

Airbus A321-211, EI-CPE & Boeing 747-436, G-BNLK

AAIB Bulletin No: 11/2004	Ref: EW/C2004/03/07	Category: 1.1 1.1
Aircraft Type and Registration:	1) Airbus A321-211, EI-CPE 2) Boeing 747-436, G-BNLK	
No & Type of Engines:	1) 2 CFM 56-5B/3P turbofan engines 2) 4 RB211-524H2-T-19 turbofan engines	
Year of Manufacture:	1) 1998 2) 1990	
Date & Time (UTC):	23 March 2004 at 1024 hrs	
Location:	Heathrow Airport, London	
Type of Flight:	1) Public Transport (Passenger) 2) Under tow	
Persons on Board:	1) Crew - 8 2) N/A	Passengers - 186
Injuries:	1) Crew - None 2) N/A	Passengers - None
Nature of Damage:	1) Rudder damaged 2) Left wing tip damaged	
Commander's Licence:	1) Air Transport Pilot's Licence 2) N/A	
Commander's Age:	1) 39 years 2) N/A	
Commander's Flying Experience:	1) 8,000 hours (of which 900 were on type) Last 90 days - 140 hours Last 28 days - 30 hours 2) N/A	
Information Source:	Aircraft Accident Report Form submitted by the pilot of EI-CPE and subsequent enquires by the AAIB	

Synopsis

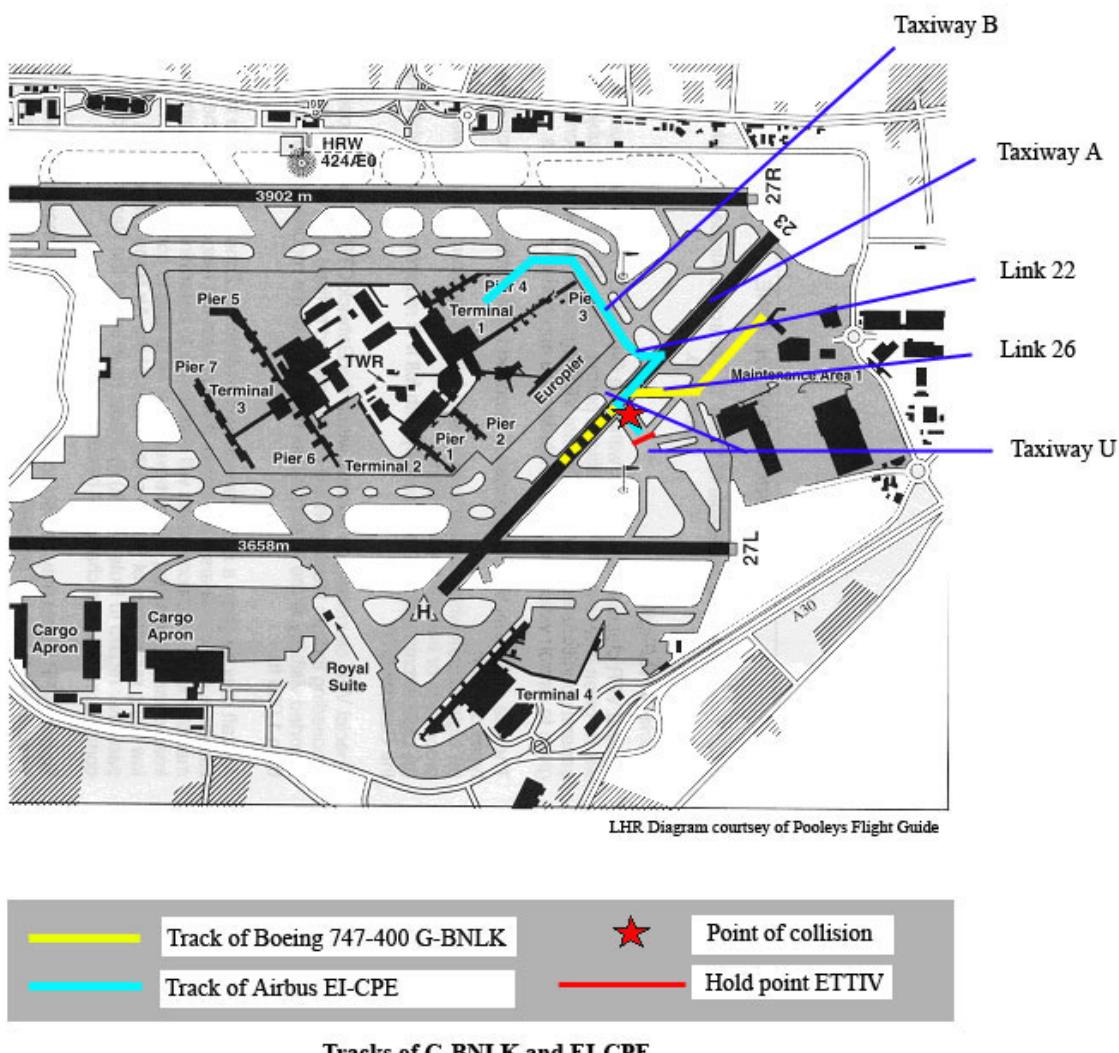
Whilst EI-CPE was stationary on Taxiway U, behind an A330 at the ETTIV holding point, its rudder was struck by the wing tip of G-BNLK, which was under tow along Taxiway A. The investigation revealed that the towing crew of G-BNLK had assumed that as they had been cleared to tow, they would be clear of all obstacles. Three recommendations have been made as a result of this investigation.

History of Flight

EI-CPE had been prepared for a scheduled flight to Dublin, Ireland. Having received clearance to push back from the stand on Pier 4A, the flight crew were given instructions by ATC to taxi along Taxiway B to holding point ETTIV in preparation for a takeoff from Runway 27L, Figure 1. The first officer taxied the aircraft along Taxiway B, onto link 22 and down Taxiway A before making a left turn onto Taxiway U. When the aircraft approached holding point ETTIV, it was brought to a halt behind an A330 that was stationary at the holding point. At this time, Ground Movement Control (GMC) instructed the flight crew to change from the ground frequency, which they had been using, and to monitor the tower frequency.

Figure 1 Tracks of G-BNLK and EI-CPE

Figure 1



G-BNLK was ready to tow at the maintenance base and, just prior to EI-CPE arriving at ETTIV, the towing crew requested, on the GMC frequency, approval to tow the Boeing 747-400 via the airport manoeuvring area, to Terminal 1. ATC gave approval for the aircraft to be moved via LINK 26, but to hold short of the intersecting Taxiway A (Runway 05/23). By the time the towing crew had reached LINK 26, the flight crew of EI-CPE were listening to the tower frequency and were not aware of the communications between the aircraft under tow and GMC on the ground frequency. A few minutes later, at 1012, GMC gave the towing crew an instruction to "MAKE A LEFT TURN ONTO

ALPHA, HOLD SHORT OF MIKE", with another instruction at 1013 of "LK GIVE WAY TO THE AIR FRANCE AND RIGHT 180 TO YOUR STAND". This manoeuvre put G-BNLK on a path that passed behind the tail of EI-CPE.

At 1015, the commander of EI-CPE felt a shudder through the aircraft and thought it might have been due to the A330 ahead of them increasing engine power to taxi. However, the first officer, who was in control of the aircraft and had his feet on the rudder pedals, felt the pedals move with the shudder and noticed that the rudder symbol deflected on the flight controls display. The cabin crew in the back of the aircraft also felt the judder, and indicated that the feeling was similar to a car passing over a cat's eye in the road. The cabin crew seated in the rear of the aircraft then noticed the nose of G-BNLK appearing to the right of the aircraft and concluded that it had struck their aircraft. The first officer then saw damage to the wingtip of G-BNLK and so the commander immediately informed ATC that they thought the Boeing 747-400 under tow might have struck their aircraft. Just after this another aircraft parked behind EI-CPE on Taxiway U confirmed that damage had occurred and GMC instructed the towing crew of G-BNLK to hold position and informed them that they may have struck the tail of the A321.

A short time later the airfield fire service arrived to assess the situation, after which EI-CPE was taxied back to a stand. The passengers disembarked and were transferred to a later flight. Because the aircraft had been waiting to take off, the crew and passengers were secure in their seats with their harnesses fastened, which minimised any possibility of injuries to the occupants.

Aircraft damage

The base of the rudder on EI-CPE had sustained damage in the form of an angled slice through its structure aft of the hinge line, consistent with the left winglet of the B747-400 passing through the rudder, and the winglet exhibited damage on its leading edge, consistent with such contact, Figure 2. No other damage was reportedly found relating to this collision. The rudder of EI-CPE was subsequently replaced, as was the winglet of G-BNLK, and both aircraft were returned to full commercial service.

Figure 2 Damage Details between EI-CPE and G-BNLK



Figure 2

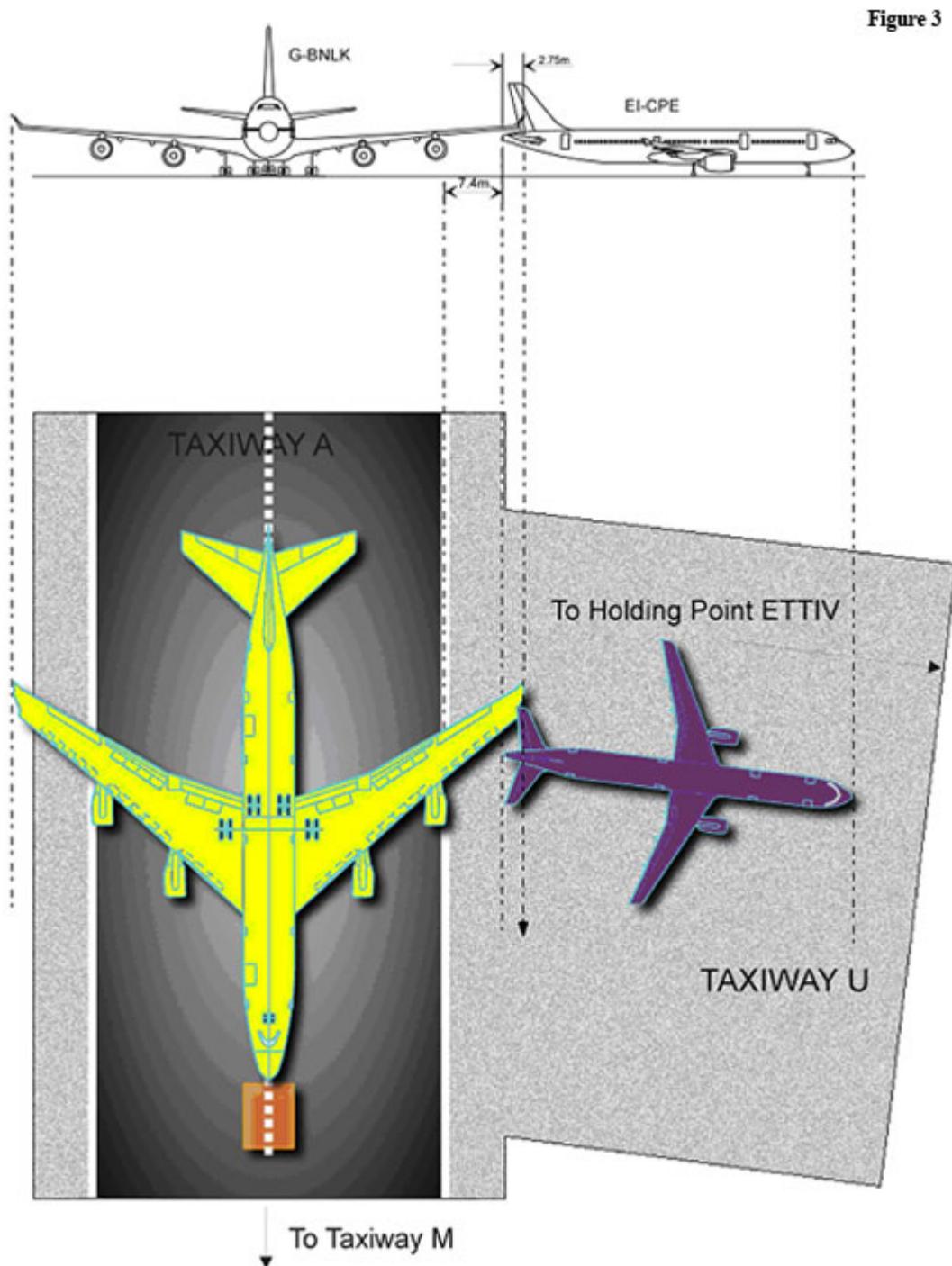


Damage Details between EI-CPE and G-BNLK

Collision geometry

From photographs taken after the accident, G-BNLK appeared to have been on the centre line of Taxiway A, but some distance past EI-CPE, which was in the holding area short of the holding point ETTIV. The longitudinal axis of this aircraft was perpendicular to the taxiway edge line and its tail was clear of the line by some 7.4 metres. With a Boeing 747-400 on the centre line of Taxiway A, its wing tip wing extends beyond this runway edge line by about 10.3 metres, leaving an overlap, in this case, between its wing tip and the tail of EI-CPE of approximately 2.75 metres, Figure 3.

Figure 3 Collision geometry between EI-CPE and G-BNLK



Towing practices and procedures

The towing crew had consisted of the minimum requirement of three persons, for the 'conventional' tug that was being used; one driver, one radio operator in the tug and one brake operator in the aircraft cockpit. The driver of the tug was aware of the A321 and saw that it was already on Taxiway U when he turned onto Taxiway A. It was as he slowly passed the aircraft that he was told to stop by ground ATC. He had not felt anything in the tug to indicate that his aircraft had struck the tail of the A321; the radio operator and the cockpit operator also felt nothing. He later indicated that, as the ground ATC had given clearance to tow, he assumed that he was also clear of all obstacles, including the tail of EI-CPE.

The visibility of the wingtips of a Boeing 747-400 is very limited from the tug driver's position and from the flight deck, and requires bodily movement to enable them to be seen. The towing crew were aware of the aircraft at the holding point but the radio operator had been concentrating on radio communications, and the brake operator was not able to see the aircraft wingtips from his vantage point in the cockpit.

Prior to being allowed to tow aircraft, a towing crew must have undertaken appropriate training and be in possession of a Permit. To obtain this Permit, the crew must attend a training programme provided by the towing operating company, which in this case was the airline. Initially, training consists of a standard 28 day ground handling training programme, which includes radiotelephony skills. Following this, the crew experience on the job training for their specific task. After six months handling experience, a radio operator then completes another specific radio course and the tug driver, after two years of handling experience, completes a further driving course before being issued with a Permit to tow aircraft. Also, both the radio operator and driver were required to hold a 'C' manoeuvring area driving licence to operate a vehicle airside at Heathrow, which is issued by the airfield operator. The airport operator defines what is required to operate a vehicle airside and provides the instructions on the training requirements for the issue of the 'C' licence. The airport operator gives training, either to training officers of the towing operators, who then carry out the training of the individuals in their organisation, or independently to individuals. The issue of Permits to tow aircraft is purely the responsibility of the towing operator and such Permits require renewal every three years.

The airline provides information on the towing of aircraft in a generic manual on ground handling. This document details procedures about preparations for a tow and the securing of the aircraft after a tow, but contains little guidance on the crew's responsibilities during the actual towing operation. This is also true of additional Local Operating Procedures (LOP) which are available to the towing crews at Heathrow. To supplement these procedures, the airline issues Operational Notices (ON) on an ad hoc basis, which cover various matters on ground handling operations. In June 2003, following a similar accident (AAIB Bulletin 7/2003, ref EW/G2003/02/09), an ON was issued which stated:

'...When towing either on the airfield or base areas, always be alert to the possibility of aircraft not fully positioned or incorrectly aligned onto stand. Never take it for granted that clearance exists, even if you are given clearance by ATC...'

The information in this notice was not incorporated into the LOP or the training syllabus for towing crews. Subsequent discussions revealed that, in training, following the conversion of the ground operation layout at Heathrow from 'block' to taxiway designations, information was provided to the attendees that wing tip clearances cannot be guaranteed.

ATC

ATC communication with both aircraft was initially on the GMC frequency of 121.9 MHz, with EI-CPE later being transferred onto the tower frequency of 118.5 MHz in preparation for takeoff. The GMC frequencies at Heathrow Airport are often congested and it is sometimes difficult for towing crews, in particular, to find an opportunity to contact the controller to gain clearances.

To assist ATC in ground movements, they have a vantage point in the control tower, which allows direct line of sight of the majority of the airport, and the use of ground surveillance radar. The radar however does not give an accurate size and shape of aircraft; instead it provides a location on a screen for each aircraft identified on the ground.

Requirements for the provision of ATC is provided in CAA document CAP 493, *Manual of Air Traffic Services*, and Part 1, Section 1, Chapter 1 paragraph 3 states:

'3 Air Traffic Control Service

3.1 An air traffic control service is provided for the purpose of:

- a) preventing collisions between aircraft in the air;*
- b) assisting in preventing collisions between aircraft moving on the apron and the manoeuvring area;*
- c) assisting in preventing collisions between aircraft and obstructions on the manoeuvring area;*
- d) expediting and maintaining an orderly flow of air traffic.'*

Regulation/Guidelines

The regulations in the *Air Navigation Order* (ANO), which have most relevance to this accident, are stated below:

'Section 2 The Rules Of The Air Regulations 1996, Section V(ii), Aerodrome Traffic Rules, Rule 37 Right of way on the ground':

'Right of way on the ground

37 (1) This rule shall apply to flying machines and vehicles on any part of a land aerodrome provided for the use of aircraft and under the control of the person in charge of the aerodrome.

(2) Notwithstanding any air traffic control clearance it shall remain the duty of the commander of an aircraft to take all possible measures to ensure that his aircraft does not collide with any other aircraft or with any vehicle.

(3) (a) Flying machines and vehicles shall give way to aircraft which are taking off or landing.

(b) Vehicles, and flying machines which are not taking off or landing, shall give way to vehicles towing aircraft.

(c) Vehicles which are not towing aircraft shall give way to aircraft.'

With regard to the ANO rule above the following is the given definition of the commander:

"Commander" in relation to an aircraft means the member of the flight crew designated as commander of that aircraft by the operator thereof, or, failing such a person, the person who is for the time being the pilot in command of the aircraft'

A guidance document, CAP 642 *Airside Safety Management*, issued by the CAA, is intended to provide information on the safe operating practises at airports. Included in this document are various sections relating to the towing of aircraft, specifically Chapter 2 'Managing the Risks', paragraph 6.8.3 'Dead aircraft handling' which states:

'6.8.3 In addition to the above considerations, the handling staff pushing back a 'dead' aircraft for towing will need to consider the following:

- *A trained staff member will normally be required to occupy the flight deck to control the brakes, monitor radio contact between tug/aircraft and ATC and control the aircraft's anti-collision and, if appropriate, navigation lights*
- *As soon as a tug is assigned a task associated with the movement of an aircraft on any part of the manoeuvring area the tug driver must normally establish RT contact with ATC and obtain a specific ATC clearance before entering the manoeuvring area. The tug driver will normally be instructed to advise ATC when the manoeuvre is complete...'.*

Also, Chapter 2 'Managing the Risks', Section 5, 'Moving Aircraft' states:

'The movement of aircraft on the ground, either under their own power or towed, creates a number of hazards that are unique to the aviation industry. In particular operating jet or propeller engines can cause fatal or serious injuries and extensive damage to equipment or other aircraft.'

Later in the document, Chapter 4 'Airside Vehicle Operation and Driving', deals with vehicles operating airside at an airport, including tugs. Also, in this section, guidance on training for drivers is given and includes a detailed example of a syllabus to be followed. However, this training guidance does not include information on the interpretation of ATC commands and their relevance for obstacle or wingtip clearance. Indeed, paragraph 3.10 'Control', states:

'3.10.1 Control of vehicles on the manoeuvring area is normally the responsibility of Air Traffic Control. On apron areas, control of taxiing aircraft and aircraft under tow is the responsibility of Air Traffic Control but the control of vehicles is subject to rules and instructions issued by the aerodrome authority.'

Discussion

This accident was clearly due to the winglet of G-BNLK slicing through the rudder of EI-CPE because of insufficient clearance between the two aircraft. The outcome of this accident could have been a lot worse. In the first instance, the towing crew were not aware that their aircraft had struck the tail of another aircraft, and were continuing with the tow until stopped by ATC. Secondly, if the flight crew on EI-CPE had not noticed the rudder deflection through their rudder pedals and cockpit display, they may have assumed that the judder was from the jet efflux of the A330 ahead of their aircraft, and continued with the flight. If the flight had taken place with the rudder damaged, then it is possible that part of the rudder on the A321 could have departed in flight and maybe have caused control difficulties.

It might be expected that the crew undertaking the tow of G-BNLK would have kept a good lookout generally, and assessed any risk of collision with the stationary A321, in particular. By their own honest and open volition they had assessed the situation and, given the instruction to proceed by GMC, assumed they were clear of all obstacles and, in particular, other aircraft. This assumption of obstacle clearance was compounded by the lack of guidance information in the practices and procedures manuals for the towing crew. Nowhere in these manuals was there information on the responsibilities of the towing crew during towing operations, including information on obstacle clearance. The only place this did appear was in an ON (given for information), the guidance of which was not included in the manuals following its issue. In addition, the relevant regulations in the ANO and documents issued by the CAA, also omit to mention the responsibilities of towing crews in an airport manoeuvring area.

Like the towing crew, it might be expected that ATC should have predicted the collision and provided forewarning to the crew towing G-BNLK. However, the vantage point provided to the ground controller only enables the identification of obvious potential collisions and therefore the onus for obstacle clearance must rest with the person responsible for the aircraft, be it the towing crew or flight crew. This is borne out by the instructions in CAP 493 *Manual of Air Traffic Services* in which an ATC service is provided to assist in preventing collision between aircraft on the manoeuvring area.

The communications by the ground controller were clear, correct and complied with the ATC procedures. The instructions to G-BNLK to continue along Taxiway A were in anticipation of EI-CPE being clear of the track of the Boeing 747-400 but were not intended to infer any obstacle or wingtip clearance. Indeed, information provided to towing and flight crews by the airline in the ON issued in June 2003, includes a statement that wingtip clearances cannot be guaranteed.

Safety Recommendations

The ANO contains a rule on the right of way on the ground, Rule 37, which states that it is applicable to all vehicles on any part of the aerodrome and which could be inferred to include tugs with aircraft under tow. Rule 37(2) then goes on to mention that, regardless of any ATC clearance, it remains the duty of the commander of an aircraft to take all possible means to ensure the aircraft does not collide with another aircraft. But the ANO defines the commander as '*the member of the flight crew designated as commander' or 'the person who for the time being the pilot in charge of the aircraft*'. Therefore, this part of the rule does not strictly apply to a driver towing a 'dead' aircraft. The last part of rule 37(3b) seems to support the towing crews assumption on clearance as this requires aircraft which are not taking off or landing to give way to aircraft under tow. This last rule would infer that the flight crew of EI-CPE should have given way to G-BNLK, but EI-CPE was already stationary at the time and the flight crew would not have been aware of the Boeing 747-400, behind them, under tow. In addition, even if they had been aware of the aircraft, they had no room to manoeuvre to avoid a collision, and would have had to call on the GMC frequency to alert the towing crew. It is therefore recommended:

Safety Recommendation 2004-72

The Civil Aviation Authority should consider amending Rule 37(2) of the *Air Navigation Order* (CAP 363) to specifically make it the duty of those persons responsible for the towing of aircraft on manoeuvre areas of aerodromes to take all possible means to ensure that the aircraft under tow does not collide with another aircraft, or other obstacle, regardless of any Air Traffic Control or Ground Movement Control clearance.

CAA document CAP 642 *Airside Safety Management* provides guidance on safe operating practises at airports and includes various sections on the towing of 'dead' and 'live' aircraft. It also includes a large section on the use of vehicles on the airside part of an airport and the recommended training syllabus for the drivers. Nowhere does it mention that the towing crew of an aircraft under tow is responsible for obstacle and wingtip clearance, indeed some of the guidance puts the onus back onto ATC for the provision of this clearance. Although, Chapter 2 'Managing the Risks', Section 5 'Moving Aircraft' states:

'The movement of aircraft on the ground, either under their own power or towed, creates a number of hazards that are unique to the aviation industry. In particular operating jet or propeller engines can cause fatal or serious injuries and extensive damage to equipment or other aircraft.'

this document neither expands the information above for the towing of aircraft in airport manoeuvring areas, nor does it specifically identify the hazards, such as wingtip clearance, nor does it provide guidance on how to avoid them. Also omitted from these documents is any guidance to the towing crews on what action should be taken, if there is need to obtain clarification or assistance should a potential hazard present itself. It is therefore recommended that:

Safety Recommendation 2004-73

The Civil Aviation Authority should enhance CAP 642 *Airside Safety Management* to include guidance on the responsibilities of towing crews of aircraft under tow, especially with regard to obstacle and wingtip clearance in aircraft manoeuvring areas so that such clearance is not inferred from ATC clearances to tow an aircraft.

The operator, who had in turn been trained by the airport authority, provided the training for the towing crew. Nowhere in this training had there been any emphasis on the responsibilities of the crew whilst the aircraft is under tow, for maintaining a look out and ensuring obstacle and wing tip clearance. It is therefore recommended:

Safety Recommendation 2004-74

British Airports Authority plc should ensure that training of individuals for the issue of 'C' manoeuvring area licences, includes the responsibilities of drivers for obstacle clearance and that ATC clearance instructions does not infer obstacle or wingtip clearance.

Action taken by the towing operator

Following the accident the operator responsible for the towing crews immediately issued a notice to all their staff involved in the towing of aircraft and this will be incorporated into the manuals. The notice states that ATC instructions do not guarantee wing tip clearance. They are also due to conduct a full review of all elements associated with aircraft towing in the organisation, including their safety management.