ACCIDENT

Aircraft Type and Registration:	1) Boeing 777-236, G-VIIK 2) Airbus A321-231, G-EUXH
No & Type of Engines:	1) 2 General Electric GE90-85B turbofan engines 2) 2 International Aero Engine V2533-A5 turbofan engines
Year of Manufacture:	1) 1998 2) 2004
Date & Time (UTC):	27 July 2007 at 1900 hrs
Location:	London Heathrow Airport
Type of Flight:	1) Commercial Air Transport (Passenger) 2) Commercial Air Transport (Passenger)
Persons on Board:	1) Crew - 14 Passengers - 213 2) Crew - 9 Passengers - 102
Injuries:	1) Crew - None Passengers - None 2) Crew - None Passengers - None
Nature of Damage:	1) Left aileron and wing panel damaged 2) Vertical fin and fairing damaged
Commander's Licence:	1) Airline Transport Pilot's Licence 2) Airline Transport Pilot's Licence
Commander's Age:	1) 49 years 2) 46 years
Commander's Flying Experience:	1) 13,429 hours (of which 2,073 were on type) Last 90 days - 211 hours Last 28 days - 71 hours 2) 11,800 hours (of which 2,700 were on type) Last 90 days - 169 hours Last 28 days - 45 hours
Information Source:	AAIB Field Investigation

Synopsis

Boeing 777, G-VIIK, collided with a stationary Airbus A321, G-EUXH, whilst being pushed back from its stand at London Heathrow Terminal 4. Moments earlier, the Airbus had taxied behind the Boeing 777 towards its own stand, but had been unable to park because the electronic stand guidance had not been activated. It stopped short of the parking position, partially obstructing the taxiway behind the Boeing 777, and was not seen by the pushback crew until just before the collision.

The accident occurred primarily because the Boeing 777 pushback was not conducted in accordance with

the aircraft operator's normal operating procedures and safe practices. A number of organisational issues were also identified which may have been contributory. Five Safety Recommendations are made.

Description of the accident

The two aircraft, operated by the same company, collided on a taxiway adjacent to London Heathrow Terminal 4. The Airbus A321, G-EUXH, had landed after an uneventful flight from Zurich and had taxied to Stand 431 under instructions from the Ground Movements Control 2 (GMC2) controller. As it did so, the crew of the Boeing 777, G-VIIK, were preparing to depart for Washington from Stand 429 (Figure 1). Another A321 in the same livery was parked on Stand 432, immediately to the left of G-EUXH.

As the Airbus approached its stand, the crew realised that the electronic Stand Entry Guidance (SEG) system was not switched on. This was because the operator's ground staff responsible for activating it had not yet arrived at the stand. The Airbus commander stopped his aircraft about 50 metres short of the intended parking position; it was aligned with the stand centreline, but with about half the aircraft protruding into the taxiway behind. He made a radio call to GMC2, to advise that the stand guidance was not illuminated, but the frequency was very busy and the call was not acknowledged. Whilst the commander informed the passengers and cabin staff that the aircraft was not yet on stand, the co-pilot attempted to contact his company on discrete frequencies to request that ground crew attend the stand.

About a minute after the radio call from the Airbus to GMC2, the crew of the Boeing 777 called GMC2 to request pushback from Stand 429, which the controller approved. During pushback, the Boeing 777's left wing collided with the Airbus' fin. The tug driver reported that he had seen the Airbus moments earlier and had applied the vehicle's brakes, but was too late to prevent the collision. The driver of a coach who was awaiting the Airbus' arrival took a photograph of the two aircraft in proximity (Figure 2).

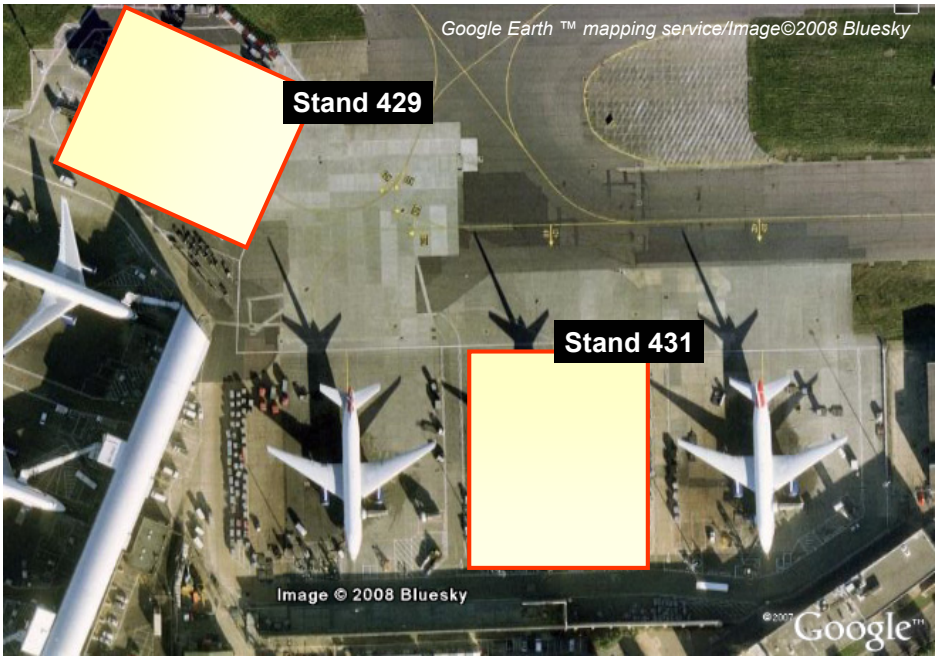

Figure 1

Layout of stands and taxiway in accident area

(Photograph courtesy of H Ghattaoura)

Figure 2

Aircraft in proximity at about the time of the accident

The collision was felt on both aircraft. The Airbus crew made a further call to GMC2, stating that their aircraft had been struck, but it, too, was not acknowledged. They then twice broadcast a PAN-PAN call, which was acknowledged after the second broadcast. The Boeing 777 crew also made a PAN-PAN call. The GMC2 controller took the appropriate actions, and alerted the airport emergency services. The tug was equipped with a radio capable of receiving and making transmissions on the GMC2 frequency, but it was not switched on prior to, or during, the pushback.

The Airbus remained stationary after the collision, but the Boeing's pushback crew immediately pulled the aircraft forward again, back onto Stand 429. The passengers on both aircraft reportedly remained calm and were disembarked via steps. There were no reported injuries.

Pushback crewmen's accounts

The Boeing 777 pushback crew consisted of two members: a tug driver and a headset operator, both employed by the aircraft operator. The driver had been employed for seven years as a headset operator and had qualified as a tug driver six months previously. The other crewman had worked for the operator for more than twenty years and, although he was acting as headset operator during the pushback, he was also an experienced tug driver.

Both crewmen gave their accounts of the accident. When they arrived at the Boeing 777, the headset operator established interphone communications with the aircraft commander, who informed him of an expected 15 minute delay. The tug driver removed the aircraft steps (the aircraft was on a remote stand) whilst the headset operator performed a 'walkround' check. Both crewmen then waited in the tug vehicle's cab.

When approved by the GMC2 controller, the commander informed the headset operator that the aircraft was ready for pushback. The headset operator asked the commander to release the aircraft's brakes, and the aircraft nosewheel was then raised by the tug in preparation for pushback. Although it was standard practice in accordance with the company's training for the headset operator to walk alongside the aircraft during pushback, he was still in the cab when the pushback commenced. He reported that he attempted to leave the cab, but had difficulty doing so because his headset lead had become entangled. Consequently, he had been in the cab for most of the pushback operation. The tug driver did not describe the headset operator having difficulty with the lead, but confirmed that the headset operator remained in the cab for most, if not all, of the pushback.

The tug driver described the limited view from the tug during pushback, and said he was concentrating on keeping the aircraft's main gear wheels about the taxiway centreline. He only became aware of the conflicting Airbus at a very late stage, as he was manoeuvring the aircraft tail to follow the taxiway. He applied the tug's brakes immediately, but the collision occurred before the aircraft/tug combination could be stopped. The headset operator then gave him instructions to pull the aircraft forward again.

The headset operator said that his attention had been directed towards the Boeing's right engine which was being started, and therefore away from the direction of the Airbus. He was unaware of the conflicting Airbus, and first realised that a collision had occurred when the Boeing's commander queried what had happened.

Flight crews' accounts

The Boeing crew reported an entirely normal pushback sequence until the point of collision. The Airbus commander was aware that his radio call to GMC2 had not been acknowledged, and intended to follow it up with a further call when radio traffic permitted. Meanwhile, he made a passenger announcement to the effect that the aircraft was not yet on stand. He was not immediately concerned about the aircraft's position, as it was on a relatively quiet part of the apron. The Airbus co-pilot spent some time attempting to make contact with his company on a discrete frequency but, as there was no answer on this, had to look up an alternative one.

Accident site

When the AAIB arrived on scene later that evening, Airbus A321 G-EUXH was still positioned on the centreline of Stand 431, about 50 metres short of the intended parking position. Boeing 777 G-VIIK had been towed back onto Stand 429 and was still attached to its tug. The rear half of the Airbus was encroaching into the taxiway (Figure 3). The main wheels were on the taxiway, two metres from the taxiway/stand demarcation line, and its tail extended 17 metres into the taxiway. The force of the collision had caused the Airbus' nose to move approximately two metres to the right. Tyre marks on the taxiway indicated that the aircraft had rotated around its left main landing gear.

Another Airbus A321, also in the operator's livery, was parked on Stand 432, adjacent to G-EUXH, prior to and during the accident.

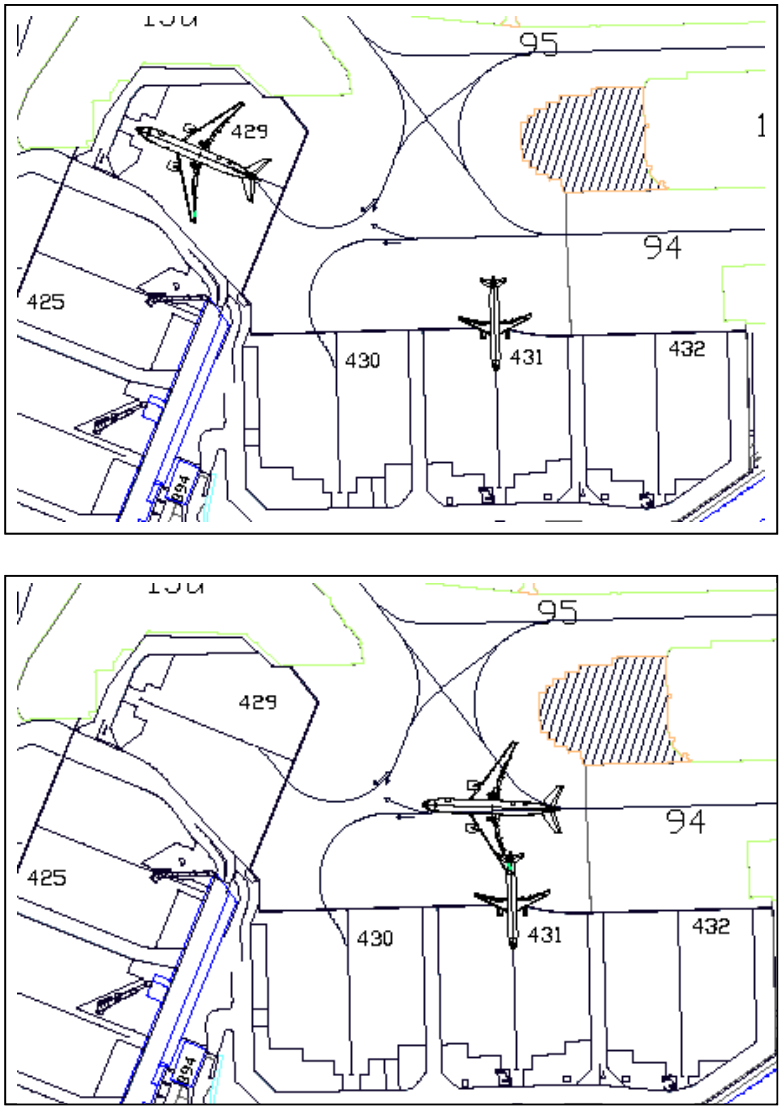

Figure 3

Positions of the two aircraft before and after pushback of G-VIIK (other aircraft not shown)

Aircraft damage

Boeing 777, G-VIIK

The collision caused significant damage to the Boeing 777's left aileron. A one metre long section of its surface, starting at a point 2.7 metres from the wingtip, had detached and become embedded in Airbus G-EUXH's fin lower fairing. A lower wing access panel and two aileron hinge-attachment points were also damaged. There was no other damage to the wing.

Airbus A321, G-EUXH

The fin and fin fairings were damaged; the majority of the damage was to the fin lower fairing, in which was imbedded the one metre long section of the Boeing 777's left aileron. The fairing immediately above this was also damaged and there was scuffing of the paintwork on the right side of the fin, extending some 1.85 metres aft of the fin front spar. Non Destructive Testing of the carbon composite material of the fin revealed some abrasion damage to the outer skin plys and damage to the inner

back-face tape ply. Significant delamination was also evident on the carbon composite right hand flange, used to attach the lower fairing. There was no other damage, and an examination of the fin to fuselage attachment points did not reveal any secondary damage.

Towbarless tug vehicle

The tug vehicle was a Douglas TBL400 towbarless tug vehicle (TLTV). When maximum braking is demanded, the braking system applies the brakes progressively, limiting the loads to protect the aircraft's nose gear from damage. A TLTV pushing back an aircraft weighing 300 tonnes on level dry ground, at a speed of 4 mph, has a stopping distance of 14 feet (4.3 metres) under maximum braking. G-VIIK was calculated to weigh 240 tonnes at pushback. The TLTV was examined and found to be serviceable, and subsequent tests showed its braking performance to be acceptable.

During pushback, the tug vehicle travels in reverse: the driver's seat rotates through 180° to face aft. The passenger seat, on the left side of the cab, is fixed in a forward-facing position. Figure 4 illustrates how Airbus G-EUXH would have appeared at the start of the pushback, as viewed from each seat position in the tug.

Recorded information

Each aircraft was fitted with a solid-state Flight Data Recorder (FDR), Cockpit Voice Recorder (CVR) and a Quick Access Recorder (QAR).

One minute after G-EUXH had stopped short of Stand 431, the flight crew of G-VIIK transmitted their request for pushback from Stand 429. The GMC2 controller acknowledged, and after a short pause replied "(callsign) PUSH APPROVED TO FACE WEST".

According to ground radar information provided by National Air Traffic Services (NATS) at Heathrow, G-VIIK began pushback slightly more than two minutes after G-EUXH had come to a stop. As pushback started, the headset operator said to the commander "OK CLEAR TO START ENGINES WHENEVER YOU'RE READY". The headset operator made no mention to the commander of any difficulty he may have been experiencing, and there was no further headset communication until after the collision.

At 1900:30 hrs, three and a half minutes after G-EUXH had stopped, G-VIIK struck G-EUXH at a ground speed of about 4 kt. The CVRs for both aircraft confirm the

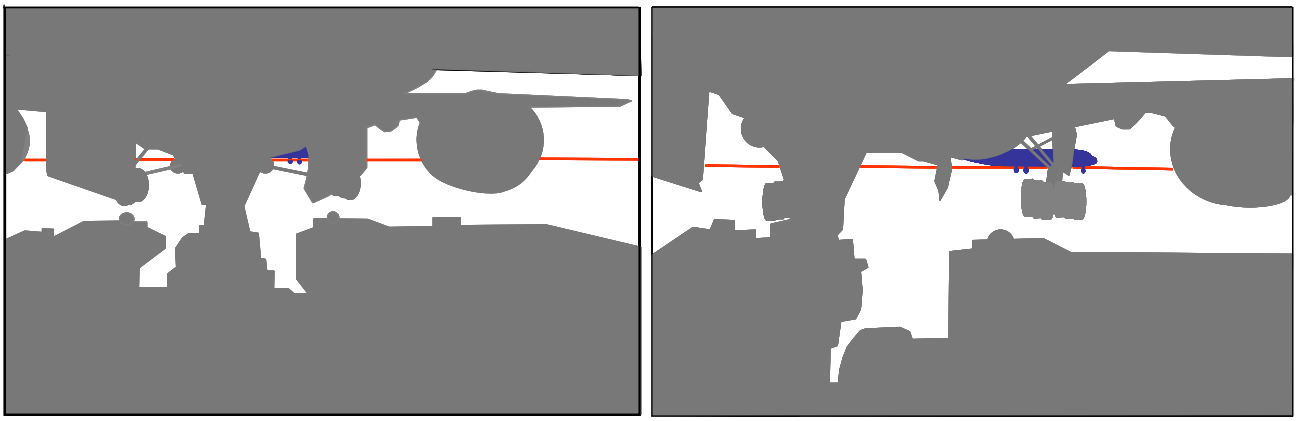

Figure 4

View from tug driver's seat (left) and view rearwards from the forward facing tug passenger seat (right) at start of pushback. Approximate position of Airbus G-EUXH shown in blue.

flight crews of each immediately recognised that a collision had occurred. The Airbus A321 FDR showed a lateral acceleration peak of 0.16g and an abrupt heading change from 182°(M) to 189°(M). The Boeing 777 FDR showed that the aircraft slowed to a stop within three seconds, covering a distance of around six metres.

After the collision, The Boeing 777 commander asked "WHAT DID WE HIT?" and the headset operator replied "AN AIRCRAFT GOING ONTO STAND FOUR THREE ONE..." It was evident from subsequent communications that the headset operator was surprised to find G-EUXH in the position that it was. As the Boeing 777 was being pulled back onto stand, the headset operator asked the commander "YOU WERE GIVEN PERMISSION TO PUSH BACK WEREN'T YOU?", to which the commander replied "AFFIRM".

Air Traffic Control

The GMC2 controller had started duty at 1230 hrs and had been at his position for 1hr 20 mins at the time of the accident, which was within prescribed limitations. When the Airbus commander made his "NO GUIDANCE STAND FOUR THREE ONE" transmission, the controller was busy rearranging the taxi sequence of other aircraft and did not hear the call. He later stated that, had he heard the call, he would have understood it to mean that the aircraft had not taxied onto stand.

The GMC2 position in the Heathrow control tower faces towards the accident area but is some 2,100 metres distant. An inspection of the controller's position showed that it was difficult to detect visually that an aircraft in the accident area was not fully parked on stand.

Surface Movement Radar (SMR) was only routinely used during periods of poor visibility. To avoid excess clutter, system software removed aircraft returns from the display when it sensed that an aircraft had moved onto a designated stand area, replacing the aircraft return with a diamond symbol. In this case, the Airbus had entered the stand area sufficiently far for it to be classified by the software as 'on stand'.

On receipt of the Airbus commander's PAN-PAN call, the GMC2 controller initiated an Aircraft Ground Incident and made an "ALL STATIONS STANDBY" broadcast. The PAN-PAN call from the Boeing 777 was made as the controller was reacting, so was not acknowledged immediately.

Pushback crew's responsibilities

Pushback and towing operations were functions of the operator's Aircraft Movements (ACM) department, part of its Heathrow Customer Services (HCS) department. Normal procedures were contained in an *Aircraft Towing and Pushback Manual* (ATPM). The ATPM included as a key safety point:

> *'When towing or pushing back either on the airfield or base areas, always be alert to the possibility of A/C[1] not fully positioned, incorrectly aligned on stand, and/or other obstructions. Never take for granted that physical clearance exists, even if you are given movement clearance by ATC.'*

The tug driver had overall responsibility for safety whilst undertaking pushback operations. The ATPM stated:

> *'Drivers are responsible for obstacle clearance for the A/C, ATC clearance instruction does not infer obstacle or wingtip clearance[2].'*

Footnote

[1] Aircraft.

[2] Incorporated into the manual in response to AAIB Safety Recommendation 2004-74, relating to towing accident of 23 March 2004 (AAIB ref EW/C2004/03/08).

In relation to the headset operator, an aide-memoire issued to staff by the ACM department stated that he was to *'...support and assist the team leader in his overall responsibility for safety'*. Included in the aide-memoire was the text:

> *'If you feel that to proceed would endanger you, others or risk an accident you must request the Team Leader / Tractor driver to stop and give him full reasons.'*

Concerning engine starting, the ATPM contained an explicit warning:

> *'Engine starting is not permitted until the engine to be started can be fully monitored by the person who has direct communication with the flight deck.'*

Supervisory staff within ACM stated that the stands in question were regarded as amongst the most straightforward stands for pushback at Terminal 4, and did not require specific instructions or procedures. It was also described as standard procedure for the headset operator to walk alongside the aircraft, normally on the outside of any turn. This would have been on the aircraft's left in this case.

Requirements for the use of radios in vehicles on the apron were set by BAA Heathrow Airport Limited (HAL), in accordance with recommendations in the CAA's Civil Aviation Publication (CAP) 642 *Airside Safety Management*. They required that drivers ensure their vehicle's radio was working, and tuned to the appropriate frequency, before entering the manoeuvring area, and thereafter that *'a listening watch must be maintained on the relevant GMC frequency/channel…'* This requirement was covered in ACM departmental training and testing material.

Ground crew working hours (local times)

Ground crew working hours were governed by regulatory requirements and additional requirements stipulated by the operator. Together, these limited the maximum consecutive days worked to nine, with two days off in any 14 day period. Double shifts were permitted, but consecutive double shifts were not. There was a maximum of 16 working hours in any 24 hour period, and a maximum of 72 working hours was permitted in one week. Normal shift hours for the ground crew were from 0615 to 1430 hours and 1430 to 2300 hours: actual shift beginning and end times were based on a staff clocking-in/out system.

The tug driver had exchanged shifts with a colleague, and had started work at 0614 hours on the morning of the accident, to work a double shift. His off-duty period prior to the shift was 7 hr 14 min and he had worked about 13 hr 45 min of the planned 16 hr 45 min shift when the accident occurred. The headset operator had worked an evening/night shift from 1400 hours the day before, to 0600 hours on the day of the accident, returning to work at 1810 hours. The tug driver had logged 55 hr 15 min of overtime in the month of July prior to the accident and the headset operator had logged 96 hr 30 min.

The pushback crew's working time records for the preceding four weeks showed that working hours rules had not always been adhered to. Clocking-in/out times did not always reflect overtime worked or, in some cases, normal shift periods, making it very difficult to track actual working hours for part of the time. From a combination of the planned roster, logged overtime and available clocking in/out information, it was calculated that both crewmen had worked in excess of the permitted 72 hours per week, for at least part of the

four week period. One of the crewmen had worked four consecutive double shifts in the period. Actual shift start/finish times during this period were not always reflected in the clocking on/off record.

In March 2007, a new staff administration system was introduced, which was intended to assist and improve management of staff working patterns. Industrial relations and system confidence issues had delayed its operational start date, and at the time of the accident ACM line managers were still dependent upon the clocking-in/out system to monitor staff hours.

Stand Entry Guidance issues

HAL issued an Operational Safety Instruction (OSI) in July 2005, which detailed the responsibilities of airline and ground handling staff with regard to the operation of SEG systems. The OSI stated that switching on the SEG signified to a flight crew that the stand was unobstructed and ready for use. Concerning flight crew actions, the OSI stated:

> *'In the event of there being no activated SEG displayed upon approach to the stand, flight crews should contact Ground Movement Control to request marshalling assistance. Aircrew must not attempt to self-park if the SEG is not illuminated or calibrated for their aircraft type.'*

HAL's Airside Operations department commented that this was intended to mean that no part of the aircraft should cross the stand perimeter line. There were no specific instructions in the operator's Operations Manual to prohibit aircraft commanders from partially entering a stand area whilst awaiting activation of the SEG, although such an instruction was introduced after this accident.

The aircraft operator required a qualified person to confirm the stand area was safe to receive an aircraft before activating the SEG. The person normally carrying out this duty would be one of the operator's Turn Round Managers (TRM). In this case, the TRM allocated to G-EUXH had been delayed getting to the stand due to waiting for a Passenger Services Agent (PSA), as the two would normally travel to off-pier stands together. An internal investigation by the operator into an aircraft towing accident in February 2003 (AAIB report EW/G2003/02/09), in which an aircraft stopped short of stand whilst awaiting SEG illumination, made a number of recommendations, including:

> *'Review failure of Dispatcher to switch on SEG system in time for arriving aircraft. Modify process as required and/or introduce contingency plans.'*

This recommendation was signed off by the operator's Ground Safety Board, but the problem of late SEG activation persisted. A data gathering exercise carried out by the operator between November 2006 and August 2007 produced a total of 1,630 crew reports of delays caused by SEG not being switched on, or by stands being blocked by ground equipment. There were 217 such reports in the 14 days after the subject accident.

The operator subsequently proposed a number of measures to address the problem, including increased numbers of TRMs, a measure that was due to take full effect by September 2007. The arrangement whereby the TRM would wait for the PSA before proceeding to the stand was stopped, and mobile 'chocks and power' teams were introduced to help alleviate the problem. Engineers were also being trained to activate the SEG if required, and the Operations Manual was amended to ensure flight crews did not stop their aircraft partially on stand.

Operator's Safety Management System

Hazard analysis and risk assessment

A hazard analysis and risk assessment for the pushback operation at Heathrow had been conducted by the ACM department in May 1997. It was reviewed annually, most recently in March 2007. The hazards considered were:

> *'Vehicle traffic routes / pedestrians*
> *Noise*
> *Engine ingestion'*

The protective control measures in force were identified as:

> *'Personal protective equipment*
> *Safe systems*
> *Training / instruction*
> *Full training of HAL operational byelaws'*

A further, separate, risk assessment pertaining to the pushback operation was held locally within ACM. The hazards identified by this were in relation to the health and safety of personnel conducting the pushback operation, rather than the operation as a whole. In this case, most control procedures were in effect delegated to HAL and NATS Heathrow, with only *'training procedures'* residing within the operator's direct influence.

Following the towing accident of 2003, the internal investigation made the following recommendation:

> *'Include the hazards of aircraft stopped short of stands in all pushback/towing risk assessments.'*

The recommendation was signed off by the operator's Ground Safety Board, but was not adopted. However, the ATPM did warn ground crew to be alert to the possibility of aircraft not fully positioned, incorrectly aligned on stands, and/or other obstructions.

Safety Management System reviews

Following a further towing accident in March 2004 (AAIB report ref EW/C2004/03/08), an internal investigation by the operator's safety department recommended a full and detailed review of all elements associated with the safe movement of aircraft by the operator's Heathrow Customer Service department. The report also recommended that the operator should:

> *'Undertake a review of recommendations resulting from previous accidents ... to ensure full and proper closure. The review should also consider whether the recommendations have been effective and ensure that a robust recommendation tracking system is in place.'*

The recommended review took place in September 2004. Improvements were noted in several areas and the operator conducted a number of risk assessments in regard to complex pushbacks and where high risk was identified. However, despite specific mention, a risk assessment of aircraft stopping short of stands was not performed.

Safety awareness training

The operator had run a recurrent safety awareness training course for ACM staff, but this was discontinued in February 2003 due to resourcing issues. The operator's internal report on the 2004 towing accident recommended that safety training be reintroduced, and the subsequent SMS review made the same recommendation. At the time of this accident recurrent safety training, including the review of past events and sharing of knowledge for ACM staff, had not yet been reinstated.

'Rampsafe' behavioural risk improvement programme

The operator introduced its 'Rampsafe' programme in 2005, intended to identify 'at risk' behaviours in the airside environment. The programme consisted of observations of ramp activities by appropriately trained supervisory staff, who would complete a simple checklist and debrief staff on the spot if any unsafe activities were seen. In the seven months to the end of July 2007, 443 Rampsafe checklists were returned. There was no evidence of headset operators remaining in the cab during pushback operations.

Analysis

Pushback crew's actions

The headset operator was required to be in a position to monitor the pushback area and the engine being started. These responsibilities were listed in the applicable publications and aide-memoires, and were principles which both crewmen had worked to for a number of years. Both would have known that to commence pushback with the headset operator still in the cab of the tug was not in accordance with their operating procedures.

If the headset operator had intended to leave the cab before pushback started, he could have done so. Since it was he who gave the tug driver the instruction to start the pushback, he could have delayed the instruction until the tangled headset lead had been dealt with. Similarly, he gave the commander clearance to start engines before the commander had requested it, which also indicates that the headset operator was content with his situation at that stage. He remained in the cab as the right engine was started, where his view of the engine was hindered by the seating arrangement and the aircraft structure, preventing him from adequately monitoring it, as he was required to do. The headset operator's actions, and the lack of mention by the tug driver of any difficulty with the headset, would suggest that any problem with the headset lead was minor, and of limited impact. Therefore, it was not a contributory factor.

As the tug driver stated (and Figure 4 illustrates), the view behind the aircraft from his position was very restricted, so he was dependent to a large extent upon the headset operator warning of obstacles or hazards that may not be visible to the driver. The driver would have been aware that the headset operator's continued presence in the cab was contrary to procedures and would affect his ability to identify possible hazards. The driver had overall responsibility for the safety of the aircraft and ground crew during the pushback; he could have delayed or halted it at any time, but he did not.

It was a requirement of the airport authority and the aircraft operator that the tug's radio be used to monitor the appropriate GMC frequency. As the radio was switched off, there was no possibility of the ground crew hearing any of the radio calls that could have alerted them to the developing situation.

Towing the Boeing 777 forward after the collision ran the risk of exacerbating the damage to both aircraft, and could potentially have hindered the accident investigation. Two experienced crewmen were involved, which highlights the need for a thorough grounding and regular recurrent training in accident and emergency procedures. The ATPM did not contain generic post-accident procedures. and the lack of recurrent safety training meant that there was limited opportunity to review such procedures in a formal training environment.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-034

It is recommended that British Airways PLC should include generic post-accident and emergency procedures for ground handling staff in its *Aircraft Towing and Pushback Manual*, and include such procedures in recurrent safety awareness training.

Human factors

The headset operator was the older of the two crewmen, and had many years of experience in pushback and towing operations. He was described as being amongst the longest serving crewmen in the department. Although it is possible the tug driver condoned the headset operator's actions, it is more probable that a significant adverse 'authority gradient' existed, which in effect caused the tug driver to defer to the older and more experienced man.

The headset operator's post-accident comments heard on the CVR were spoken at a time of obvious stress. However, they indicate a lack of awareness that an ATC approval to pushback an aircraft did not imply that obstacle or wingtip clearance was assured. Knowledge of this fact was fundamental to a safe pushback operation, and it had been included in the ATPM after being identified as a factor in a previous accident. The headset operator's incorrect assumption that pushback approval offered a measure of protection is likely to have influenced his actions, and was therefore a contributory factor.

At the time of the accident there was an Airbus A321 aircraft, in the operator's livery, parked on Stand 432. This was on the far side of Stand 431 when viewed from the tug position. The ground crew would almost certainly have seen this aircraft earlier, though it would not have been a factor for the pushback. With G-EUXH stopped short of Stand 431, it would have appeared to an observer in the tug cab to be in about the same relative position (albeit closer) as the aircraft on Stand 432, and probably partially obscured the aircraft actually parked there (Figure 5). It is conceivable that one or both of the ground crew had seen G-EUXH from the tug's cab

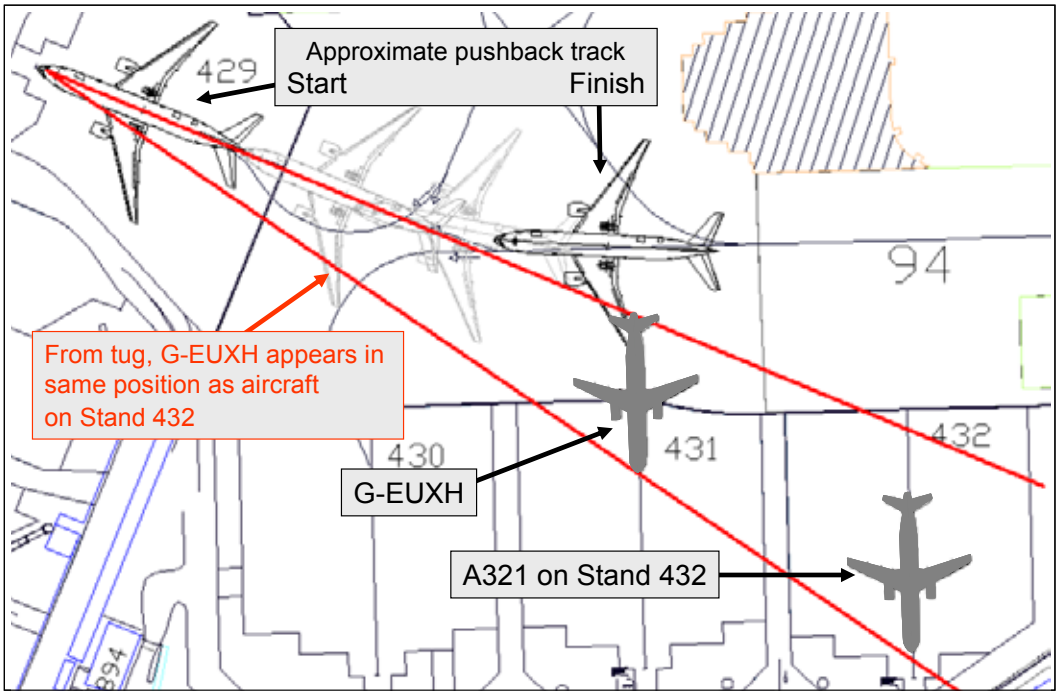

Figure 5

Relative position of the two Airbus aircraft as viewed from the tug cab

before pushback, but believed it to be the aircraft they had seen earlier on Stand 432, which for all practical purposes was identical to G-EUXH. If so, this illusion would have persisted until shortly before the accident.

Working hours issues

The tug driver had been off-duty for 7 hr 14 min before clocking in again at 0614 hrs local time. Even allowing for a short commute, it is unlikely that he had the opportunity to sleep for more than six hours before starting a shift that would last 16 hr 45 min. The accident occurred 13 hr 46 min after the driver started work. The headset operator had been on shift a relatively short while and his previous rest period was just over 12 hours, but this had been taken during the daytime, which may have affected the quality of his sleep. Considering the irregular and un-rostered shift patterns, levels of overtime, and duty times immediately preceding the accident, the possibility that fatigue played some part in the ground crew's performance cannot be discounted.

Line managers in the ACM department were dependent upon the clocking-in/out system to monitor staff hours. However, the system made this task difficult, and records for the preceding four weeks showed that working hours rules had not always been adhered to. The crewmen themselves also had a responsibility to ensure that their working hours did not breach the rules, but the evidence indicated that they did not exercise this responsibility. The records showed that each had worked considerable overtime in the previous four weeks, and one of the crewmen had worked four consecutive double shifts, which was not permitted.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-035

It is recommended that British Airways PLC should ensure that an effective and robust system is in place to monitor and manage the working hours of its Heathrow Aircraft Movements staff, ensuring compliance with applicable working time rules and agreed practices.

British Airways stated that the staff administration system was scheduled to be fully implemented by end of April 2009.

Safety Management System

Since the 2003 review of safety management within HCS, a number of improvements were made. These included the 'Rampsafe' initiative, which was generally well-received and had produced positive results. Nevertheless, some of the contributory factors to this accident are largely unchanged from those of earlier accidents and, for the most part, fall under the direct control of the operator.

The risk assessment of the pushback operation did not adequately identify or address the hazard of other aircraft stopped short of stands; this was highlighted as an area of concern in 2003, and was the subject of a specific recommendation. Recommendations to review risk assessment data were made in 2002 and 2004, but there was no indication that this had been done. The operator's SEG problems at Heathrow were commonplace at the time of this accident, despite a 2003 recommendation to address the issue.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-036

It is recommended that British Airways PLC introduce a process to review recommendations arising from formal corporate safety investigations, to ensure closure and to consider whether they have been effective.

British Airways stated that a formalised tracking system of all corporate safety investigation incident recommendations was introduced in early 2006, but this did not retrospectively review past investigations. Hence a review of recommendations arising from previous incidents, as referred to in this bulletin, would not have been carried out. In 2007 further improvements were introduced, with the Corporate Quality department conducting the reviews instead of the original safety investigator. Additionally, all corporate safety recommendations now require metrics to be added to enable an objective measure of the effectiveness to be made.

Training

Training was listed as a control measure in the operator's risk assessment for the pushback operation, yet ACM staff recurrent safety awareness training including the review of past events and sharing of experience was withdrawn in 2003. Despite a call for it to be reinstated after the 2004 accident, and again as part of the 2004 SMS review, such training was still not in place at the time of this accident. Such training typically draws on lessons from past accidents and incidents as well as reinforcing the need for adherence to procedures and improving awareness of hazards. As such, the operator's decision to discontinue such training was considered to be a contributory factor in this accident.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-037

It is recommended that British Airways PLC reinstate recurrent safety awareness training for its Aircraft Movements staff.

Airbus G-EUXH

Neither HAL's OSI nor the operator's procedures appeared specifically to prohibit the Airbus commander from partially entering the stand area to await SEG activation. Given the number of occasions that the operator's aircraft were prevented from parking through late activation of SEG, there would have been an understandable desire on the part of flight crews to reduce potential congestion by entering the stand part-way, which had become a common practice.

Were an aircraft commander to be specifically prohibited from partially entering a stand area without SEG, the subsequent risk of collision would be reduced, as the aircraft would in most cases physically block the taxiway and present a much more obvious hazard. Although HAL's OSI had intended to convey this message, there was a degree of ambiguity which was passed on in the operator's guidance to its flight crews.

The following Safety Recommendation is therefore made:

Safety Recommendation 2009-038

It is recommended that Heathrow Airport Limited reissue the requirements of Operational Safety Instruction OS/20/05, specifically prohibiting aircraft commanders from allowing any part of their aircraft to enter a stand area if the Stand Entry Guidance system is not activated.

The Airbus commander's radio call to GMC2 was not acknowledged, therefore it had to be assumed that the

controller had not heard it. The busy radio situation prompted the commander to make the call brief, but its brevity may have been the reason it was not heard. Had the transmission been made as a direct request for action on the part of the controller (eg to request marshalling assistance, as directed in HAL's OSI) rather than as an information call, it may have been more likely to attract his attention.

Air Traffic Control

It is unlikely that the GMC2 controller could have determined visually that G-EUXH presented a threat to G-VIIK. The approval he issued did not imply that obstacle separation was assured, nor did it relieve the pushback crew of the responsibility for collision avoidance, a responsibility which was emphasised in ACM departmental documentation. The GMC2 controller's actions were therefore not contributory to the accident.

Conclusion

The accident occurred primarily because the Boeing 777 pushback was not conducted in accordance with the aircraft operator's normal operating procedures and safe practices. Organisational factors which may have contributed to the accident included: the withdrawal of recurrent safety awareness training for ground handling staff, late stand guidance system activation issues, and incomplete risk assessments for towing and pushback operations.