

AIRCRAFT INCIDENT REPORT 1/2001

Air Accidents Investigation Branch

Department of the Environment, Transport and the Regions

**Report on the serious incident involving
Boeing 747-436, G-BNLY
and Airbus A321, G-MIDF
at London Heathrow Airport
on 28 April 2000**

This investigation was carried out in accordance with
The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996

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ISBN 0 11 552317 0

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Department of the Environment, Transport and the Regions
Air Accidents Investigation Branch
Berkshire Copse Road
Aldershot
Hampshire GU11 2HH

24 April 2001

The Right Honourable John Prescott
Secretary of State for the Environment, Transport and the Regions

Sir,

I have the honour to submit the report by Mr M M Charles, an Inspector of Air Accidents, on the circumstances of the serious incident involving British Airways Boeing 747-436 and British Midland Airways at London Heathrow Airport on 28 April 2000.

I have the honour to be

Sir

Your obedient servant

K P R Smart
Chief Inspector of Air Accidents

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AAIB	-	Air Accidents Investigation Branch	QNH	-	corrected mean sea level pressure
agl	-	above ground level	RTF	-	radiotelephony
AIP	-	Aeronautical Information Package	SMR	-	Surface Movement Radar
amsl	-	above mean sea level	SRATCOH	-	Scheme for the Regulation of Civil Traffic Control Hours
ATC	-	Air Traffic Control	SRG	-	Safety Regulation Group
ATIS	-	Automatic Terminal Information System	SSR	-	Secondary Surveillance Radar
ATM	-	Air Traffic Monitor	SVFR	-	Special Visual Flight Rules
CAA	-	Civil Aviation Authority	TC	-	Terminal Control
CVR	-	Cockpit Voice Recorder	TCAS	-	Traffic Collision and Avoidance System
DFDR	-	Digital Flight Data Recorder	UK	-	United Kingdom
EPR	-	Engine Pressure Ratio	UTC	-	Co-ordinated Universal Time
FL	-	Flight Level	UTP	-	Unit Training Plan
FPS	-	Flight Progress Strip	VCR	-	Visual Control Room
GMC	-	Ground Movement Control			
GMP	-	Ground Movement Planning			
hrs	-	hours			
IFR	-	Instrument Flight Rules			
ILS	-	Instrument Landing System			
INT (N)	-	Intermediate Director (North)			
km	-	kilometre(s)			
kt	-	knot(s)			
LATCC	-	London Area and Terminal Control Centre			
LCE	-	Local Competency Examiners			
LHR	-	London Heathrow			
MATS	-	Manual of Air Traffic Services			
MHz	-	MegaHertz			
MOR	-	Mandatory Occurrence Report			
NATS	-	National Air Traffic Services Ltd			
NDB	-	Non-directional beacon			
nm	-	nautical miles(s)			
OJTI	-	On Job Training Instructor			
OR	-	Operational Requirement			
PAPIs	-	Precision Approach Path Indicators			
QAR	-	Quick Access Recorder			

Air Accidents Investigation Branch

Aircraft Incident Report No: **1/2001** **(EW/C2000/4/6)**

Registered Owner 1. British Airways
 2. British Midland Airways

Operator: 1. British Airways
 2. British Midland Airways

Aircraft type: 1. Boeing 747-436
 2. Airbus A321

Nationality: British

Registration: 1. G-BNLY (Callsign 'Speedbird Six')
 2. G-MIDF (Callsign 'Midland One November Zulu')

Place of Incident: Runway 09 Right at London Heathrow Airport

 Latitude: 51° 28.7' North
 Longitude: 000° 27.7' West

Date and Time: 28 April 2000 at 1405 hrs

All times in this report are UTC

Synopsis

The incident was reported to the Air Accidents Investigation Branch (AAIB) on 28 April 2000 at 1800 hrs and the investigation began on 2 May 2000 when additional details of the incident became known. The AAIB team comprised Mr M M Charles (Investigator-in-Charge), Mr R W Shimmons (Operations), Mr J Blackwell (Operations), Mr R J Vance (Flight Recorders), Mr P Lawrence (Air Traffic Control) and Dr S Baker (Human Factors).

The incident occurred at London Heathrow Airport when Runway 09 Right (09R) was being used for take off and Runway 09 Left (09L) was being used for landing. At the time, the ATC controller with responsibility for Runway 09R was a mentor who was supervising a trainee. There was also a local procedure whereby aircraft could land on Runway 09R if traffic conditions allowed. A number of aircraft had been given conditional line-up clearance for

Runway 09R and an arriving aircraft ('Speedbird Six') was approaching for a landing on Runway 09R.

With one aircraft ('Midland One November Zulu') still on the runway for take off, 'Speedbird Six' was instructed to go-around at a late stage of its approach. During this procedure, the aircraft performing the go-around descended to 118 feet radio height above the runway; the aircraft on the runway for departure had a tail fin height of 38 feet 7 inches.

The investigation revealed the following causal factors:

- (1) The ATC mentor allowed the situation to develop to the point where 'Speedbird Six' could not be safely integrated with the departure of 'Midland One November Zulu'.
- (2) When this became apparent, the initial actions of the mentor, on taking control of the RTF, were inappropriate.

Three safety recommendations are made during the course of the investigation.

1 Factual Information

1.1 History of the incident

1.1.1 General

Heathrow ATC was using Runway 09 Right (09R) for take off and Runway 09 Left (09L) for landing. An ATC trainee was operating as the 'Air Departures' controller under the supervision of a mentor and controlling take offs from Runway 09R. At 1355 hrs, the Heathrow Intermediate Director (North) at the London Area and Terminal Control Centre (LATCC) contacted 'Air Departures' and received permission for an aircraft, 'Speedbird Six', to land on Runway 09R. Shortly afterwards, with 'Speedbird Six' showing on the Air Traffic Monitor (ATM), the mentor asked the trainee to assess the distance to touchdown. After some discussion, the two controllers agreed that the aircraft was approximately 15 nm from touchdown and the trainee estimated that this would equate to approximately 5 minutes flying time. The trainee had already estimated that it would take about 6 minutes for the aircraft cleared for conditional line-ups to get airborne and 'cocked' the last aircraft's 'Flight Progress Strip' ('Midland One November Zulu') on the display as a reminder that that clearance might have to be cancelled. At Heathrow, the minimum departure interval is one minute. However, depending on aircraft type and routeing, this interval varies. On this occasion, the trainee's estimation allowed for a two minute departure interval requirement between two of the aircraft in the sequence.

'Heathrow Director' had informed 'Speedbird Six' at 1402 hrs that "THERE'S NO ATC SPEED CONTROL YOU'RE NUMBER ONE FOR NINE RIGHT". At 1403 hrs, 'Speedbird Six' was transferred to 'Air Departures' and checked in with "SPEEDBIRD SIX ON FREQUENCY RANGE SIX MILES NINE RIGHT". The trainee responded: "SPEEDBIRD SIX CONTINUE APPROACH WIND ZERO SEVEN ZERO EIGHT KNOTS". At the time, three aircraft still had provisional line-up clearances from the full length threshold and the trainee then cleared the first, 'Shamrock Seven One Five', for take off at 1403.40 hrs. At about this time, the mentor advised the trainee to ensure that the next two aircraft for departure would be ready for immediate take offs. Accordingly, at 1404.20 hrs, with 'Lufthansa Four Five Seven Seven' lining up on the runway, the trainee asked the third aircraft: "MIDLAND ONE NOVEMBER ZULU WHEN SO CLEARED CAN YOU TAKE AN IMMEDIATE DEPARTURE THERE'S LANDING TRAFFIC FOUR MILES". When 'Midland One November Zulu' confirmed that he could, the trainee cleared 'Lufthansa Four Five Seven Seven' for an immediate take off at 1404.40 hrs; 'Lufthansa Four Five Seven Seven' replied that he was "ROLLING".

By now, 'Midland One November Zulu' was taxiing towards the runway but the crew could see a return on their Traffic Collision and Avoidance System (TCAS) display that indicated an aircraft at approximately two miles on final approach to Runway 09R; the crew then transmitted: "MIDLAND ONE NOVEMBER ZULU JUST CONFIRM WE ARE CLEARED TO LINE UP". The trainee immediately replied in the affirmative and 'Midland One November Zulu' acknowledged this message at 1404.50 hrs. The trainee then gave a conditional line-up clearance "AFTER LANDING SEVEN FOUR SEVEN AT TWO MILES" to the next aircraft in the departure sequence and this was acknowledged at 1405.10 hrs. At this point, the mentor took control of the RTF and transmitted to the aircraft on approach: "SPEEDBIRD SIX KEEP IT COMING THERE'S ONE TO ROLL THE WIND ZERO SEVEN ZERO EIGHT KNOTS". After 'Speedbird Six' acknowledged this message, the mentor transmitted at 1405.20 hrs: "MIDLAND ONE NOVEMBER ZULU START POWERING UP ON THE BRAKES AND YOU'RE CLEAR IMMEDIATE TAKE OFF ZERO NINE RIGHT THE WIND ZERO SIX ZERO EIGHT KNOTS". The crew acknowledged this instruction but the mentor immediately responded, at 1405.30 hrs, with: "MIDLAND ONE NOVEMBER ZULU CANCEL TAKE OFF I SAY CANCEL AGAIN TAKE OFF HOLD POSITION"; this message was acknowledged with: "HOLDING POSITION ONE NOVEMBER ZULU". The mentor then transmitted: "SPEEDBIRD SIX GO AROUND SAY AGAIN GO AROUND ACKNOWLEDGE". 'Speedbird Six' immediately acknowledged this instruction.

The mentor retained control of the RTF and was aware that his priorities were now to deconflict 'Speedbird Six' on his go-around with 'Lufthansa Four Five Seven Seven' which had just got airborne. He transferred 'Shamrock Seven One Five' to his departure frequency and then checked the altitude of 'Lufthansa Four Five Seven Seven' before restricting 'Speedbird Six' initially to an altitude of 2,000 feet amsl. The required separation was maintained between the two aircraft and they were subsequently transferred to other RTF frequencies; 'Speedbird Six' was then vectored back for an uneventful approach and landed on Runway 09R at 1418 hrs.

On the runway, the crew of 'Midland One November Zulu' saw 'Speedbird Six' overfly and the commander advised ATC that he would be submitting a report. 'Midland One November Zulu' was later cleared for take off at 1408 hrs and was transferred to a departure frequency at 1409.20 hrs. The mentor and trainee were relieved from duty approximately 5 minutes after the incident.

1.1.2 Controller reports

Both controllers submitted a report immediately after the incident and were interviewed some 10 days later; there were some aspects about which they had a different recollection. They both considered that they were adequately rested and that all relevant ATC equipment was serviceable. The mentor commented that,

from his seated position, he had to lean across the front of the trainee to activate his microphone when he took control.

The mentor had come on duty slightly early and had not realised that he had been allocated a training duty during his shift. He assumed his duties as the 'Air Departures' controller at 1320 hrs and had been operating for some ten minutes when the trainee arrived and informed him that he was programmed to train her during the shift. Since he had trained her previously, albeit some 5 to 6 weeks before, he was content to take the duty and asked her to sit and monitor while he updated her on the situation. He was aware that she had completed approximately one third of her training and that she was progressing well. Once she was familiar with the situation, he moved out of his seat and allowed her to take control under his supervision. As he monitored her, he considered that she was controlling in a confident manner and was making good decisions. He heard INT (N) call and ask about 'Speedbird Six' and he allowed her to make the decision without any input from him; she accepted the aircraft for a landing on Runway 09R. The mentor commented to her that he would not personally have accepted it but that he was perfectly happy that it could be safely integrated. Shortly afterwards, when he noticed 'Speedbird Six' showing on the Air Traffic Monitor (ATM), he asked the trainee for her estimate of its distance to touchdown. There was some discussion and he concluded that the aircraft had some 15 miles to run which would take approximately 5 minutes. His recollection was that there were still about 4 aircraft to get airborne. Throughout this period, the mentor recalled that he had discussed spacing and departure sequence with the trainee.

At about this time, the mentor became aware that one aircraft, 'Shamrock Seven One Five', had still not commenced its take-off roll and realised that the line-up order meant that 'Shamrock Seven One Five' required a two minute separation to comply with spacing regulations. He still considered that 'Speedbird Six' could be safely integrated but that they had to act without undue delay. He instructed the trainee to confirm with the next two departing aircraft that they were ready for immediate take off. She confirmed this with 'Midland One November Zulu' and then cleared 'Lufthansa Four Five Seven Seven' for an immediate take off. Shortly after, the mentor heard 'Midland One November Zulu' question his line-up clearance but considered that the aircraft was already past the 'Cat 1 Hold' and so did not interject when the trainee confirmed the line-up clearance. The mentor was now aware of the rapidly developing situation, saw 'Speedbird Six' on finals and took control of the RTF. He instructed 'Speedbird Six' to continue and then cleared 'Midland One November Zulu' for an immediate take off. However, he realised almost immediately that this plan was flawed, cancelled the take off clearance for 'Midland One November Zulu' and ordered 'Speedbird Six' to go-around. His next priority was to ensure that 'Speedbird Six' was deconflicted with 'Lufthansa Four Five Seven Seven' and did this primarily by vertical separation.

The trainee commented that, at the time of the discussion about the distance to go for 'Speedbird Six', she still had at least 5 aircraft conditionally cleared to line-up. She mentally calculated that 'Speedbird Six' would land in 5 minutes and that it would take 6 minutes for the departing aircraft to get airborne. Her recollection was that she asked the mentor if she should cancel the line-up clearance for 'Midland One November Zulu' as she 'cocked' the relevant Flight Progress Strip (FPS); his reply was that she should continue and see how things progressed. Then, when 'Speedbird Six' checked in on her frequency, she did not inform the crew of the number of aircraft still to get airborne because she expected the number to change. Shortly afterwards, she cleared 'Shamrock Seven One Five' for take off and again asked the mentor if she should cancel the line-up clearance for 'Midland One November Zulu'. His reply was for her to check if the two aircraft were ready for immediate take offs. She also recalled that, at the time she stated that 'Speedbird Six' was at 2 miles, she had noted this range from the ATM but also saw the lights of the aircraft.

1.1.3 Flight crew reports

'Midland One November Zulu' had moved to the right to allow 'Lufthansa Four Five Seven Seven' to overtake and to line-up on the full length of Runway 09R. In response to the controller, the crew had confirmed that they were ready for an immediate take off. Then, after 'Lufthansa Four Five Seven Seven' had acknowledged his take-off clearance, the crew of 'Midland One November Zulu' saw an aircraft indicating on TCAS at about two miles range from their position; they did not have visual contact with the aircraft. The commander was sure that his aircraft was still short of the 'Cat 1 Hold' when he queried his line-up clearance. He reacted immediately when this clearance was confirmed and was fully prepared for take off. On the runway, he was somewhat surprised by a non-standard call instructing him to "START POWERING UP ON THE BRAKES" but the first officer, as handling pilot, increased power to the normal stable position in preparation for take off. Once he had received the take-off clearance, the first officer released the brakes but almost immediately re-applied them as clearance was cancelled. Both pilots estimate that the aircraft had only moved a few metres before stopping. Thereafter, both pilots were startled to see an aircraft fly directly over them, along the runway centre-line and approximately 200 feet above them. The commander transmitted to the controller that he would be filing a report. About three minutes later, 'Midland One November Zulu' was again cleared for take off. After the aircraft was airborne, the controller transferred the crew to their next frequency and also stated that he would take the necessary action; this initiated a further discussion between the controller and aircraft commander.

'Speedbird Six' had flown from Narita Airport in Japan and made initial contact with the Heathrow Intermediate Director (North) at 1349 hrs; the crew reported

that they had received the current Automatic Terminal Information Service (ATIS). They were aware that Runway 09L was being used for landing but were also aware that they could be allocated Runway 09R. In accordance with their company procedures they did not request Runway 09R but accepted the offer when it was made by ATC at 1355 hrs. During the initial approach, the commander was operating as handling pilot and, in accordance with normal company procedures, was prepared for the first officer to assume these duties when he, the first officer, became visual with the runway. Both pilots recalled that they were transferred to 'Heathrow Tower' at approximately 6 miles range from touchdown. The first officer became visual with the runway at about 900 feet amsl and took the handling duties, with the aircraft fully configured for landing and fully established on the ILS; as he did so, he could see the runway but could not make out any aircraft on the runway. The commander looked up and also saw the runway. Neither could recall hearing information from ATC about the number of aircraft still to get airborne but, as they continued their approach, they both had a mental picture that one aircraft was still to take off. The commander then saw an aircraft, which seemed to be lined up at an intersection on Runway 09R (close to the displaced runway threshold) and understood that to be the relevant aircraft. He expected landing clearance once that aircraft lifted off and that view was reinforced when the controller called "KEEP IT COMING THERE'S ONE TO ROLL". However, as 'Speedbird Six' approached about 200 feet agl, the commander saw another aircraft lined up on the runway before the displaced threshold; the commander later commented that this aircraft was difficult to see against the runway surface. As the crew initiated a go-around, the controller also called for them to go-around. The commander considered that the first officer carried out an immediate and positive go-around with minimal height loss. Thereafter, they were vectored back for an uneventful landing on Runway 09R.

1.2 Injuries to persons

None.

1.3 Damage to aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Flight crew

The flight crew on both aircraft were qualified and current to operate the flights. The commander of 'Speedbird Six' had a total of 23,000 flying hours of which 3,800 hours were on type. The commander of 'Midland One November Zulu' had a total of 7,000 flying hours of which 500 hours were on type.

1.5.2	ATC Mentor:	Male aged 35 years
	Licence:	Initial issue 19 October 1993
	Ratings:	Aerodrome control issued 26 November 1996 Approach control issued 19 October 1993 Approach radar control issued 19 October 1993
	Medical certificate	Current
	Start of duty period	1330 hrs
	Previous rest period	24 Hours

The mentor completed his ATC course at the College of ATC at Bournemouth and arrived at LHR in January 1993. After qualifying, he initially undertook radar duties but, by November 1996 was fully validated in Aerodrome Control. In November 1998, he completed the On the Job Training Instructor (OJTI) course at Bournemouth and subsequently trained personnel on radar duties. In May 1999, he began training personnel in Aerodrome Control. Prior to the incident, his work cycle had commenced on 26 April following 3 days off. On the two days prior to the incident, his duties did not involve a requirement for him to undertake training tasks.

1.5.3	ATC Trainee:	Female aged 28 years
	Licence:	Student Air Traffic Controller's Licence
	Medical certificate	Current
	Start of duty period	1330 hrs
	Previous rest period	24 Hours

After completing her ATC course at the College of ATC at Bournemouth, the trainee arrived at LHR in July 1999 and commenced her training in December 1999. At the time of the incident, she had completed 130 hours of training; 450 hours are normally required before validation. Prior to the incident, her cycle

of work had commenced on 26 April and she had trained in Aerodrome Control on both that day and on 27 April.

1.6 Aircraft information

The aircraft on the runway (G-MIDF) was in the standard company colour scheme of dark blue and grey on the upper surfaces. The normal navigation and beacon lights were serviceable and on. The beacon lights were red and flashing and one was located on top of the fuselage. At the time of the incident, the company policy was for the strobe lights to be operating in the automatic mode which means that they only illuminate when the main gear strut is not compressed i.e. when the aircraft is airborne. These are synchronised white flashing lights; one located at each wing tip with another below the tail cone.

The tail fin of G-MIDF extends to a height of 38 feet 7 inches above the ground.

1.7 Meteorological information

1.7.1 Automatic Terminal Information Service (ATIS)

The 1320 hrs ATIS broadcast continued until 1400.40 hrs and comprised the following information:

"THIS IS HEATHROW ARRIVAL INFORMATION VICTOR ONE THREE TWO ZERO HOURS WEATHER LANDING RUNWAY ZERO NINER LEFT ZERO FOUR ZERO DEGREES ZERO NINE KNOTS VARIABLE BETWEEN THREE THREE ZERO AND ZERO NINE ZERO DEGREES FIVE THOUSAND METRES OVERCAST NINE HUNDRED FEET TEMPERATURE PLUS ONE THREE DEW POINT PLUS ONE ZERO QNH ONE ZERO ZERO SEVEN MILLIBARS PLEASE BE ADVISED THE HEATHROW NDB IS OUT OF SERVICE PILOTS ARE TO REPORT AIRCRAFT TYPE AND ACKNOWLEDGE ARRIVAL INFORMATION VICTOR ON FIRST CONTACT WITH HEATHROW"

The 1350 hrs ATIS broadcast commenced at 1400.50 hrs and comprised the following information:

"THIS IS HEATHROW ARRIVAL INFORMATION WHISKEY ONE THREE FIVE ZERO HOURS WEATHER LANDING RUNWAY ZERO NINE LEFT WIND ZERO THREE ZERO DEGREES AT ZERO SIX KNOTS VARIABLE BETWEEN THREE TWO ZERO DEGREES AND ZERO EIGHT ZERO DEGREES VISIBILITY SIX KILOMETRES CLOUD OVERCAST AT NINE ZERO ZERO FEET TEMPERATURE PLUS ONE THREE DEW POINT PLUS ONE ZERO QNH ONE ZERO ZERO SEVEN MILLIBARS PILOTS

SHOULD BE ADVISED THE HEATHROW NDB IS OUT OF SERVICE PILOTS ARE TO REPORT THEIR AIRCRAFT TYPE AND ACKNOWLEDGE ARRIVAL INFORMATION WHISKEY ON FIRST CONTACT WITH HEATHROW"

1.7.2 Weather aftercast

Following the incident, an aftercast was obtained from The Meteorological Office at Bracknell. The synoptic situation at 1400 hrs showed a slack area of low pressure over Belgium with a warm front lying just to the east of Heathrow. A light to moderate north easterly airstream covered the area. Visibility was 6 km, mean sea level pressure was 1007 Mb, cloud was overcast at 900 feet amsl and the surface wind was 030°/ 06 kt.

1.8 Aids to navigation

Not applicable.

1.9 Communications

1.9.1 General

A recording was available, and transcription made, of all RTF frequencies considered relevant to the investigation. These comprised 'Air Departures' on 118.5 MHz, 'ATIS' on 123.9 MHz, Terminal Control - Heathrow Intermediate Director (North) on 119.725 MHz, Terminal Control - Heathrow Intermediate Director (South) on 134.975 MHz, Terminal Control - Heathrow Final Director on 120.4 MHz. The transcript of 'Heathrow Tower' (Air Departures) on frequency 118.5 MHz is included as Appendix A. Additionally, recordings were available, and transcriptions were made, of Tower - Air Desk 1 and Tower - Air Desk 2 telephones.

1.9.2 ATC

The mentor and trainee controllers were both listening on frequency 118.5 MHz. The equipment allows only one of the two controllers the capability of transmitting on the frequency at a time. The ability to transmit is controlled by a switch on the front of the desk, at a position between where the two headsets are plugged in. Consequently, the mentor had to lean forward, in front of the trainee, to change the switch when he wished to transmit on the frequency. Training/splitter boxes, the use of which enables either controller to transmit, are provided at Heathrow. However, these are not in current use.

The correct phraseology, to be used by controllers, is to be found in MATS (Manual of Air Traffic Services) Part 1 and CAP (Civil Aviation Publication) 413 (Radiotelephony Manual).

1.9.3 Aircraft

'Speedbird Six' contacted Heathrow 'INT N' at 1349 hrs and was informed at 1355 hrs that the flight would be landing on Runway 09R. After being transferred to 'Heathrow Final director' at 1357 hrs, the crew reported established on the ILS at 1403 hrs and were transferred to 'Air Departures' at that time.

Radio contact was established between 'Air Departures' and 'Midland One November Zulu' at 1355 hrs when the crew were instructed to hold on the right hand side of the holding area at the threshold of Runway 09R. At 1357 hrs, the crew were instructed to line-up after a Lufthansa Boeing 737 (Lufthansa Four Five Seven Seven) which would pass them on their left side. At this time, there were 5 aircraft to depart ahead of 'Midland One November Zulu'; additionally, during these departures two further aircraft were co-ordinated and cleared to taxi across Runway 09R.

1.9.4 Telephone

The telephone transcripts confirmed that 'Air Departures' was advised of the position, and accepted 'Speedbird Six' for landing on Runway 09R at 1355 hrs. Further reference to the flight by the Heathrow and LATCC controllers was made at 1401 hrs, when the former reported being able to see 'Speedbird Six' on the ATM. This obviated the Heathrow MATS PART 2 requirement that Intermediate or Final Directors pass an aircraft a 10 nm range check to Heathrow whenever inbound aircraft are making an approach to the promulgated departure runway.

1.9.5 Verbal

There was no facility to record direct communication between the mentor and trainee.

1.10 Aerodrome information

1.10.1 General

Heathrow Airport is served by two main runways; 27L/09R and 27R/09L, which are parallel and separated by approximately 1,340 metres and by one subsidiary, single direction Runway 23. The full length take-off distance for 09R is 3,658 metres but, due to a displaced threshold 305 metres from the beginning of the

runway, the landing distance is 3,353 metres. The Precision Approach Path Indicators (PAPIs) and ILS Glide Path aerial for Runway 09R, which indicate the touchdown point, are situated beside the runway on the boundary between 'Block 79' and 'Block 103'. ATC also uses two intersection positions, 'Block 79' and 'Block 102', for departures on Runway 09R. Long-haul British Airways flights, such as 'Speedbird Six', use Terminal 4, which is situated to the south of Runway 09R. An aerodrome chart is attached as Appendix B.

As a general principle, Runways 27L and 27R are used in preference to 09L and 09R whenever the tailwind component is 5 kt or less and the runway is dry. For environmental reasons, a runway alternation procedure exists, whereby, at specified times of the day/night, on a weekly basis, a particular runway has to be used for landing. During westerly operations the procedure is in use at all times, except between 0600 and 0700 hrs local when both runways are used for landings and take offs. During easterly operations, the landing runway is only alternated weekly between the hours 2300 and 0600 hrs local. The main reason for the difference in easterly/westerly runway alternation procedures is the requirement to reduce noise disturbance to the residents of Cranford by minimising the use of Runway 09L for departing aircraft. However, the departure runway can be used for arriving flights with appropriate co-ordination between LATCC and Heathrow ATC. This is used to reduce holding delay to an acceptable level and to attempt to provide an element of balance between arrival and departure delay. Generally, on westerly operations, this procedure will be invoked when there is a 30 minute airborne holding delay, with at least 20 minutes delay in the inner stacks. Up to six landing aircraft per hour can be accepted on the departure runway. On easterly operations, agreement is sought for the number of landings per hour that can be accepted on the departure runway, when the inbound holding delay is anticipated to be 20 minutes or greater. It is considered beneficial to select 'Heavy' aircraft for landing on the departure runway, in order to capitalise on reduced vortex wake spacing. Another important consideration is the stand allocation for incoming aircraft.

During April 2000, there were 38,543 movements (including helicopters) at Heathrow, of which 19,268 were arrivals and 19,275 were departures. Runway 09L had 8,693 landings and no departures; Runway 09R had 492 arrivals and 9,413 departures; Runway 27L had 4,729 arrivals and 5,244 departures; Runway 27R had 5,330 arrivals and 4,593 departures. Including the incident on 28 April, there were 31 go-arounds during April.

1.10.2 Heathrow ATC operating information

An 'Approach'/'Approach Radar' service to aircraft landing at Heathrow is provided by controllers situated in the Terminal Control Room at the London Area

and Terminal Control Centre (LATCC), West Drayton. Aircraft inbound from the north are controlled by the Heathrow Intermediate Director (North), whereas those from the south are controlled by the Heathrow Intermediate Director (South). The Heathrow Final Director is responsible for integrating the two streams of aircraft and for vectoring and sequencing them for final approach. The Heathrow Final Director will normally retain control of inbound aircraft until such time as the pilot reports that he is established on the ILS, when the flight is transferred to 'Air Arrivals' for landing on the arrivals runway, or to 'Air Departures' if the landing is to be made on the departure runway. 'Air Arrivals'/'Air Departures' issue the appropriate landing clearance.

The Heathrow Aerodrome task is split into Air, Ground Movement Control (GMC) and Ground Movement Planning (GMP). The first of these tasks is subdivided into 'Air Arrivals' and 'Air Departures' positions. GMC is responsible for aircraft from the time that they are authorised to push back from their stand until they are transferred to 'Air Departures'. Taxi clearance is given from the parking stand to the appropriate runway holding area. Once no further ground movement confliction exists, control of the aircraft is passed from 'GMC' to 'Air Departures' and the accompanying Flight Progress Strip (FPS) is passed by hand for display on the 'Air Departures' controller's board.

Aircraft intending to enter the airways system are required to be cleared via one of a number of Standard Instrument Departures (SIDs) which detail position and altitude requirements. Compliance with the SID ensures that the aircraft remain within controlled airspace and that a degree of separation is achieved from aircraft operating on other SIDs, and from aircraft operating to the north of Heathrow within the Northolt Radar Manoeuvring Area. The knowledge that departing aircraft will be following a pre-determined track with a minimum climb gradient also allows controllers to plan separation for aircraft operating within the Heathrow Control Zone on Special Visual Flight Rules (SVFR) clearances. 'Air Departures' is responsible for all movements on the nominated departure runway and 'Air Arrivals' is responsible for all movements on the nominated landing runway. Transfer of control to the appropriate outbound radar controller is made as soon as possible after resolving any aerodrome conflictions but the aircraft's FPS is retained in the 'Air Departures' controller's display for at least five minutes after the aircraft's departure time.

1.10.3 Visual control room (VCR)

The Heathrow VCR is manned by a Supervisor, five air traffic controllers and various supporting staff. Three of the controllers deal with ground movements and two, 'Air Arrivals' and 'Air Departures', are responsible for all movements on the respective arrival and departure runways. The Air controllers' positions are on

a raised dais facing the same direction, east or west depending on the runway direction in use. This allows a good view of the runways and the approach and departure tracks, although the VCR roof interrupts sightings of aircraft climbing away when close to the airfield. Both Air positions are fully equipped including FPS displays and the controllers have access to dedicated RTF and telephone facilities, together with an ATM display and a Surface Movement Radar (SMR) display. 'Air Arrivals' occupies the northerly position, with 'Air Departures' sitting to the south. Although space within the VCR is limited, there is sufficient room to enable training staff to sit adjacent to each of the operational positions. Co-ordination between all of the staff is direct person to person without the use of any electronic medium and is not automatically recorded.

1.10.4 Aerodrome Traffic Monitor (ATM) and Surface Movement Radar (SMR)

An ATM is provided to assist in achieving maximum runway utilisation and aerodrome capacity. Operation of the ATM is not associated with a particular air traffic control rating and, although it displays radar data, it must not be used as a surveillance radar to provide approach radar services. At Heathrow, both Air controllers are provided with an individual ATM to assist them in their task. The equipment consists of a high brightness monochrome display utilising radar data to confirm airborne aircraft position and identity. It is operated by control panels and a menu/windows system manipulated by a rollerball/cursor. Controllers can select a pre-determined set of ranges (10, 15, 20 or 30 miles) and may use either a pre-set central position or an off-centre function to allow for personal choice. It is understood that the ATM for 'Air Departures' was off-centred at the time of the incident. At Heathrow, in common with many other airports, the ATM has a filter to reduce interference from aircraft on the ground.

In accordance with Heathrow MATS Part 2, the ATM, when fully serviceable, may be used to:

- (1) "Determine the landing order, spacing and distance from touchdown of arriving aircraft;
- (2) Assist in taking initial corrective action when the separation between arriving aircraft becomes less than the prescribed minima. Actions that may impact on separations from other aircraft not on the 'Air' controllers frequency, must be co-ordinated with the appropriate radar controller;
- (3) Establish separation in the event of a missed approach. It may be assumed that Mode C readouts on arriving aircraft have been verified unless otherwise notified;

- (4) Confirm that the initial tracks of departing aircraft are co-incident with the allocated SIDs/departure clearances;
- (5) Identify departing aircraft and to then validate SSR codes of departing aircraft and when required, verify associated Mode C readouts;
- (6) Establish separation between departing aircraft from the same runway. Where 2 minutes separation is specified, a departure interval of at least 5 nm may be used as an alternative for aircraft on diverging tracks only;
- (7) Assess a specific departure interval between aircraft departing from parallel runways provided that the tracks of the aircraft involved do not converge;
- (8) Monitor departures from different runways where the (SID) tracks will cross. Vertical separation based on verified Mode C may be used;
- (9) Monitor the progress of overflying aircraft identified by TC or SVFR/Thames radar to ensure that they do not conflict with the tracks of arriving or departing aircraft;
- (10) Pass traffic information;
- (11) When requested, pass range from touchdown."

The SMR, using primary radar, provides a plan view of the airport, to help controllers monitor the position of aircraft and vehicles on the manoeuvring area.

1.10.5 Separation requirements:

Airspace surrounding the airport has been accorded Class A classification in accordance with Annex 11 to the Convention on International Civil Aviation; details are published in the UK Aeronautical Information Package (UK AIP). In such airspace, all aircraft are required to operate in accordance with Instrument Flight Rules (IFR) and under an air traffic control clearance. Controllers are required to provide standard separation between all aircraft in Class A airspace. This can be achieved by the provision of either vertical separation (1,000 feet) or radar separation. The normal minimum prescribed radar separation is 3 nm, although Heathrow Airport has been approved to operate to lower limits of 2.5 nm minimum radar separation on final approach under certain circumstances. Additionally, in accordance with MATS Part 1, these minima may be reduced in the vicinity of the airport under any of the following conditions:

- (1) 'Adequate separation can be provided by the aerodrome controller when each aircraft is continuously visible to this controller; or
- (2) Each aircraft is continuously visible to pilots of the other aircraft concerned, and the pilots report that they can maintain their own separation, or
- (3) When one aircraft is following another, the pilot of the succeeding aircraft reports that he has the other in sight and can maintain separation.'

To allow the Air Departures Controller to provide the most expeditious sequence, a standard time separation between departures, generally one or two minutes, depending on SIDs and speeds, is used. A speed limit of 250 kt IAS (300 kt in the case of Concorde) applies to all departures from Heathrow whilst flying below FL100, unless the restriction is previously removed by ATC. The Heathrow MATS Part 2, states that in order to expedite traffic further, when conditions permit, preference should be given to using one of the reduced separations for use in the vicinity of aerodromes as specified in MATS Part 1 and quoted above. In all cases, spacing has to be increased, if necessary, to allow the appropriate wake vortex spacing. The application of the appropriate time interval between departures, together with speed limitation, will assist in the provision of separation for the first 20 to 30 miles between aircraft following the same route.

1.10.6 ATC procedures

Aerodrome control is described in the MATS Part 1 as having responsibility for issuing information and instructions to aircraft under its control to achieve a safe, orderly and expeditious flow of air traffic and to assist pilots in preventing collisions between:

- (1) 'Aircraft flying in, and in the vicinity of, the aerodrome traffic zone,
- (2) Aircraft taking off and landing,
- (3) Aircraft moving on the apron,
- (4) Aircraft and vehicles, obstructions and other aircraft on the manoeuvring area,
- (5) Aerodrome control may be divided into air control and ground movement control. Air control shall provide services for the first two circumstances above and has absolute authority over all movements on active runways and their access points.'

The following procedures are detailed in MATS Part 1:

“An aircraft shall not be permitted to begin take off until the preceding departing aircraft is seen to be airborne or has reported ‘airborne’ by RTF and all preceding landing aircraft have vacated the runway in use.”

"When given the instruction ‘cleared for immediate take off’ it is expected that the pilot will act as follows:

- (1) At the holding point, taxi immediately on to the runway and commence take off without stopping the aircraft. (Not to be given to Heavy aircraft.)
- (2) If already lined up on the runway, take off without delay."

"A landing aircraft will not be permitted to cross the beginning of the runway on its final approach until a preceding aircraft is airborne.”

The International Civil Aviation Organisation publication Doc. 4444, Rules of the Air and Air Traffic Services, states that, with certain provisos, a landing aircraft will not normally be permitted to cross the beginning of the runway on its final approach until the preceding departing aircraft has crossed the end of the runway-in-use, or has started a turn. An aircraft may be cleared to land when there is reasonable assurance that the separation prescribed above, will exist when the aircraft crosses the runway threshold.

Heathrow ATC has approval from the CAA's Safety Regulation Group (SRG) to use an “after the departing” procedure. As stated in the Heathrow MATS Part 2:

“When the runway-in-use is temporarily occupied by other traffic, landing clearance may be issued to an arriving aircraft provided that the Air Controller is satisfied that at the time the aircraft crosses the threshold of the runway-in-use, the following conditions exist:

Landing following departure - The departing aircraft will be airborne and at least 2,000 metres from the threshold of the runway-in-use, or if not airborne, at least 2,500 metres from the threshold of the runway-in-use.”

For this procedure to be used, the reported meteorological conditions have to be equal to or better than a visibility of 6 km and a cloud ceiling of 1,000 ft. At the time of the incident, the reported cloud ceiling was 900 ft. Therefore, 'Air Departures' had to ensure that 'Midland One November Zulu' was airborne before clearing 'Speedbird Six' to land.

1.11 Flight recorders

1.11.1 'Midland One November Zulu', G-MIDF

No information relevant to the incident was available on the Digital Flight Data Recorder (DFDR) or Cockpit Voice Recorder (CVR) from G-MIDF as both recorders had overrun. Information had been requested to try and determine the exact position of 'Midland One November Zulu' on the runway and thus the minimum vertical distance between the two aircraft. Nevertheless, the recollection of the crew enabled the investigators to estimate the position of the aircraft reasonably accurately.

1.11.2 'Speedbird Six', G-BNLY

No information relevant to the incident was available on the DFDR or the CVR as the recorders had overrun before the AAIB requested recorder replay. However, crew recollection was available and consistent. Additionally, the aircraft was equipped with a Quick Access Recorder (QAR). Data from the QAR were synchronised with the ATC RTF recordings and the subsequent information was used in the investigation. A plot of the relevant QAR data is shown at Appendix C together with relevant ATC RTF extracts.

The recorded data show that an accurate ILS approach was flown to Runway 09R. The aircraft was at 1,950 feet agl when the crew checked in with 'Air Departures' at 6 miles range. When the crew were subsequently advised by ATC to 'keep it coming', the aircraft was at 450 feet agl. Twenty seconds later, the crew were instructed to 'go-around' with the aircraft passing 175 feet agl. The QAR data is consistent with a go-around being initiated by the crew coincident with, or immediately before, the ATC instruction. In the three seconds before this ATC instruction, the aircraft pitch attitude increased from 3° nose up to 5° nose up causing a small excursion (1/2 dot) above the ILS glideslope.

When the go-around was initiated, the engine thrust increased to 1.5 Engine Pressure Ratio (EPR) and the pitch attitude increased at about 0.5° per second, from 5° nose-up to 9° nose-up. The subsequent height loss after the initiation of the go-around was about 50 feet and the minimum height reached was 118 feet agl. Seventeen seconds after the initiation of the go-around and with the aircraft passing 320 feet agl, the pitch attitude increased to 12° nose-up and the engine thrust increased to 1.6 EPR.

Using the recorded altitude and glideslope data, a time history of aircraft height (agl) against distance from Runway 09R threshold was calculated. However, the exact position of 'Midland One November Zulu' was not known and small errors

had been introduced into the recorded glideslope data as a consequence of aircraft legitimately entering the ILS sterile area. Nevertheless, from the available information, including the brief variation in recorded radio altitude (see Appendix C), it was calculated that 'Speedbird Six' was at 150 feet (+/- 20 feet) agl when it was overhead 'Midland One November Zulu'.

The subsequent approach and landing by 'Speedbird Six' on Runway 09R was uneventful.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological

There were no medical aspects relevant to the incident.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

1.17.1 General

The Operational Requirement (OR) at Heathrow is for 61 ATCO Certificates of Competence spread across 5 watches of 12 staff plus one ATCO in ATC operations. At the time of the incident on 28 April 2000, there were 58 controllers filling these posts. However, in addition, each watch has a Watch Manager who has a Certificate of Competence as does the Head of ATC Training. These personnel can be used to offset temporary shortages in the OR.

The Manager ATC stated that no more than two aerodrome trainees are accommodated within each watch. He considered that, ideally, all controllers

would be qualified as On the Job Training Instructors (OJTIs) but that eight OJTIs per watch would be reasonable.

The Watch Manager on duty at the time of the incident, reported having a staff of twelve ATCOs, two ATCO trainees, nine Assistants and one trainee Assistant. This included 7 OJTIs, a Watch Training Officer, two radar Local Competency Examiners (LCEs) and one Visual Control Room (VCR) LCE. She commented that her present staff numbers were sufficient for the task although she would prefer more OJTIs.

Limitations on controllers' working hours are detailed in 'The Scheme for the Regulation of Civil Air Traffic Controllers Hours (SRATCOH) in the UK' issued by the CAA (CAP 670). The purpose of the scheme is "to ensure, so far as reasonably possible, that controller fatigue does not endanger aircraft and thereby to assist controllers to provide a service safe and effectively".

The scheme details maximum duty and operational periods, together with requirements for breaks and intervals between duty. At Heathrow, at the time of the incident, no operational duty period was to exceed a maximum of two hours, followed by a break of not less than 30 minutes. Additionally, certain tasks, including the 'Air Departures' position, are limited by local instruction to a maximum of 90 minutes. All personnel on duty at the time of the incident had complied with these limitations.

The Head of ATC Training agreed that there was no official time allocated for briefing and debriefings between OJTIs and trainees. However, he considered that there was sufficient time for this to occur within normal duty time. The Watch Manager concurred with this view.

1.17.2 Unit Training Plan (UTP)

This document, published by NATS at Heathrow and approved by the CAA Safety Regulation Group (SRG) Air Traffic Services (ATS) Standards Department, details procedures and responsibilities concerning the training of controllers at Heathrow.

The training strategy utilises a system-based approach to the training task which has evolved from the Review Group ATC Training Consultative process. The strategy consists of two separate elements; the first being the initial attendance in the Heathrow Training Unit for a programme of lessons, visits and simulator training, which is then followed by the OJT element.

The UTP states theoretical and practical objectives that should be achieved at various stages of training. These phases relate to the number of training hours completed. The target time for a first certificate of competence student to complete the UTP for Aerodrome Control at Heathrow is 450 hours.

1.17.3 On The Job Training Instructors (OJTIs)

Controllers who are approved to instruct trainees shall meet the following CAA criteria:

- (1) Hold, and have held for the previous year, a certificate of competence at that unit in the rating and for the sector or operational position in which he will instruct.
- (2) Have successfully completed an approved OJTI course conducted at a recognised ATC college.
- (3) Have an OJTI certificate signed by the ATS Provider.
- (4) Have received unit specific training on the conduct of the Approved Unit Training Plan (AUTP) or the unit training scheme.

At Heathrow, a local restriction required that a controller must have been competent in the aerodrome discipline at Heathrow for at least two years before becoming an OJTI in that discipline. Completion of these requirements is deemed to have taken place when the controller is given his CA 1248E countersigned by the Head of ATC Training.

The OJTI course which Heathrow controllers attend is held at the National Air Traffic Services Ltd (NATS) College of ATC, Bournemouth. The course has been approved and audited by the CAA/SRG ATS Standards Department. It consists of two distinct parts, a pre-course learning package and a four and a half-day course at the college. The pre-course package, which provides the background theory, consists of a training manual and an associated video. This part of the course is expected to take approximately twenty hours to complete. Candidates must pass a written assessment associated with the pre-learning package prior to commencing the college part of the course.

The four and a half day college course is directed towards the practical application of OJTI training techniques. The theory element of the course is mainly directed towards the revision of those parts of the pre-learning package that are essential to the practical application.

A continuous assessment of each practical session is carried out, leading to a final decision on whether the candidate has reached a satisfactory standard on the course. The CAA/SRG ATS Standards Department is informed when the candidate has passed the course and a report is sent to the appropriate ATC Unit by the college.

At Heathrow, the Manager ATC is responsible for the selection, appointment, appraisal and development of Unit Training Personnel. The Unit Training Officer is responsible, in consultation with the relevant Watch Manager, for selecting potential OJTIs. The Head of ATC Training at Heathrow stated that he considered that the present number of OJTI Instructors was adequate. He confirmed that he liaises with the Watch Managers for the selection of OJTIs and commented that, although all qualified controllers were considered, not all were selected. The Watch Manager of the watch on duty at the time of the incident said that she would discuss any selection of potential OJTIs with the LCEs on her watch and then confirm the selection with the Head of ATC Training and Manager ATC.

The Manager ATC is responsible for ensuring that all OJTIs under his jurisdiction maintain a high standard of training technique. The responsibility is delegated to the Watch Manager, who will advise Manager ATC should a problem exist. The Manager ATC explained that the normal way for controller problems to be highlighted would be by continual monitoring by the Watch Manager and two LCEs on each watch. The Watch Manager interviewed commented that there is no formal checking of OJTIs although there is continuous monitoring by her LCEs and herself.

Meetings between the Manager ATC, the Head of ATC Training and the LCEs take place four times a year to discuss and confirm the standardisation of the operation. Additionally, quarterly meetings are held between the Manager ATC, the Head of ATC Training and the Watch Training Officers to review all aspects of training.

1.17.4 Mentor operational performance

The Air Departures Controller concerned in this incident had been involved in another occurrence on 3 April 1999. On that occasion, he cleared a Boeing 757 to cross the runway in front of a Boeing 747, which had been cleared for take off. The situation was resolved after the pilot of the departing aircraft queried his clearance. The conclusion reached by Unit Management was that it happened because of an apparent lack of concentration by the controller. Comments were made at the time that another previous radar incident involving the same controller also indicated a temporary lack of concentration. Following the incident on

3 April 1999, the controller was interviewed by the then Manager ATC in June 1999 and warned about his future performance.

The controller commenced OJTI duties in Aerodrome Control in May 1999. His Watch Manager said that she was aware of his previous incident in April 1999 and that he had been interviewed by the Manager ATC. She recalled that she discussed the situation with his LCE (since retired) and considered that the incident in 1999 was an error of judgement and a one-off event. Consequently, she believed that there was no reason against allowing him to commence OJTI duties in Aerodrome Control. The Head of ATC Training said that he was aware that the incident had occurred but he had no recollection that the Manager ATC had interviewed the controller concerned.

1.17.5 Trainee operational performance

All indications were that the trainee was progressing well in her training task and no deficiencies were noted in her performance.

1.18 Additional information

1.18.1 RTF terminology

Standard phraseology was used by ATC up until the beginning of the transmission when the mentor cleared 'Midland One November Zulu' for an immediate take off. During this period he instructed the flight to "start powering up on the brakes".

1.18.2 Human factors

1.18.2.1 The Trainee/Mentor situation

Despite the use of ATC simulators, the training of air traffic controllers prior to their validating on a particular sector or position relies heavily on On the Job Training (OJT) i.e. working alongside and being monitored by an experienced controller under whose licence the task is performed. Such a training situation has been in place for many years and, though effective, does place a number of demands on the mentor. Not all individuals enjoy being mentors and the mentor involved in this incident commented, during the investigation, that he did not particularly enjoy the duty. There was no indication that he had expressed this view to his managers.

In the OJT situation the mentor has, in effect, a number of simultaneous tasks to perform. These include acting as teacher and mentor to the trainee by providing

guidance and information while, at the same time, monitoring the air traffic situation to ensure that the safety of the operation is maintained. The extent to which a trainee is permitted to make his or her own decisions and plans with regard to the traffic is very much dependent on the level of experience of the trainee. It can vary from being essentially a 'mouthpiece' for the mentor, in the early stages of OJT, to a situation, usually close to the qualifying examinations, in which the trainee is taking virtually all the decisions but still being closely monitored. This process requires that the mentor maintains a high level of vigilance in monitoring both the traffic and the actions of the trainee.

1.18.2.2 Planning and decision making

The ATC task involves the controller in formulating plans for the aircraft under his or her control. Often there will be a number of interlocking plans, which the controller has to integrate to form the overall traffic 'picture'. Circumstances may change fairly rapidly and plans may have to be revised to accommodate those changes. Some situations provide cues to the fact that a plan, once formed, may no longer be appropriate or may indicate flaws in the original plan.

1.18.2.3 Briefing and debriefing

At Heathrow, in common with other UK ATC units, there was no formal allocation of time for briefing and debriefing of a trainee by the mentor.

1.19 **New investigation techniques**

None

2 Analysis

2.1 Introduction

The incident occurred when Runway 09R at LHR was being used for take off and an aircraft was offered the opportunity to land on that runway. This contingency is well practised at LHR and is only offered when certain conditions are met. During the time of the incident, the work load on 'Air Departures' was assessed by the controllers as medium and the acceptance, by the trainee, of 'Speedbird Six' for a landing on Runway 09R was reasonable. The fact that the mentor has stated that he would not have accepted the aircraft was not related to workload or safety and indeed he felt no need to countermand the trainee's decision. Therefore, the acceptance of the aircraft was a reasonable decision and should not have resulted in the subsequent incident. Nevertheless, the integration of the aircraft into the departure plan existing at the time the two controllers discussed spacing should have raised questions as to whether the departure plan needed to be revised. The trainee recollected that she raised this question but the mentor does not recall it. Additionally, there was some difference in recollection as to the number of aircraft still to get airborne at that time. However, with some 5 minutes to go before 'Speedbird Six' would land, it was reasonable to allow the situation to progress.

The first point at which it was apparent that the plan needed to be amended was when 'Speedbird Six' checked in with 'Air Departures' at 6 miles to go before touchdown; this relates to a time of about two minutes. With three aircraft still to get airborne and a time interval between each of them of about one minute, the existing plan was not viable. Thereafter, the situation deteriorated with additional warning signs becoming apparent, including a prompt by 'Midland One November Zulu'. Finally, when action was taken, the wrong option was initially adopted. This analysis considers the involvement of each individual in the incident to determine the actions, which could have prevented it. It also considers what other factors may have had a bearing on the incident. Throughout the analysis, one aspect which is relevant is that Heathrow controllers have a reputation for very high standards of controlling and the RTF density is such that queries from crews are rarely made and when used are concise.

2.2 'Speedbird Six' crew

The crew had listened to the ATIS and were under the radar control of Heathrow Intermediate Director (North) when they were advised that they would be landing on Runway 09R. On the subsequent frequency with Heathrow Final Director, the aircraft was vectored onto the ILS at 180 kt and the crew were informed that there was no speed control and that they were "Number one for nine right". This message correctly indicated that they would be the next aircraft to land on

Runway 09R. However, although it would indicate that there was no landing traffic to impede their progress, the crew would have been aware that there would have been departing aircraft.

Once the crew checked in with 'Air departures', they were not given any information on the number of aircraft still to take off. If this message had been passed, it might have helped the crew to formulate an accurate 'mental picture'. This was also the first time that they were on a common frequency with the departing aircraft. These departing aircraft had already been given line-up clearance so the Speedbird crew would only have been able to assess the full situation by subsequent radio transmissions; as indicated in Appendix C, the time period from check in to commencing their go-around was 2 minutes 30 seconds. While examination of the RTF recording confirmed that three different aircraft were given clearance to take off after 'Speedbird Six' checked in, these messages were interspersed with other RTF transmissions. Additionally, one transmission to 'Speedbird Six' which would have been compelling to the crew was the call of "SPEEDBIRD SIX KEEP IT COMING THERE'S ONE TO ROLL". The 'mental picture' of the crew was that this preceding aircraft was the one near the intersection ('Lufthansa Four Five Seven Seven') and it was understandable that the crew were watching the progress of this aircraft while awaiting their landing clearance. The operating procedure of 'Midland One November Zulu' also meant that the strobe lights were not yet active thereby denying 'Speedbird Six' an additional alert feature. The crew became aware that there was another aircraft on the runway about the time the controller instructed them to 'Go-around'. Thereafter, the crew commenced a go-around which quickly arrested the rate of descent.

In conclusion, the crew of 'Speedbird Six' would not have expected the situation that existed when they checked in on 'Air Departures'. Subsequently, they were not given the information which might have raised their suspicions and therefore, it was understandable that they did not then appreciate the true situation on their approach. The go-around was initiated co-incident with the instruction from ATC.

2.3 'Midland One November Zulu' crew

The crew were aware of their position in the line-up queue and that an aircraft was approaching to land on Runway 09R. The commander of 'Midland One November Zulu' had been asked if the crew were ready for an immediate take off and had replied in the affirmative; they were therefore fully prepared for departure. However, just after 'Lufthansa Four Five Seven Seven' started its take-off roll, the commander noted from his TCAS display that an aircraft was on final approach at about two miles range and, although he did not acquire it visually, questioned the line-up clearance; the controller immediately replied "AFFIRM". The crew's subsequent reaction to this message was prompt. At this stage, the crew could

have refused the line-up clearance but this would only occur if the crew considered that acceptance of the clearance would not be safe.

At Heathrow, crews are operating in a busy environment, with well respected controllers and with intensive RTF. At the time, 'Speedbird Six' had not been cleared to land, the crew of 'Midland One November Zulu' had no visual contact with the approaching aircraft and the commander had received an immediate reply to his query. Therefore, the action of the crew in entering the runway was reasonable. The commander was then surprised to hear the instruction to "START POWERING UP ON THE BRAKES" but the message continued with a clearance to take off so the crew continued with their normal procedure. They also reacted promptly to the call to "HOLD POSITION" and estimated that they moved only a matter of metres before coming to rest.

Thereafter, the commander initiated two separate calls with just his callsign to indicate that he wanted to pass a message. At the time, the controller was involved in deconflicting 'Speedbird Six' and 'Lufthansa Four Five Seven Seven' but acknowledged the second call. The controller was then advised by the commander of 'Midland One November Zulu' that he would be filing an MOR (Mandatory Occurrence Report) as he considered that the incident had been "very dangerous indeed". Information that crews intend to submit a report should be advised to the controller at the earliest opportunity but the commander subsequently acknowledged that the later part of his message was inappropriate. However, the crew had just been startled by the overflight of 'Speedbird Six' at an estimated 200 feet above their aircraft and the message content was an understandable reaction to the event. Nevertheless, it could have adversely affected the controller and diverted him away from his primary task of deconflicting two aircraft.

As noted in para 2.2 above, the use of strobe lights would have improved the conspicuity of the 'Midland One November Zulu' aircraft on the runway. Some UK companies have operating procedures requiring their crews to activate strobe lights whenever their aircraft are on an active runway. However, at present there is no national regulation requiring this. The use of strobe lights on the ground could be disturbing to other crews awaiting take off particularly at night. Nevertheless, the use of strobe lights would increase the conspicuity of aircraft on an active runway. It would therefore be appropriate for the CAA to standardise procedures and require all UK aircraft to use strobe lights, when fitted, when on an active runway in UK.

2.4 Mentor

Not all controllers enjoy the task of acting as an On the Job Training Instructor (OJTI) and the mentor involved in this incident is one such individual. He

confirmed that he had not sought it but accepted it as part of his function at the unit. This, coupled with the fact that he had not expected to be acting as OJTI on the day in question was unlikely, at least initially, to have placed him in the best frame of mind to fulfil the training function, although the trainee did not detect anything unusual in the mentor's attitude toward her or the training on the day in question.

The fact that the mentor stated that he was not aware that he was rostered for training on the day of the incident indicated that the watch programming system was not fully effective. Although this may have been an individual problem, the watch roster has since been modified.

A mentor retains overall responsibility for the safe operation of a position whilst monitoring a trainee. To meet this responsibility, the mentor must ensure that he/she is aware of the trainee's progress and level of competence and should clarify the training objectives for the forthcoming session. It is self evident that this should be achieved by a briefing. The session should be followed by a debrief to discuss performance issues and lessons learnt. The extent of briefing and debriefing required is variable depending on the instructor's knowledge of the trainee and the trainee's progress. Although management personnel at Heathrow ATC consider that there is sufficient time in normal duties to allow for briefing and debriefing opportunities, it would be appropriate for ATS providers to include an adequate allocation of time for briefing and debriefing of student controllers undergoing operational training.

At the time of this incident the mentor was aware that his trainee was relatively inexperienced, especially on the Air Departures position. The Heathrow ATCO Unit Training Plan (UTP) details the expected performance level for a trainee with 150 hours on the job training. This sets certain objectives for the Air Departures position which the trainee should attain in light traffic and with "considerable OJTI help". No mention is made of the need to demonstrate the ability to integrate arriving and departing traffic on the same runway.

Reports indicate that this particular trainee was progressing well but, since she had completed only about one third of her training at the time of the incident, it would be reasonable to expect that she would be receiving not only the mentor's close attention but also some advice with regard to making decisions and formulating plans. Information gathered during the incident investigation process suggests that there were deficiencies in both these aspects. When the request was received for landing on Runway 09R the mentor reported that the trainee had looked questioningly at him, presumably for a decision. He states that, in response, he "blanked her out" leaving the trainee to make the decision for herself. As already described, he then went on to discuss the fact that he would not have accepted the

landing aircraft though there was no good safety reason for not doing so. This was the first occasion during training that the trainee had been required to make such a decision herself. Since the mentor had not anticipated having to train on the day in question, no briefing had occurred. Had this taken place it should have clarified, in advance, the respective responsibilities in relation to the decision making process. On previous similar occasions, including sessions with the same mentor, she had been acting on decisions made for her. The trainee was placed in a somewhat ambiguous situation. She had sought advice, been refused it and then, having had to take the decision, had been in the position of having that decision criticised during the operational session.

When 'Speedbird Six' was accepted by the trainee for landing on Runway 09R the mentor, by his own admission, did not assist her in reaching a conclusion. He was in a position to reverse her decision if he considered it advisable. Nevertheless, following 'Speedbird Six' being accepted for landing on Runway 09R, it was the mentor's responsibility to assist the trainee in ensuring the safe integration of the arrival with the departing traffic.

When 'Speedbird Six' was accepted, a total of 5 aircraft had been given conditional line-up clearances on Runway 09R. Subsequently, when 'Speedbird Six' was about 15 nm from touchdown and a discussion about aircraft spacing took place between the mentor and his trainee, two of these aircraft had departed and a further two ('Lufthansa Four Five Seven Seven' and 'Midland One November Zulu') had received conditional line-up clearances. The mentor believed that the departure order was such that only one minute was required between departures and in his opinion, although the situation was tight, he considered that the plan would work. However, he was unaware that the order implemented by his trainee required a two minute spacing between two of the departing flights. It is assessed that this oversight occurred because he was not monitoring his trainee's actions closely enough.

'Speedbird Six' contacted 'Air Departures' at a range of six miles. At this time there were still three aircraft with conditional line-up clearances expected to depart ahead of the arrival, one of which was cleared for take off shortly afterwards. It would have been prudent for the line-up clearance to the last of these ('Midland One November Zulu') to be cancelled. The mentor continued to allow his trainee to transmit on the frequency but said that she should ask if the two remaining aircraft were ready for an immediate take off, thereby implying that he still thought that the plan would succeed. After the first of these ('Lufthansa Four Five Seven Seven') was cleared for an immediate take off, 'Midland One November Zulu' queried its line-up clearance. The mentor said that he would have cancelled its clearance but because his trainee answered "AFFIRM" and it appeared that the aircraft had crossed the Category 1 holding point, he allowed the decision to stand

but decided to take active control. He could see 'Speedbird Six' on approach and decided to resolve the situation by clearing 'Midland One November Zulu' for an immediate take off. However, having received a readback of this instruction, he instructed the pilot to cancel take off and instructed 'Speedbird Six' to go around. His subsequent actions to de-conflict the go-around from the previous departing aircraft were effective.

The controller was relieved from his operational position within approximately five minutes of the resolution of the incident.

2.5 Trainee

On arriving in the VCR, the trainee was given an update on the traffic situation by the mentor before taking the duties of 'Air Departures'. When, subsequently, she had to decide whether to agree to 'Speedbird Six' landing on 09R, she said she looked towards her mentor for his guidance. However, as it was apparent that he was leaving the decision to her, she checked the outbound situation and accepted the movement. This was the first instance on which she had taken such a decision without prior agreement with her mentor although she had experienced arrivals on the departure runway on a number of previous occasions.

When 'Speedbird Six' was on base-leg, about 15 nm from touchdown, she discussed the outbound situation with her mentor. She said that, because the inbound would take five minutes to land and it would be about six minutes before the last departure on a conditional line-up clearance ('Midland One November Zulu') could get airborne, she was concerned that the latter would not be able to depart before 'Speedbird Six' landed. She said that she 'cocked out' the flight progress strip for 'Midland One November Zulu' to remind herself of the problem and asked her mentor if she should cancel the aircraft's line-up clearance. The mentor had no recollection of this query.

With regard to how closely she was being monitored, the mentor stated that there had been a discussion concerning the departure sequence. His plan of action had differed from that of the trainee and he had not registered the fact that she had implemented her plan rather than his. He stated that this accounted for his not noticing a two minute SID separation which reduced the time available to complete the proposed departure sequence. This may indicate a lapse in monitoring since, irrespective of who had originated the plan, the trainee was issuing verbal instructions to the aircraft which should have alerted the mentor to any discrepancy between her instructions and what he expected to be the case.

She explained that, when 'Speedbird Six' called at 6 nm, she did not inform the crew that there were still three aircraft to depart as she believed that the situation

would change, whereby 'Midland One November Zulu' would have its line-up clearance cancelled. She said that she queried the latter's clearance again with her mentor. At his suggestion, she confirmed with the pilot of 'Midland One November Zulu' that he could accept an immediate departure. 'Lufthansa Four Five Seven Seven' was then cleared for an immediate take off. When 'Midland One November Zulu' asked for confirmation of his line-up clearance, she answered "AFFIRM" because she believed that that was what her mentor expected her to do. As she could see 'Speedbird Six' on final approach she was able to pass a conditional line-up clearance to the next aircraft at the holding point. Immediately following this transmission, the mentor took control of the frequency.

2.6 Planning and decision making

In the time leading up to the incident in question, the mentor received a number of cues or reminders that the sequencing was unlikely to work and that the planned course of action should be revised. The first cue that should have raised awareness of a potential problem occurred when the trainee and mentor discussed the sequencing. Both the trainee and mentor recall a discussion when 'Speedbird Six' turned base leg (as seen from the ATM) and it was estimated that the aircraft had approximately 15 miles to run equating to approximately 5 minutes flying time. The trainee recalls that, at this point, she estimated that 6 minutes would have been required for the departing aircraft, including 'Midland One November Zulu', to get airborne. It was then that the next two cues were put in place - the trainee 'cocked out' the flight progress strip for 'Midland One November Zulu', usually an indication that a situation needs attention, and also recalled asking whether she should cancel the aircraft's line up clearance. Shortly afterwards, 'Speedbird Six' made an initial call on the frequency at about 6 nm range and, after clearing 'Shamrock Seven One Five' for take off, she stated that she had again queried 'Midland One November Zulu's' line-up clearance i.e. the fourth cue. The mentor's response was to ask her to check whether 'Lufthansa Four Five Seven Seven' and 'Midland One November Zulu' were ready for immediate take off.

There is a discrepancy in the reports of the trainee and mentor concerning the above sequence of events. Although the trainee is quite clear in her assertion that she twice queried the line-up clearance for 'Midland One November Zulu', the mentor has stated that he cannot recall the trainee mentioning, at any stage, that the sequence was not going to work and has stated that he believed that "with expedition", it looked achievable.

Irrespective of these discrepancies in recall, there were sufficient other cues in the situation to have indicated quite clearly to a controller of the mentor's experience that the planned sequencing was not achievable. A final cue was the 'Midland One

November Zulu' crew asking for confirmation of line-up clearance which could reasonably have been seen as indicating some doubt on their part. Despite these cues, the mentor took no action to revise the sequence, apparently believing that it was still feasible. The mentor's motivation for pushing ahead with the plan of action in the face of all the evidence to the contrary is a matter of conjecture since he has no clear explanation for it except his belief that it would work.

The trainee stated that, despite having voiced her concerns, the mentor appeared to want to continue with the planned sequence. Consequently, when the pilot of "Midland One November Zulu" queried his line up-clearance, the trainee felt that she had effectively reverted to being a mouthpiece for the mentor. She stated that, when responding in the affirmative she was now carrying out what she perceived as his, rather than her own, plan. At this point, the mentor finally intervened on the RTF though not, initially, with the intention of preventing "Midland One November Zulu" from taking off. His intentions, even at this late stage, were to expedite the departure, even though by this time the lights of 'Speedbird Six' were visible on the approach. The advisability of proceeding with such an apparently flawed plan is questionable. In a training situation such a course of action is even more questionable and, at best, indicates an extreme lack of caution.

2.7

ATC procedures

Co-ordination for the use of the departure runway, in respect of 'Speedbird Six', was carried out between LATCC-TC and Heathrow 'Air Departures' in accordance with standard operating procedures. There were no safety reasons to prevent the use of the departure runway for arriving aircraft.

To comply with the clearance to land procedures, 'Midland One November Zulu' had to be airborne before 'Speedbird Six' could be cleared to land. It was apparent that there was insufficient spacing between these flights to allow this procedure to be applied.

In order to ensure maximum runway utilisation, in accordance with MATS Part 1, regular use is made at Heathrow and other airports of conditional line-up clearances for a number of aircraft at a time. However, this incident illustrates the risks inherent in adopting this technique for a large number of aircraft, when the runway is being used for landing and take off. Heathrow ATC Operations staff are currently considering the introduction of a limitation on the number of aircraft which can hold such conditional clearances at any one time.

Departures were being controlled in accordance with the timed departure interval pertaining to the appropriate SID routings.

The correct procedure, whereby the arriving aircraft was given a go-around and the departing flight's take-off clearance was cancelled, was carried out, albeit at a very late stage and without the use of standard phraseology. However, although incorrect phraseology was used, it is not considered that this had any effect on the incident as the pilot knew what was expected of him and reacted accordingly.

2.8 OJTI selection

It was evident from the opinions expressed by Heathrow personnel with responsibility for selecting OJTIs that they believed that the ideal situation would be when all controllers were OJTIs. While this may be the ideal situation, the disadvantage is that all controllers, regardless of suitability or personal preference, might become OJTIs as soon as they have achieved the minimum requirement. While there is no evidence that this situation existed at Heathrow, the selection of the mentor as an OJTI in the middle of 1999 raises some doubts about the selection system at that time. From his own admission, the mentor did not particularly enjoy the job. While this may not have been evident to the management, the mentor had been involved in an incident in April 1999 and was subsequently interviewed by Manager ATC in June 1999. In May 1999, he became a mentor in Aerodrome Control. There is evidence that not all of the personnel with managerial responsibility were aware of the actions taken. A more prudent course of action would have been to ensure that these individuals were aware of the situation and for the controller's performance to be monitored over a period of time before confirming him as an OJTI.

Since the incident in April 2000, the procedures at Heathrow have been reviewed locally and a formal system of selection and monitoring of OJTIs has been instigated. Among other aspects, the system will ensure that all relevant personnel are aware of all incidents and subsequent actions concerning controllers for whom they have responsibility. However, it would also be appropriate for the CAA to review the procedures at other ATC units to ensure that formal systems of selection and monitoring of OJTIs are used.

2.9 VCR equipment

Both the ATM and the SMR were reported as serviceable during the incident. However, the controllers involved could not recollect whether the latter equipment was switched on at the time. There is no requirement for this equipment to be continuously in use. 'Speedbird Six' was visible on the ATM during its approach.

Training/splitter boxes are available in the VCR although they are not used. Discussions have taken place in the past on the relative merits and demerits of

splitter boxes with no definite conclusion. However, irrespective of whether a training box is used, the crucial factor is the facility and speed with which the mentor can intervene should the need arise. Both the Head of ATC Training and the Watch Manager interviewed were of the opinion that the present system was satisfactory and allowed a mentor to take control in a prompt fashion if necessary.

No unserviceabilities of any other ATC equipment relative to the task were reported.

3 Conclusions

(a) Findings

- (i) The mentor and trainee controller were properly licensed, medically fit and adequately rested to operate their shift.
- (ii) Prior to the arrival of the trainee, the mentor was not aware that he was rostered for training duties during his duty on 28 April 2000.
- (iii) The trainee was aware that the mentor was rostered to train her during her duty on 28 April 2000.
- (iv) The 'C' watch programming system for detailing training allocations at the time of the incident was not fully effective but has subsequently been changed.
- (v) The procedures for integrating landing aircraft onto the departure runway were clear and frequently utilised.
- (vi) The number of conditional clearances in the light of dual operations on Runway 09R was inappropriate.
- (vii) The crew of 'Speedbird Six' complied with all ATC instructions.
- (viii) The crew of 'Midland One November Zulu' complied with all ATC instructions.
- (ix) The company procedure on the use of strobe lights meant that 'Midland One November Zulu' was not as visible as possible on the runway.
- (x) After initial contact on the 'Air Departures' frequency, the crew of 'Speedbird Six' were not informed of the number of aircraft still to depart.
- (xi) The ATC mentor allowed the situation to develop such that 'Speedbird Six' could not be safely integrated with the departure of 'Midland One November Zulu'.
- (xii) The trainee was uncomfortable about the developing situation but continued with the plan as she perceived the mentor required.
- (xiii) No criticism can be made of the trainee's performance.

- (xiv) The ATC mentor subsequently allowed the situation between 'Speedbird Six' and 'Midland One November Zulu' to develop to a hazardous position.
- (xv) When the mentor took control of the RTF, he initially took inappropriate action.
- (xvi) The mentor resolved the confliction between 'Speedbird Six' and 'Lufthansa Four Five Seven Seven' in an effective manner.
- (xvii) Part of the RTF call made by 'Midland One November Zulu' following the incident, whilst understandable, was inappropriate.
- (xviii) The decision to use the mentor as a trainer within the VCR, very soon after an earlier incident on 3 April 1999, was inappropriate.
- (xix) The system for selecting On the Job Training Instructors at Heathrow ATC at the time of the incident was flawed but has subsequently been revised.
- (xx) The monitoring and standardisation of trainers at Heathrow ATC up to the time of the incident was not fully effective and no formal system was in place for monitoring the continued effectiveness of On-the-Job-Training Instructors.
- (xxi) The rostering at Heathrow ATC at the time of the incident did not include a formal allowance for brief and debrief times.

(b) Causes

The investigation revealed the following causal factors:

- (1) The ATC mentor allowed the situation to develop to the point where 'Speedbird Six' could not be safely integrated with the departure of 'Midland One November Zulu'.
- (2) When this became apparent, the initial actions of the mentor, on taking control of the RTF, were inappropriate.

4. Safety Recommendations

The following recommendations are made:

Recommendation 2001-42. The Civil Aviation Authority should issue instructions requiring United Kingdom Registered aircraft to use strobe lights, if fitted, when on an active runway in the UK.

Recommendation 2001-43. The Civil Aviation Authority should ensure that Air Traffic Control providers include an adequate allocation of time for formal briefing and debriefing of student controllers undergoing operational training.

Recommendation 2001-44. The Civil Aviation Authority should ensure that Air Traffic Control units use formal systems for the selection and monitoring of On the Job Air Traffic Control Training Instructors.

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March 2001

