actually represented a genuine collision risk.

2 Analysis

2.1 General

Before starting an analysis into the circumstances surrounding this airmiss it was considered that, if useful and relevant safety recommendations were to be made, it was necessary to look into the wider aspects of the safe operation of aircraft flying within controlled airspace, and not just at the actions of the individual ATCOs who were operating the LATCC Dover/Lydd Sector at the time. The safety of any public transport aircraft in flight depends upon a multiplicity of factors, many of which may not be relevant to a particular airmiss or incident investigation. Nevertheless, when investigating an airmiss, it is important to look at all the circumstances that may have caused two aircraft to arrive in the same section of airspace at the same time, and not merely the isolated involvement of individual pilots or ATCOs. The AAIB investigation has concentrated on the problems inherent at times of high workload rather than the problems that may be associated with quiet periods of operation.

At an early stage in this investigation it appeared that the causes of the airmiss were basic human errors by experienced and well qualified ATCOs, who failed to co-ordinate with each other and who failed to recognise a confliction whilst controlling a difficult air traffic situation under unusual conditions. However it is fundamental to all AAIB investigations that the purpose shall be to determine the circumstances and causes of an accident or incident with a view to the preservation of life and the avoidance of similar occurrences in the future; it is not the purpose to apportion blame. Thus it was important in this investigation to determine whether this was an isolated incident, or alternatively if it was indicative of a trend that might warn of similar situations in the future and, if so, what measures should be recommended to prevent recurrences. In this context it was considered important to examine not only the current LATCC operating procedures and practices, with particular reference to the human factors involved, but also to look at the methods of regulating and controlling the flow of air traffic between neighbouring sectors and countries. To this end the investigation was extended in order to examine the wider aspects of the flow of international air traffic. The purpose of studying the equipment and operational procedures in use at the ATCCs at Maastricht, Paris, Frankfurt and Prestwick was not to compare the equipment or operating procedures of any one with another or, in any way, to criticise one or another, but rather to look for the best aspects of all the Centres and to assess their potential in order to enhance air safety in relation to LATCC operations.

2.2 The Airmiss & Dover/Lydd Sector Operation

The sequence of events leading to the airmiss essentially began at LATCC at about 0930 hrs when the watch supervisor was informed of the the proposed '10 minute' closure of the Gatwick runway, but he was not consulted concerning the timing of the closure and its possible effect on traffic. On 16 March 1988 the AAIB informed the CAA of a draft safety recommendation suggesting that pre-planned closures of runways at airports within the London TMA should be centrally co-ordinated in order to minimise disruptions to an orderly flow of traffic. Subsequently procedures have been agreed that, except in an emergency, LATCC is to be informed in good time of any proposed temporary runway closures and consulted on the likely effect to traffic. The closure of the Gatwick runway, which started at 1056 hrs, unfortunately lasted longer than forecast (19 minutes) and an already significant build up of traffic was further exacerbated when, at 1126 hrs, it was necessary to order the immediate closure of the Heathrow runway 27L for emergency surface repairs. Due to the experience of traffic peaks over previous successive Saturdays, inbound flow restrictions had already been applied for aircraft routeing via Abbeville, Boulogne, and Koksy. These restrictions were to be effective from 1100hrs.

The standing agreed descent levels for all aircraft inbound to destinations within TMA(S) were cancelled and it was necessary to co-ordinate individually the progress of all aircraft. At the same time there was also a significant and, to the ATCOs concerned, an unexpected increase in the flow of inbound traffic to the Dover/Lydd sector. As the traffic flow increased, the CSC1 considered that the Lydd sector controller, who at that time was controlling both Lydd East and West (a normal situation) was becoming uneasy and therefore, quite reasonably, decided to split the sector, and assign the control of all aircraft in the Lydd holding pattern to a second controller, Lydd (W). It was unfortunate that the controller who was most immediately available and validated to control the Lydd sector had just completed 90 minutes as ASC on the Dover sector and had just been relieved in order to take a break. He volunteered to operate the position and was then allocated control of all aircraft in the Lydd holding pattern. He was thus faced with the minimum time in which to assess the overall traffic situation.

By the time that the Lydd West controller had organised his operational position's switches so as to be ready to accept the traffic, the Lydd East controller was already working the first 4 aircraft holding at Lydd, and he immediately transferred this traffic to the Lydd West frequency, since his RTF loading was then becoming heavy. As soon as the Lydd East controller had transferred control of aircraft in the holding pattern he instructed (at 1135.49 hrs) BAW 305 to descend to FL 180 and turn onto a radar heading of 300°. One minute later the

Lydd West controller was informed that FL 120 was available at Eastwood and instructed LAZ 967 to descend and take up a radar heading of 270° prior to establishing in the Eastwood holding pattern. It was following these two instructions that the airmiss occurred, and it resulted directly from a lack of co-ordination and communication between the two controllers operating the split Lydd sector. In addition the Dover/Lydd CSC2, who had also only recently assumed responsibility for the sector, had a high workload due to the need to co-ordinate individually the descent (and climb) of all aircraft within the combined sector, and he was unaware of the confliction.

With hindsight it is easy to state that if the split of the Lydd sector had taken place earlier, and if the CSC1 had had more time in which to assess the overall traffic situation and the sector controllers had had more time in which to communicate with each other, then the airmiss may well not have occurred. The lack of advance warning of potential traffic build up must be considered to be a primary factor in the circumstances preceding the incident. With the limited information available to him at the time, the decision of CSC1 to split control of the Lydd sector in the way that he did was entirely reasonable. Equally the decision of the Lydd East controller to descend BAW 305 to a flight level below the lowest level of the Lydd holding pattern aircraft and furthermore to order a radar heading that ensured, to his mind, both horizontal and vertical separation from Lydd holding traffic does not merit criticism. In parallel, the actions of the Lydd West controller were also reasonable. As soon as it became possible to descend the first aircraft from the Lydd holding pattern, and to transfer it for further onward clearance, he ordered the descent of LAZ 967 and at the same time a radar heading that would have ensured a reasonable track distance in order that the aircraft might lose height before entering the Eastwood hold. Whilst it is apparent that the primary causal factor in the resulting airmiss was the failure of the individual Lydd East and Lydd West controllers to co-ordinate with each other, another significant causal factor was the lack of sufficient warning of potential traffic build ups that the LATCC system cannot, at present, provide. A safety recommendation reflecting this view is further discussed in paragraph 2.6.

There are two further factors concerning the general operation of the Lydd sector that merit further examination. Firstly the situation regarding the priority of use of the R2 position. Unless there is a contingency plan to remove the LJAO controller to a position elsewhere, employing a Lydd West controller in the R2 position cannot be considered to be a reliable and safe option for coping with an increase in sector workload. It is therefore recommended that the priority for use of the Lydd R2 be reversed and allocated to the Lydd West controller.

The second factor is the position and use of the holding areas within the Lydd sector. The central position of the Lydd VOR holding patterns are not ideal and aircraft holding at FL 260 and below can be in conflict with other aircraft descending to Heathrow, Luton and Stansted. This can involve extensive use of radar vectoring, thus increasing controllers' workloads at a time when they would already have been busy. Due to the limited airspace within the sector it is difficult to see where the holding patterns could be better placed. BEXIL is an alternative for use between FLs 150-190 inclusive, and was not used on 6 February 1988, however it is appreciated that there is, at present, no standard organised routeing to the BEXIL holding pattern from Dover or Lydd. It is therefore desirable that a further examination of the positions and priorities of holding patterns within the whole Dover/Lydd sector should be carried out and a safety recommendation is made along these lines.

2.3 Human factors aspects

Because it appeared that "human error" might have been a major contributory factor to the circumstances of this airmiss, it was considered necessary to ask for the advice of a psychologist from the Royal Air Force Institute of Aviation Medicine. His report is included, in its entirety, at Appendix 5. Whilst the report stands on its own as a detailed and reasoned analysis of the human factors that may have contributed to the circumstances of the airmiss, there are two conclusions that need to be high-lighted and further commented on as being in need of immediate attention.

The first concerns the observation that whilst a major strength of the LATCC operational system is its flexibility, it also has the potential to obscure impending problems and, at periods of high workload, to favour unsafe methods. There seems to be no doubt that the greater the traffic flow, then the less that proper supervision, co-ordination and cross-checking can take place. To put it simply it appears that during periods of high traffic loading that may be further aggravated by bad weather or an unforeseen runway closure, the operational methods do not fail safe - on the contrary there is a greater tendency for mistakes to go unnoticed than there might be in other more modern systems. Throughout the investigation, the ability and dedication of the LATCC controllers has not been in doubt. It is the lack of modern equipment, especially in relation to the installation of automatic systems that reduce the necessity for verbal co-ordination and thereby reduce the overall workload on individuals that needs urgent attention. It is difficult to see how such a system could be installed within the present equipment and therefore no safety recommendation is included. Nevertheless the CAA have been advised that this is an area that requires further consideration.

The second area of concern is the lack of an ATC simulator. Under the current system of continuous 'on the job' assessment of ATCOs and a licence renewal that involves only a medical examination plus a short oral examination, a controller can go for years without witnessing or being directly involved in an emergency situation. The only practical counter to the stress of emergencies is training. In the airmiss situation the Lydd East controller, when he realised there was a confliction, transmitted the callsign BAW 305 but did not complete the message, presumably because he could think of nothing useful to say. "Traffic 12 o'clock same level - opposite direction" would have been an appropriate phrase. However the transmission of traffic information is not part of normal operating procedures, and therefore it becomes more important that reaction to abnormal situations is practiced. Not only would this permit the acquisition of the relevant skills in recognising an emergency situation and responding to it immediately, but it should also increase the awareness of controllers to be constantly on the look out for the abnormal. It is therefore recommended that the installation of an ATC simulator at LATCC should be given a high priority, and that a similar facility should be installed at all other major ATC units.

2.4 Airmiss investigation and statistics

By definition, an airmiss report is filed only when a pilot considers that his aircraft may have been endangered during flight by the proximity of another aircraft to the extent that a definite risk of collision existed. This definition may be convenient for statistical and analytical purposes, but it does seem to make the unwarranted assumption that risk of collision can only occur if one or more pilots can observe and report a collision risk. It cannot take any account of the occasions when two aircraft flying in cloud have passed dangerously close to each other, nor does it account for incidents reported by ATCOs where separation criteria have been seriously eroded but when no pilot has been able to see and therefore report the confliction. However, there have been airmiss reports submitted by pilots flying in IMC, which were prompted by the avoiding action passed to them by ATCOs, and therefore led them to believe that separation standards may have been eroded. Thus it would appear to be more relevant that JAWG, when deliberating their assessment of the potential collision risk of an airmiss, were required to note and consider the pilots' evidence, but to base their findings on the assumption that the incident had occurred in Instrument Meteorological Conditions (*ie* in cloud). If this point needs emphasising it is pertinent to note that, in the airmiss under investigation, the flight deck crew of the Balkan Bulgarian Airlines Tupolev 154, who flew their aircraft in accordance with ATC instructions, were completely unaware that they had passed dangerously close to the British Airways Tristar. The geometry of the closing angles made it virtually impossible for them to have seen the other aircraft, yet the airmiss took place clear of cloud in Visual Meteorological Conditions.

An analysis of MORs submitted by ATC sources, since 1983, has shown that there have been a number of incidents where either a marginal erosion of separation criteria, or a collision risk, has been reported. Although the data currently available does not allow an objective scientific analysis of the problem, it does suggest that more incidents are being reported. A percentage of this increase may well reflect a growing awareness of the existence of a problem by the ATCOs submitting these reports. Nevertheless there is also evidence of a trend, and the trend is upward. CHIRP reports from ATCOs also suggest that there have been a significant number of 'unreported' conflictions which, if perceived and reported upon by pilots, would probably have been classified as 'airmisses'. Because reports of these two categories are not submitted to JAWG the incidents are not recorded in the JAS database, and therefore are not included in the airmiss statistics regularly issued by the CAA and NATS. Thus the overall conclusion must be that the published statistics concerning 'airmisses' are selective, albeit unintentionally so, and that they cannot accurately reflect the total situation. Furthermore, the ICAO categorisation as used by JAWG cannot truly reflect the precise severity of an occurrence, because it does not identify why separation standards have been eroded in controlled and regulated airspace. The collation of such statistics reflecting the true cause of an occurrence should be designed to highlight possible weaknesses within the ATC system so that improvements can be made. A recommendation reflects this view.

It is vital in the interests of air safety to ensure that all incident reports, from whatever source, that relate to potential collision risks are investigated comprehensively and analysed. If increased flight safety is to result from an analysis of the circumstances and causes of 'airmiss' reports, it is more likely to be achieved if all reports of collision risk are investigated and included in statistics, and not just those that have been submitted by pilots. It is understood that HQ NATS is carrying out a study with the intention of introducing new procedures, particularly relating to ATC originated reports, that will provide data in the detail comparable with that currently available from airmiss investigations. It is important that any new reporting procedures, and the investigation that follows, should be especially designed to get the full confidence of ATCOs (who might well be reporting their own mistakes) in order to maximise the chance of an incident being reported as an MOR, and fully investigated, rather than submitted later as a CHIRP report which obviously cannot be investigated at all. A safety recommendation reflects this view.

2.5 Radar and RTF recordings

As the fundamental purpose of investigating aircraft accidents (or airmisses) is to prevent similar occurrences it is important that the investigators have instant access to the best evidence available at the earliest possible opportunity. Concerning the investigation of an airmiss within controlled airspace, or indeed any aircraft accident, this requires instant access to the radar recordings which should show precisely what the aircraft did. Similarly instant access to the RTF recordings that should show precisely what the pilots were told to do. Whilst both these requirements are individually available at LATCC, they cannot at present be played back simultaneously and in synchronised real time. Therefore much time consuming work is necessary in order to co-relate ATC instructions, and the pilot responses to those instructions, with the actual tracks of aircraft before an initial judgement on the circumstances can be formulated. It is important that the initial judgement should be made as soon as possible, in order to be able to separate a potentionally hazardous operation from a simple mistake, and thus save valuable time. For example an airmiss caused by a misunderstanding or an incorrect read back of an altitude clearance might not warrant the same depth of investigation as should be afforded to a more complicated operational situation.

At the start of this investigation it was found that the radar and RTF recording play back facilities at LATCC were less than satisfactory. Whilst the facilities may be considered by management to be adequate for making an initial assessment of controllers' involvement in reported incidents, they are not adequate for full and detailed investigations. The radar re-play equipment was not only unreliable but also the RTF recordings, whilst immediately available, could not readily be synchronised in real time with the radar recordings. In the event this was finally achieved by making a television video film of the radar picture, and then re-recording the RTF tapes onto the sound track of the video film. This was time consuming and resulted in an unacceptedly long delay between the incident itself and the time that the investigators were able to examine a recording that accurately co-related the aircraft flight profiles with ATC instructions.

It is evident, from demonstrations of the recording facilities at both Maastricht UAC and Paris ACC, that the technology is available to produce instant synchronised playbacks of both radar and RTF recordings together with a print out of aircraft flight profiles. This facility is not only of valuable use to any investigation, but can also be used as a practical and realistic training aid for

ATCOs. It is therefore considered desirable that similar equipment be installed at LATCC and, where appropriate, at other ATC centres. A safety recommendation reflects this view.

2.6 Air Traffic Flow Management

Air Traffic Control exists to provide a safe, orderly and expeditious flow of air traffic. Whilst flight safety must always be paramount, the growth in traffic movements over the past few years and the consequent commercial pressures on airlines has produced an increased demand for expedition. It is the conflict between flight safety and the expedition of air traffic that has largely brought the ATC system to saturation point. In an attempt to alleviate the situation, ATFM measures have been introduced at most of the major European ATCCs. However the individual methods of identifying the problems, and the solutions adopted, have sometimes differed to an extent that an orderly flow of international flights has become more difficult to achieve. Amongst the lessons learned from the experience of the traffic peaks of 1987, was that the application of in-bound ATFM measures did, in themselves, sometimes cause bunching of air traffic. If this is further exacerbated by an emergency runway closure in an already busy TMA, then a potentially dangerous air traffic situation can easily develop. Whilst, in the current air traffic environment, it is patently not possible to organise a system which regulates and controls the flow of international air traffic to an extent that sudden build ups of air traffic are avoided, it is certainly possible, with more advantageous use of the technology available, to make these situations far more predictable. As this airmiss investigation has shown, it was not the build up of traffic itself that was a primary causal factor, it was, more importantly, the lack of sufficient advance warning of a sudden increase in total traffic flow that contributed to the incident. High traffic flow is commonplace in the current ATC environment and is not, in itself, a hazard to flight safety. Controllers are accustomed and well practiced in dealing with such a situation. However a sudden and unexpected further increase in the flow of traffic can quickly overwhelm a sector's capability to cope with such traffic, unless adequate warning allows time to further deploy additional controllers. One of the main reasons for this problem is the inadequate and out-dated system of data exchange between aircraft operators, ATFMs and ATCCs. At present the agreed parameters for initiation of ACT messages to the 9020D appear to give too little warning to the sector controllers of a potential problem due to bunching of air traffic. It is therefore recommended that NATS management should reconsider and renegotiate the agreed parameters with a view to increasing, as far as practicable, the warning of the time of entry of aircraft into LATCC airspace.

There is general agreement between the major airline operators and national ATC managements of most European nations that the imposition of ATFM measures is necessary in order to ensure the safe operation of aircraft on domestic and international routes. There is less agreement on the methods by which this should be achieved. Experience from the early peak periods of the summer of 1988 has shown that whilst the ATFM measures in force have generally enabled the safe separation of aircraft in flight, they have done so at the expense of keeping a large number of aircraft delayed on the ground. Flight delays have frequently reached an unacceptably high level, and the consequent increased pressures on airline operators to meet take-off deadlines could also have been detrimental to flight safety. There is no obvious short term answer to this problem and it would be inappropriate in this report to attempt to suggest solutions that would depend upon prolonged negotiations for international agreement. Commonality of practices, procedures and automatic data transmission systems are of prime importance, but until it is generally recognised that national boundaries do not necessarily have to be ATC boundaries, it is difficult to see how a safe and expeditious flow of international air traffic, that makes the maximum possible use of the airspace available, can ever be achieved. This is particularly pertinent in south-east England with its close proximity to the FIRs and international boundaries of neighbouring nations.

Accepting the fact that the long term ideal of an internationally agreed and centrally controlled method of regulating the flow of air traffic is unlikely to be achieved in the near future, the short term measures that might alleviate the problem are limited to attempting to refine and improve the 'status quo'. In this respect it is apparent that the method and, more importantly, the speed of data transmission between ATCCs and their associated ATFMUs is less than satisfactory. With air traffic 'slots' on a particular route that may be restricted to, say, 8 aircraft per hour, and aircraft with an average cruising speed of, say, 8 miles per minute, it is important that, in order to avoid bunching, and thus a potentionally difficult situation (for ATCOs) developing, that tactical flow management methods need to be further refined.

The medium term strategic planning measure of imposing an hourly flow rate of traffic through an individual sector has to be finite simply because it must depend upon an estimation of a sector's (*ie* controllers') capability of safely controlling a given number of aircraft through that sector. Where adjacent sectors have differing capacities it is the lowest that must determine the flow rate between the two. Once sector capacities have been established and flow rate limitations promulgated, the medium term strategic planning of air traffic is basically a mathematical problem. It is the hour-to-hour, or more precisely minute-to-minute, tactical application of flow control measures to ensure a regulated and orderly flow of traffic that is proving to be a major problem. However solving this problem will result in increased safety and the greater expedition of air traffic. For an individual aircraft, tactical ATFM may be said to cease after it has been allocated a 'slot'. Thereafter it's separation from other traffic is exclusively an ATC problem. There is, however, an unavoidable time lag between the issue of a ground 'slot' and an aircraft's actual appearance in the airborne ATC environment. Should an aircraft be unable to take off on its 'slot' time, then this airspace provision is liable to be lost forever, as the present system does not have the flexibility to re-allocate 'slots' quickly. In this respect amalgamating the medium term strategic and tactical planning elements of the London ATFMU would seem advantageous. It is also considered desirable that the London ATFMU should be equipped with a separate computer, not reliant on the 9020D for its processing, but dedicated to the statistical analysis and forward planning of air traffic flow, and also capable of accepting and analysing details of the daily tactical traffic flow. Safety recommendations are made accordingly.

2.7 Automation and monitored procedures

It must be recognised and clearly stated that, when considering the safe transit through controlled airspace of the modern public transport aircraft, the role of the air traffic control officers is equally important to that of the airline transport pilots. Both disciplines require the high degree of individual skills necessary to operate sophisticated electronic equipment and demand finite periods of extensive concentration. It is here that the similarities diverge.

The modern passenger transport aircraft is generally equipped with the maximum practicable automation that was available at the time of its design and manufacture, and manufacturers and aircraft operators generally attempt to modify and up-date the aircraft's automatic systems in order to take full advantage of improvements in technology. Modern aircraft can be and generally are equipped with computers that operate flight management systems which control dual or triple automatic pilots, dual or triple automatic navigation systems, and provide comprehensive automatic warning systems that include 'ground proximity alert', 'altitude warning', and warning signals of significant deviations from pre-selected flight plan profiles. Standard operating procedures are designed to ensure that at all critical stages of flight, particularly take-off, departure, approach and landing, the minimum permissible crew of two pilots are constantly monitoring both the automatic systems and each other's actions. Recognising the high degree of concentration that is required of airline pilots, statutory limits are enforced on the total flying hours that they may complete within defined periods, and the minimum rest times that they must have between defined periods of duty.

The same high standards of professional skill and concentration that are expected from airline pilots are also expected from air traffic control officers. Experience has shown that within the UK this has almost invariably been provided. However what has not been provided is the degree of automation that is currently technically available, that would have enabled NATS to obtain the maximum benefit from the skills of their air traffic controllers. Indeed over recent years the expeditious flow of air traffic through UK airspace has depended more on the expertise of the controllers and the ATC procedures that they have been required to follow, than on the capabilities of the equipment they have been required to operate. The philosophy of designing aircraft systems that automatically carry out the 'routine' tasks best performed by computers is equally applicable to the design of ATC systems. The design and operation of the MADAP system operated by Maastricht UAC, is based on the principle of relieving controllers from routine tasks (which in any case are better and more quickly carried out by computers), thus giving them more time for their most important task: to take control decisions and carry them out. In carrying out this task the sector team consists of two controllers, one planning and one executive, and they both monitor each other. This is known as the Executive & Support concept (E&S). Similar dual monitoring procedures are followed at other centres, including Paris ACC and ScATCC.

Whilst it is acknowledged that, during the last decade, there have been many significant improvements and updating of both the radars, the radar data processing equipment, and the air traffic control procedures that are now in operation at LATCC, there is still a need for further improvement. The degree of automation that is installed and in operational use at Maastricht UAC (and Paris ACC) cannot, unfortunately, be fully introduced into the present LATCC equipment. LATCC II is still at the planning stage and is unlikely to be operational until 1996, and thus if the safe and expeditious flow of traffic through UK airspace is not to be jeopardised until then, it is important that short to mid-term modifications are introduced both to the radar data displays and to LATCC operating procedures. There are three features, directly relating to the airmiss, which if installed and adopted would reduce the chances of a similar occurrence. These are the installation of a complete 'conflict alert' warning system, the installation of facilities to display on the radar picture an aircraft's cleared flight level in juxtaposition to its actual flight level, and the introduction of operational procedures that require that, except at times when traffic flow is known and forecast to be light, there are two validated controllers, operating on the same RTF frequency, sharing the workload at each sector control position. It is appreciated that one of the penalties for the failure to install and implement EDDUS, and its associated two controller (E&S) concept, is that the Mediator control suites at LATCC are not generally compatible with two-controller operation. However it is considered that the two-controller dual monitoring concept is important to increased safety, especially at times of peak traffic flow, in that it would not only reduce the chances of any errors going unnoticed but would also increase controllers' confidence during periods of stress. Three safety recommendations reflect these views.

2.8 Equipment, manning and future planning

The plans for updating the LATCC equipment envisaged by NATS as presented to the Monopolies and Mergers Commission in 1983, showed remarkable foresight and awareness of the likely future requirements of LATCC in the late 1980s. It is not within the scope of this report to determine the reasons why the total plan failed to come to fruition, but it must be stated that had it been successfully implemented, then the ability of the complete system to deal with the present levels of traffic would have been both greater and safer. This is especially true regarding the capability of such a system to cope more successfully with unexpected traffic overloading.

The investigation has also shown that there must be some considerable doubt whether the present manning levels at LATCC are sufficient to provide a full and continuous service throughout the entire traffic peak season. Indeed comparing the annual manning levels of ATCOs established at LATCC with the increase in traffic between 1983 - 1988, it is difficult to see how an acceptably high standard of service has been maintained. That it has done so, and the fact that the reputation of the UK ATC service remains high amongst international operators, must largely be attributed to the controllers themselves and to the flexibility of the LATCC operational procedures.

As traffic is forecast to increase further during the next few years and the duration of peak traffic flow can thus be expected to lengthen, the number of ATCOs available to man the operational suites may well become a severely limiting factor. This is likely to result in the application of more stringent flow control measures to protect the sectors, and thus more aircraft delayed on the ground. That this may be necessary, due to shortage of manpower, is not an acceptable solution to the operators utilising the ATC services. HQ NATS reports that agreement has been reached both on the re-rostering of ATCOs and also on the re-deployment of some support staff to duties where ATCO experience and expertise are not required. Support staff training commenced in October 1988. The ATCO cadet intake for 1989 also shows a significant increase.

Although, in the short term, there are plans to continue to modify and improve the existing LATCC equipment and procedures, and in this context the development and introduction of CCF is certainly a major step, the long term change to

LATCC II, a Centre which is to be designed to be capable of handling the forecast traffic in the year 2000 and beyond, is unlikely to be completed until the late 1990s. It is not the purpose of this report to recommend how this should be achieved, but it is relevant to comment that, as a result of this investigation, it has been concluded that if maximum use of airspace is to be made there is an urgent need for greater international agreement on traffic flow systems, and international commonality of communications and automatic data exchange methods.

3 Conclusions

(a) Findings

(i) Both aircraft were fully serviceable and were properly flown in accordance with Instrument Flight Rules.

(ii) The ATC equipment serving the Dover/Lydd suite was serviceable at the time of the airmiss.

(iii) Both flight crews were properly qualified and experienced to carry out the flights.

(iv) The ATCOs were properly qualified and held the required sector validations.

(v) The airmiss occurred during a period of high workload that, in the short term, was neither foreseen nor forecast.

(vi) A high level of traffic flow is not necessarily hazardous to flight safety. However a sudden and unexpected increase in traffic flow can lead to a sector being overwhelmed before manning can be re-organised in sufficient time to deal with the situation.

(vii) The traffic peak was exacerbated by the temporary closure of the Gatwick runway for pre-planned maintenance work. The maintenance work took almost twice as long as had been originally forecast.

(viii) Due to an unavoidable closure of a Heathrow runway for emergency surface repairs, the ATC workload was further increased.

(ix) There was no standard procedure for co-ordinating pre-planned runway closures with forecast traffic levels.

(x) Accurate warning of traffic levels is not readily available to the Chief Sector Controllers such that they can plan the most efficient deployment of ATCOs.

(xi) The greater the traffic level the less time the CSC is able to devote to supervision.

(xii) The Lydd sector was split at a late stage in the traffic build up.

(xiii) The sector split implemented by the Chief Sector Controller (1) was logical and reasonable in the circumstances.

(xiv) After the split both controllers on the Lydd sector were aware of their individual control responsibilities.

(xv) The Lydd West Controller was allocated control of traffic in the Lydd holding pattern with the minimum time in which to assess the overall traffic situation.

(xvi) Both Lydd Sector Controllers failed to co-ordinate, with each other, the descents of the subject aircraft.

(xvii) The LATCC radar system did not incorporate 'conflict alert warning' that might have warned the controllers of the confliction.

(b) Cause

The primary cause of the airmiss was a lack of co-ordination between two experienced Air Traffic Control Officers who were controlling the two aircraft, in the same section of airspace, but on two different radio frequencies. Other causal factors were the lack of sufficient warning of impending traffic peaks, lack of dual monitoring requirements between Controllers, the lack of a conflict alert warning system, and the lack of formulated procedures to co-ordinate pre-planned runway closures with inbound traffic flow.

4. Safety Recommendations

It is recommended that:

4.1 When a pre-planned closure of a runway at an airfield within the London TMA is intended, the timing of that closure should be first discussed with the LATCC watch supervisor and, if possible, adjusted to ensure the minimum disruption to traffic flow.

4.2 In the Lydd sector the priority for use of the R2 position should be allocated to the Lydd West controller and not to the LJAO controller.

4.3 The positions and priorities of use of the holding patterns within the Dover/Lydd sector should be re-examined.

4.4 An ATC simulator should be installed and in operation at LATCC as soon as possible; and consideration should be given for the installation of similar facilities at all other major ATC units.

4.5 MORs relating to loss of separation submitted by ATC sources should be investigated to the same extent as pilot initiated airmiss reports, and the results of these investigations should be included in airmiss statistics.

4.6 Statistics should be maintained for airmisses and losses of separation in controlled and regulated airspace which reflect the level to which the ATC system may have failed to detect or prevent a confliction rather than an assessment of collision risk.

4.7 The radar recording and RTF playback facilities at LATCC should be modified such that instant playbacks of any incident are always immediately available, and the playback should include synchronised radar display with RTF transmissions.

4.8 NATS should reconsider the agreed parameters with adjacent ATCCs for the initiation of ACT signals and 'estimate messages', with a view to increasing as far as is practicable the warning of the time of entry of aircraft into LATCC controlled airspace.

4.9 The medium term strategic and tactical elements of the London ATFMU should be amalgamated further and operate as far as practicable as a single entity.

4.10 The London ATFMU should be equipped with a separate computer system, not reliant on the 9020D for its processing, but dedicated to the statistical analysis and forward planning of air traffic flow, and also capable of accepting and analysing details of the daily tactical flow of traffic.

4.11 A conflict alert warning system should be installed and made operational, on all sectors, within both LATCC and ScATCCC as soon as is possible.

4.12 Consideration should be given to modifying the radar data processing system such that an aircraft's cleared altitude can be displayed in direct contrast to its actual altitude. It is acknowledged that this may require considerable modification to current Mediator suites.

4.13 A prime objective in future planning should be to ensure that operational procedures require that, at all times of high traffic flow, there are two validated controllers operating the same RTF frequency, and sharing the work load at each discrete sector control position.

R C McKINLAY
Inspector of Accidents

Air Accidents Investigation Branch
Department of Transport
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