

Boeing 747-412(Megatop), 9V-SPF and BAC One Eleven 530FX, G-AYOP

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Aircraft Type and Registration: 1) Boeing 747-412(Megatop), 9V-SPF
ii) BAC One Eleven 530FX, G-AYOP

No & Type of Engines: i) 4 Pratt & Whitney PW4056 turbofan engines
ii) 2 Rolls-Royce Spey 512-14DW turbofan engines

Year of Manufacture: i) 1995
ii) 1971

Date & Time (UTC): 16 September 2000 at 0716 hrs

Location: Runway 24R at Manchester International Airport

Type of Flight: i) Public Transport
ii) Public Transport

Persons on Board: i) Crew - N/K - Passengers - N/K
ii) Crew - 5 - Passengers - 102

Injuries: i) Crew - None - Passengers - None
ii) Crew - None - Passengers - None

Nature of Damage: i) None
ii) None

Commander's Licence: i) Airline Transport Pilot's Licence
ii) Airline Transport Pilot's Licence

Commander's Age: i) N/K
ii) N/K

Commander's Flying Experience: i) Not applicable
ii) Not applicable

Information Source: AAIB Field Investigation

History of the flights

At 0711 hrs a BAC One Eleven outbound from Manchester to Bergamo, Italy, was cleared by the Manchester tower controller to taxi to the holding point for Runway 24R. At 0713 hrs the controller cleared the aircraft to line up after a landing Airbus A320. Following this aircraft on the ILS approach to Runway 24R was a Boeing 747 inbound from Amsterdam. After checking in on the tower frequency the B747 crew had informed the tower controller that 'WE'RE HEAVY AND WE'LL BE USING THE WHOLE RUNWAY'.

After landing the A320 was slow to vacate the runway and so the controller instructed the crew to 'EXPEDITE TO THE RIGHT AND CONTACT GROUND 121.85'. He also transmitted to the crew of the One Eleven to be 'READY WHEN CLEARED'. The crew of the A320 did not clear the runway in the time expected by the controller and so, although he had instructed the crew to change to the ground frequency he transmitted '..... COULD YOU EXPEDITE THE RAPID EXIT'. The A320 crew, who were fortunately still on the tower frequency, were able to confirm that they would.

As the A320 vacated the runway at the second rapid exit turnoff (RET) the controller cleared One Eleven, which by now was lined up, for take off. The commander of the One Eleven was aware of the heavy B747 on finals and commenced his take off roll immediately. At this time the inbound B747 was at approximately 1 mile from touchdown and the controller asked the B747 commander if he could see the 'rolling' One Eleven. The B747 commander advised that he could. The controller reported that 'the One Eleven's acceleration appeared to him to be very slow whilst the approaching B747 appeared to be surprisingly fast so much so that it would reach the start of the runway whilst the One Eleven was only some way along it'. At this point the controller issued a '*cleared to land after the departing*' clearance to the B747 as, in his opinion, it seemed somewhat safer than to instruct an aircraft to 'go-around' with another aircraft departing at the same time.

Realising that the situation was 'tight' the controller reported experiencing some distortion in his perception of time. He reported thinking, that the 'One Eleven' was 'taking an age' to roll down the runway, while the oncoming B747 was 'surprisingly fast'. This time distortion is not uncommon in such time dependent situations and often tends to occur when insufficient time has been allocated to carrying out a predetermined plan. However, even after realising that the situation was becoming more critical, the controller did not intervene but allowed the continued approach of the B747 which, at the time the 'One Eleven' began its take off roll, was only 0.5 nm from the runway threshold until any decision was effectively taken out of his hands by the B747 pilot's decision to go-around.

As the B747 reached the runway threshold markings the commander initiated a go-around from approximately 50 feet agl transmitting 'ON A GO-AROUND ... AND WE'LL START A RIGHT TURN TO MISS THE TRAFFIC'. The One Eleven, was some 400 metres ahead of the B747 and had not yet reached rotate speed when this call was made. The controller replied 'ROGER THAT'S A RIGHT TURN'. As the B747 began to climb and diverge slightly from the departing One Eleven, which by now was airborne and climbing slowly, the commander of the B747 transmitted 'TELL US WHAT YOU ADVISE WE CANNOT SEE THAT TRAFFIC'. The controller replied that the traffic was clear to the left. The commander of the B747 then remarked 'OK WHAT DO YOU WANT NOW?' The controller responded by clearing the B747 onto a heading of 330° climbing to 3,500 feet and co-ordinated that clearance with approach control. The B747 continued under approach control and was given radar vectors for a further ILS approach. It landed without further incident at 0728 hrs. The One Eleven turned left at 2 DME in accordance with the SID and changed frequency. It was not until their

return to Manchester that the crew of the One Eleven were told by ATC that the B747 had come exceptionally close to their aircraft during take off.

Surface Movement Radar (SMR)

Surface movement radar information, recorded at Manchester, showed that the B747 was 1.5 nm from the threshold as the A320 vacated the runway (see Figure 1). As the One Eleven commenced its take off roll the B747 was at 0.5 nm from the runway threshold. The B747 crossed the threshold as the One Eleven passed link 'H' (a separation distance of 850 metres). As the B747 crossed the touchdown zone the One Eleven was half way between link 'G' and link 'F' giving an approximate separation distance of 860 metres. As the B747 passed abeam link G the One Eleven was abeam link 'KC' (approximate separation distance 480 metres). Then as the B747 passed abeam KC the One Eleven was approaching link B (approximate separation distance of 700 metres). Finally, the SMR showed that the B747 turned away to the right as its passed abeam link 'B'.

Manual of Air Traffic Services (MATS)

MATS Part 1 states that 'unless specific procedures have been approved by the Authority, a landing aircraft shall not be permitted to cross the beginning of the runway on its final approach until a preceding aircraft, departing from the same runway, is airborne'. Manchester has been approved, by the Authority, subject to certain conditions, to use a 'land after departure' procedure'. MATS Part 2 (relating to Manchester) includes details of the 'LAND AFTER DEPARTURE PROCEDURE'. The relevant extract is reproduced below:

'When the runway is temporarily occupied by departing traffic, landing clearance may be issued to an arriving aircraft provided that, at the time the landing aircraft crosses the landing threshold of the runway in use, the following minimum separation distances will exist:

Either a) The departing aircraft will be airborne and at least 2,000 metres from the landing threshold.

or b) The departing aircraft will not be airborne but will be at least 2,400 metres from the landing threshold

These distances may be reduced when both the departing and arriving aircraft are propeller driven and have a maximum Total Weight Authorised (MTWA) not exceeding 5,700 kg.....

The Air Controller is responsible for assessing that the specified separation minima will be achieved. The final responsibility to accept the landing remains with the pilot.

Conditions for Use

These procedures shall only be used when ALL the following apply:

a) By DAY

b) When the reported meteorological conditions are equal to or better than a visibility of 6km and a cloud ceiling of 1,000ft and the Air Controller is satisfied that the pilot of the landing aircraft will be able to observe continuously the departing aircraft.

c) When both aircraft are being operated normally (e.g. at normal approach speeds, no emergency etc). The pilots are responsible for notifying ATC if they are operating their aircraft other than normally, e.g. final approach speed greater than 160kt.

d) When the runway is dry and free of all precipitants such that there is no evidence that the braking action may be adversely affected.

e) When the Air Controller is able to assess the separation visually.

Assessment of Distances

The distances specified above may be assessed by reference to the following table:

DISTANCE FROM LANDING THRESHOLD	VISUAL REFERENCE	
	RUNWAY 24R	RUNWAY 06L
2400m	06L Landing Threshold	24R Landing Threshold
2000m	Link B	Abeam MCT VOR
1500m	RET BD	RET JB

Manchester (Airport) Supplementary Instruction No 024/00

On 21 June 2000 (three months before the incident) ATC Operations at Manchester issued a Supplementary Instruction describing 'Best Practice' to be applied to the 'Land After Departure procedure'. This is shown below.

LAND AFTER DEPARTURE PROCEDURE - BEST PRACTICE

1. INTRODUCTION

Following incidents concerned with this procedure, a review has taken place. It was established that the procedure is both useful and safe when correctly applied. However, it is thought necessary that 'best practice' guidelines should be published to assist controllers in the assessment of the required separation between aircraft.

2. EFFECTIVE DATE Immediate

3. PROCEDURE

Manchester has in place, to help maximise runway utilisation, the 'Land after Departure Procedure'. The Air Controller has the responsibility for assessing that the distance between the landing aircraft

and the previous departing aircraft is not less than that specified in the IK AIP (GEN 3-3-5) and MATS Part 2 (ADC 2-7). The ultimate decision to accept such a clearance rests with the pilot.

In order to achieve this assurance of separation, in addition to the MATS Part 2 conditions which must exist, the following points should be borne in mind:-

- 1) If the departing aircraft has not commenced its take off roll, it is impossible to say what the separation will be.
- 2) Aircraft performance has a major role to play in the controller making the correct decision. An inbound aircraft's speed during the last 2-3 miles of final approach can differ significantly. Thus what may work with a B737 may not work with a B747.

Typical speeds inside 4NM are: B737, B757 130kts

 B767 140kts B747-400F 162kts+

The departing aircraft's length of take off roll must also be considered.

- 3) When a 'Land after Departure' clearance is being considered, a decision must be made that the required separation will be achieved. If it will not be achieved, then missed approach instructions must be issued and consideration given to stopping the departing aircraft. The point at which this decision should be finalised is around 2NM from touchdown, after taking into account all the relevant factors. A missed approach from this range, with an aircraft just commencing its departure roll, is much easier to resolve at this stage than later on short finals.

Post incident action by the Manager ATC, Manchester Airport

Immediately following the incident the controller concerned was withdrawn from duty as a precaution against any effect the incident could have had on the controller's immediate performance. The AAIB were informed and an ATC investigation commenced. Recordings of the RTF, NODE Radar and Surface Movement Radar were preserved. Since a 'Land after Departure' clearance had been issued during this event the procedure was re-examined in detail. It was concluded that, because the procedure itself had not been followed, it was not therefore a contributory factor to the incident. In order to disseminate the appropriate safety lessons a local NOTAC (Notice to Controllers) dated 27 September 2000 was issued. This reminded controllers of the conditions required for using the procedure as well as a restatement of the 'best practice' guidelines.

Discussion

The controller appears to have embarked on a plan of action i.e. to utilise the 'land after' procedure and persevered with the plan despite a number of cues in the situation which should have alerted him to the fact that the plan was unworkable. The A320 was slow to vacate the runway, the 'One Eleven' was rolling slowly and the oncoming B747 was already at a distance of approximately 1.5 miles when the 'One Eleven' was cleared for take off. All factors which eroded the time available and militated against the plan working.

This over adherence to a plan has had all the hallmarks of a controller operating under stress. Past incidents have shown that in such situations individuals find it very difficult mentally to 'stand back', reassess their plans and make adjustments as necessary. There are various reasons for this. Sometimes people find it difficult to give up the comfort and reassurance of a plan, once formed. Sometimes they are already working to their full capacity and have few resources left to re-evaluate and amend existing plans. At other times they may be concerned about a perceived loss of face associated with having to abandon their chosen course of action.

Reference has already been made to the fact that the controller decided not to intervene during the incident sequence and that the problem was effectively resolved by the decision of B747 pilot to effect a go-round. Following the ADC controller's initial decision to use the 'land after' procedure, his subsequent controlling is characterised by a lack of positive control or intervention. He did not intervene to break off the approach of the B747 or pass information to the pilot of the 'One Eleven' nor, initially at least, did he issue any positive instruction to the pilot of the B747, despite the pilot's twice requesting it.