INCIDENT

Aircraft Type and Registration:	Raytheon Hawker 800XP, CS-DRQ
No & Type of Engines:	2 TFE 731-5BR-1H turbofan engines
Year of Manufacture:	2006
Date & Time (UTC):	31 October 2006 at 0900 hrs
Location:	London City Airport
Type of Flight:	Commercial Air Transport (Non revenue)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	12,000 hours (of which 200 were on type) Last 90 days - 123 hours Last 28 days - 18 hours
Information Source:	AAIB Field Investigation

Synopsis

This aircraft experienced significant navigation problems after taking off from London City Airport (LCY) and was unable to comply with the Standard Instrument Departure (SID). The crew were able to recover heading information after approximately 10 minutes and landed back at LCY without incident. It transpired that several similar incidents had previously occurred with other aircraft and there have been similar incidents subsequent to this one. The cause of the problem was identified as strong magnetic anomalies in the holding area for Runway 28. Six Safety Recommendations have been made.

History of the flight

The aircraft intended to depart London City Airport (LCY) on a non-scheduled flight to Brussels. Prior to departure, while stopped at holding point Mike (Hold M) (Figure 1) at LCY the pilots observed AHRS and HDG red flags on both Primary Flight Displays (PFDs), indicating that the Attitude and Heading Reference System (AHRS) had failed and that heading indications were unreliable. The pilots commented that this was a "known fault" at LCY which they thought was associated with "metal in the taxiway pilings". After lining up on Runway 28 the flags disappeared without further action. However, after departure, the pilots found that they were unable to control the aircraft in heading using the autopilot because neither of the heading selector bugs would move in response to rotation of the heading selector

control. They observed a difference of 60º between the heading indicated on PFD 1 and PFD 2 and the combined standby instrument indicated a heading of 15º less than that shown on PFD 1. A red FD flag was displayed on both PFDs and both flight directors were unavailable.

In accordance with the Emergency Procedures section of the Quick Reference Handbook (QRH) the pilots selected AHRS 1 as the source for both sets of flight instruments but found that this system did not operate normally for a further 10 minutes. They decided to return to LCY and were given radar vectors in order to do so. The aircraft landed without further incident.

Previous occurrences

Following this report the AAIB was advised of previous occurrences dating from January 2000 that were the subject of Mandatory Occurrence Reports (MORs) received from operators and from ATCOs at the London Terminal Control Centre (LTCC). These involved several types operating from LCY, including Hawker 800, Cessna Citation and Fokker 50 aircraft, all of which experienced navigation problems after departure from Runway 28 at LCY. The first such occurrences, mostly to Fokker 50 aircraft, were attributed to poor compliance by pilots with assigned routings. An ATC Occurrence

Google Earth ™ mapping service/Bluesky

Figure 1

London City Airport

Report into an incident on 23 September 2003 noted that failure to follow the correct SID route was "an increasingly regular occurrence" involving aircraft departing Runway 28 at LCY.

On 16 November 2003 a Fokker 50 was reported to have deviated to the south of the intended track whilst attempting to follow the Clacton (CLN) 5T departure from Runway 28 at LCY. This brought it into potential conflict with arriving traffic. In his report to the operator the commander of the Fokker 50 reported that the aircraft's instrumentation showed that the desired 082º radial outbound from the London (LON) VOR had been intercepted correctly. He noted, however, that there was a short delay between the indication on the co-pilot's instruments that the radial had been intercepted and the same indication on his own instruments. There have been no further reports of related occurrences to Fokker 50 aircraft departing from LCY.

A series of reports beginning on 26 October 2004 were received of aircraft experiencing problems with their heading reference systems on departure from Runway 28 at LCY. A summary of these occurrences follows.

CS-DNK (Hawker 800), 26 October 2004

On departure from Runway 28 the pilots noticed a discrepancy between the commander's, co-pilot's and standby compasses. They believed that this was caused by the sole passenger having left his mobile telephone switched on. The pilots reported that they carried out "trouble shooting", informed ATC and shortly afterwards the headings returned to normal. The passenger informed the crew that he had switched off his mobile phone during the climb. The subsequent flight was operated without incident.

CS-DNX (Hawker 800), 10 March 2005

The pilots stated that on a busy departure during which they received radar vectors, there was a temporary loss of heading information. Finding that they were unable to comply with heading instructions the pilots declared a 'PAN'. Heading information was regained shortly afterwards without crew action and the 'PAN' was cancelled.

CS-DXE (Cessna C560 Citation XL), 28 February 2006

The pilots reported that while parked at Hold M all three compasses became "unserviceable". They informed ATC that they required "a couple of minutes" to clear a "technical issue" and when ATC asked if the pilots were experiencing a compass problem they replied "yes". ATC advised the pilots that several aircraft had experienced the same problem. When the aircraft lined up, the heading reference systems appeared to function normally.

In a safety report to the aircraft operator the pilots suggested that the "loop" taxiway including Hold M should not be used until the underlying problem was solved. In discussions with the aircraft operator, the airport operator commented that pilots could request to hold elsewhere in the loop containing Hold M in order to avoid the problem.

CS-DMA (Beech 400A), 6 November 2006

After what they considered a long hold at Hold M prior to takeoff from Runway 28, the pilots noticed a "compass comparator warning", whereby a yellow HDG caption presented on both PFDs indicated that the heading displayed to each pilot differed by more than 6º. Commenting that this was a "known problem" and anticipating that the condition would resolve itself, the pilots decided to take off. However, once airborne, the compasses continued to disagree by up to

30º for a further 28 minutes, during which the aircraft had difficulty following the assigned Brookmans Park (BPK) 3T (SID).

The pilots of CS-DMA reported that they consulted the abnormal and emergency checklist and attempted several times to realign the heading reference systems, without success. They advised ATC that they were experiencing navigation difficulties and were given radar headings to follow until the compasses realigned themselves.

Initial investigation by CAA

The United Kingdom Civil Aviation Authority (CAA) became aware of these events through MORs. Initially their investigation focussed on the possibility that performance of the LON VOR ground station was degraded or affected by transmissions from other sources. No such fault was found and the absence of other reports involving the LON VOR, separate from operations at LCY, indicated that the VOR was not the cause of the problem.

Airport history

The airport, opened in 1987, was built on the site of a disused ship's loading and unloading dock. Prior to being made into an airport the dock consisted of two rows of warehouses along the northern and southern sides of the dock that were accessed by a central road and railway that ran in an east-west direction down the middle of the dock (now the airport's runway). These railway lines were removed prior to the construction of the runway. Between each row of warehouses and the waters' edge ran two sets of railway lines on which ran the ship loading/unloading cranes and rail freight wagons. These railway lines were not removed when the airport was constructed and remain in place today (Figure 2).

Courtesy of QinetiQ

Figure 2

View looking west showing the railway lines and cut off dockside bollards

Along the dock walls were mounted large cast iron bollards that were used to tie up the ships. These bollards were similar to icebergs; what was visible above the dock wall was about a fifth of the size of what was below the wall. When the airport was constructed the sections of the bollards that were above the dock wall were removed using a flame cutting method (Figure 2).

In 2003 an aircraft holding area was completed on the southern side of the eastern end of the runway (Figure 1). This holding area projected out over the water and was mounted on approximately 56 steel encased concrete piles (Figure 3). The steel casings of the concrete piles are sections from a disused oil pipeline. Neither the railway lines that run along the edge of the old dock nor the lower parts of the cast iron bollards were removed prior to this holding area being constructed.

Engineering investigation

A walk around the Runway 28 holding area with a hand-held magnetic compass by an AAIB Inspector showed that there were some large and strong magnetic anomalies that made the compass needle deviate by up to ±60º. Engineers from the magnetic survey team based at QinetiQ, Portland Bill, Dorset were contracted to conduct magnetic signature and compass deviation surveys of the Runway 28 aircraft holding area. Figure 4 shows the results of the compass deviation survey observed at various points in the holding area. The numbers annotated at each point in Figure 4 indicate the number of degrees that a magnetic compass will deviate from magnetic north when placed in that position. These readings were taken 1.4 metres above the holding area surface. The areas where readings

Courtesy of QinetiQ

Figure 3

View looking west along southern edge of Runway 28 Hold Area

could not be made, marked with a cross within a circle on Figure 4, were where the magnetic field density was so strong that the compass needle pointed either up or down, preventing it rotating to provide a reading.

The following was the conclusion of the QinetiQ surveys:

> *'It is QinetiQ's considered opinion based upon the results obtained during the magnetic and compass surveys that aircraft flux gate compass deviation problems experienced at London City Airport are caused by several ferrous magnetic signature anomalies (MA), primarily emitted as a vertical component from the 68 piled beam structures situated under Runway 28 Holding Area in excess of 60,000nT[1]. The second source of MA is emitted from remains of flame cut bollards spaced a regular intervals under Runway 28 Holding Area with a magnetic signature in excess of 30,000Nt. The third source comes from the reinforced concrete in Runway 28 Holding Area, which appears to interact with the signature from both prime and second source signature emitters. The fourth source, albeit not quite so large as the previous sources, is the railway lines below Runway 28 Holding Area.'*

Occurrences at other airports

Stockholm Arlanda, Sweden

Pilots of aircraft operating at Stockholm Arlanda Airport reported compass deviations while taxiing to Runway 01/19. The Geological Survey of Sweden measured the magnetic field at a height of 2 m above the taxiway and determined that the magnetic anomalies which it identified were sufficiently severe to explain the reported compass deviations.

Refurbishment of the taxiway revealed that the original steel nets used to reinforce it were notably harder to bend than the material commonly used for this purpose and exhibited permanent magnetism. The report stated that it was very difficult to impart permanent magnetism to the standard, more spring-like, steel nets commonly used in such construction. It concluded that the use of standard steel nets as reinforcement presented no risk of interference with aircraft compasses but that permanent magnetic steel nets constituted a significant source of interference.

There have been no further reports of such occurrences at Arlanda since refurbishment of the taxiway.

Houston, Texas

The entry for Houston International Airport (IAH) in the United States Aeronautical Information Publication states:

> *'Runway 15L/33R Magnetic anomalies may affect compass heading for take-off.'*

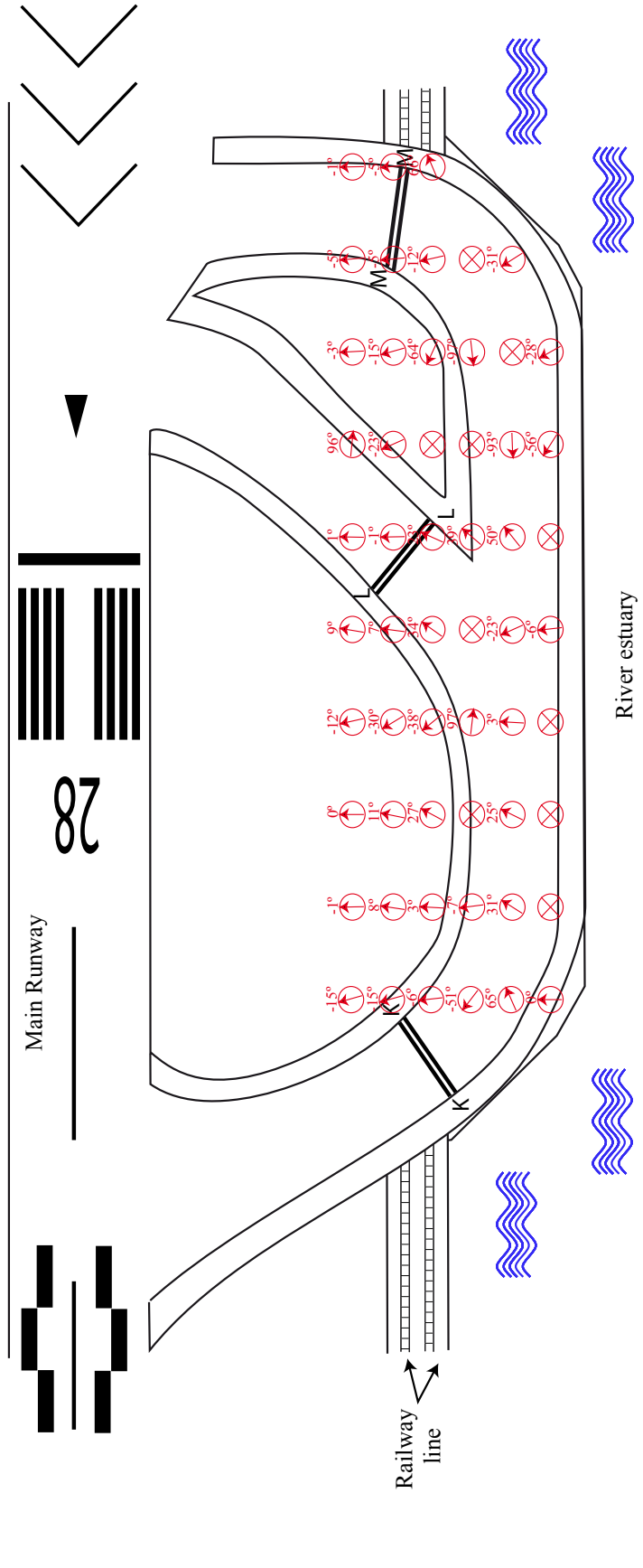
and

> *'Taxiways WA and WB Magnetic anomalies may affect compass heading.'*

When contacted by the AAIB a representative of the airport operator commented that he thought that IAH was the only airport with this problem, and provided a history of the phenomenon. In order to remove paint and rubber from Runway 15L the airport used

Footnote

[1] nT is 10^{-9} Tesla. A Tesla is the SI unit of magnetic flux density (or magnetic induction) and defines the intensity (density) of a magnetic field. The earth's magnetic field density at LCY is approximately 48,000nT. The figures quoted in this report are those of the magnetic field density above the earth's field density.



Adapted from construction drawing

Figure 4

Results of the QinetiQ Compass Deviation Survey at the hold area for Runway 28

a process in which small steel balls were blasted against the runway surface. The balls and debris were recovered, but the impact of the steel balls with the runway surface had magnetized the steel reinforcement embedded in the concrete. Subsequently, aircraft with flux valve detectors mounted in the wing tips would experience a magnetic deviation of between 40º to 90º. Several aircraft aborted their takeoffs. Those that departed either returned to the airport or regained normal compass indications shortly afterwards. Types most affected were McDonald Douglas (Boeing) MD-80 series aircraft and some ATR-42 aircraft.

In order to mitigate the problem the airport operator attempted to degauss the runway. The process was partially successful and the magnetic anomaly was found to dissipate over time. The airport did not institute special ATC procedures to address the problem and found that pilot awareness of the potential problem reduced the incidence of related occurrences, of which there have been no further reports for "several years".

La Guardia

An article entitled "*Magnetic Mystery*" in "*Callback*", the monthly safety bulletin from the Office of the NASA Aviation Safety Reporting System referred to problems encountered at New York La Guardia Airport:

> *'Our clearance required a turn to a heading of 360 degrees after takeoff on Runway 31. Our gate is very close to the departure end of Runway 31. Start-up, checklists, and taxi involved less than 4 minutes and we were cleared for take off upon reaching the end of the departure runway. During the takeoff roll, I noted that my HSI read 350 degrees when it should be reading 310 (runway heading). The Captain's HSI and both our RMI's read the same erroneous heading. No flaps or instrument failure warnings were present. With some help from Departure Control we managed to get on our correct heading and subsequently re-synced the HSI's against the wet compass. All further operations were normal.*
>
> *We learned later that the gate we had parked at prior to our departure had produced gross compass swings in the past on some aircraft. Evidently some magnetic anomaly is present there, producing as much as 40 degrees of compass swing. A subsequent rapid departure does not give the compass system time to re-sync to the correct heading and if the crew doesn't catch it, a problem after departure can develop. Our company has since issued a NOTAM in our release papers that warns against compass swing possibility at that particular gate.'*

It was not possible to establish which aircraft type had been involved in this incident and the airport operator did not state what, if any, remedial action had been taken.

Other causes of local compass deviation

Aircraft and airport operators worldwide have reported that decommissioned arrestor systems (where anchor structures remain in or near the runway surface), hangars and other metallic structures have caused compass deviations at other airports. None has generated as great a number of such reports as London City Airport.

Subsequent occurrences at LCY

Following the series of incidents described above, the AAIB requested that the airport operator and the relevant sector of LTCC contact the AAIB immediately in the event of subsequent similar occurrences so that

flight data and ATC recordings could be recovered. Several similar incidents were reported and the AAIB decided to observe a departure from LCY Runway 28 from the flight deck of a Hawker 800XP aircraft.

The observed flight departed Biggin Hill and conducted several takeoffs and landings at LCY in the course of training for a commander with no prior experience of LCY. The crew were aware of a magnetic anomaly affecting aircraft using the loop Holds K, L and M but were not otherwise briefed by the AAIB investigator.

After departure from Biggin Hill the aircraft made an uneventful approach to go around followed by an approach to land at LCY. After landing on Runway 28, the crew were instructed to exit at K and hold at M prior to departure. As the aircraft passed over Hold L a red HDG caption appeared momentarily on the right hand PFD. When the aircraft stopped at Hold M, a red HDG caption illuminated on the left PFD, accompanied by a red FD caption.

Heading indications were as follows (L – left PFD, S – standby compass, R – right hand PFD):

L	S	R	Estimated Hdg
360°	120°	057°	050°

(The heading of a PFD showing the red HDG caption defaults to 360°.)

After lining up on runway 28, the commander began to slew the heading indication on the left PFD to the runway heading of 275º. However, having been advised of landing traffic a short distance behind, he re-engaged the NORM (slaved) mode before the heading indication on the left PFD was aligned with the runway heading. At the start of the takeoff the heading indications were as follows:

L	S	R	Runway Hdg
268°	261°	277°	275°

A yellow HDG comparator caution was present on both PFDs, indicating a difference of greater than 6° between the heading on each PFD. During the initial climb, heading indications were as follows:

L	S	R	Actual Hdg
287°	271°	274°	Unknown

Shortly after takeoff the aircraft made a right turn as instructed by ATC onto a heading of 090° indicated on the left PFD. During the turn the yellow HDG caution was not present but it illuminated once again when the aircraft rolled wings level. Heading indications were as follows:

L	S	R	Actual Hdg
060°	051°	050°	Unknown

Approximately 5 minutes after takeoff and 10 minutes after the aircraft had vacated the area of Hold M, the heading indications on the left and right PFDs returned to within 6º of each other and the yellow HDG caution extinguished. During the subsequent approach with a crosswind from the south, the heading indications were as follows:

L	S	R	Runway Hdg
270°	257°	271°	275°

The landing was uneventful with no further cautions or warnings associated with the heading reference system. Two further circuits were flown. On the first of these the aircraft was again required to hold at Hold M. On this occasion a red HDG warning flag appeared on the right hand PFD. However without the pressure of landing traffic, the crew were able to realign the heading

indications on both PFDs before departure. On the final departure the pilots requested a back track along the runway to the takeoff position to avoid holding at Hold M. There were no cautions or warnings associated with the heading reference system and the departure was uneventful.

Flight deck procedures

The Emergency Procedures section of the Quick Reference Handbook (QRH) for this aircraft contained the following information regarding the red FD and HDG failure flags on the PFD:

> *'**FD***
>
> *This annunciation indicates that the respective flight director has failed. If coupled to the failed flight director, the autopilot will also disengage. If only one PFD is affected, flight director and autopilot functions may be regained by transferring control to the operative side.'*

This section did not specify how this transfer should be made, although the relevant control might be familiar to pilots of this aircraft type.

> ***'HDG***
>
> *This annunciation indicates invalid heading data from the selected source. The compass rose/arc will rotate to north-up.*
>
> *Relevant AHRS reversion switch……..Select operative AHRS.'*

The Abnormal Procedures section of the QRH contained the following information regarding the yellow HDG annunciation on the PFD:

> *'**HDG***
>
> *This annunciation indicates a mismatch between the pilot's and co-pilot's displayed heading data.*
>
> *Establish airplane in straight and level, unaccelerated flight.*
>
> *Compare indictions with Electronic Standby Instrument System*
>
> *Determine if pilot's or co-pilot's heading display is in error.*
>
> *Relevant AHS Transfer switch……..REV.'*

Action by the aircraft operator

Following these incidents the operator involved in most of the occurrences to Hawker and Cessna Citation type aircraft issued to all its pilots internal memoranda specific to each type, restating or revising the techniques to be adopted to cope with magnetic anomalies at London City Airport.

The recommended procedure for the Hawker 800XP was as follows:

> *'When aligned on the runway and either the LHS or RHS indicated heading deviates from the magnetic runway heading by more than 6 degrees perform the following actions:*
>
> 1. *Select DG on applicable AHRS panel, slew the heading to runway heading and switch back to SLAVED mode. If this does not solve the problem, perform step 2.*
> 2. *Select AHRS reversion switch on the misaligned side to REV.*
>
> *When in level unaccelerated flight, select NORMAL mode on the applicable AHRS reversion switch.'*

In the case of Hawker 800XP aircraft fitted with Pro Line 21 avionics (such as CS-DRQ), the advice was as follows:

> *'Do either of the steps that follow to correct or prevent heading errors that are induced by ground operations:*
>
> *Wait until the aircraft has either moved away from the distorted magnetic field or the distorting object has moved away and then fast slave the AHC to return it to the actual aircraft heading.*
>
> *Switch the AHC to the SLEW/DG mode and use the SLEW -/+ switch to slew the heading back to the actual aircraft heading. When the aircraft is clear of the distorted magnetic field, return the AHC to the NORM mode.'*

Each memorandum contained the statement:

> *'No take-off shall be initiated unless: both heading indicators show the correct heading and the Heading Miscompare Warning is not present.'*

Training to operate at London City

All aircraft operators wishing to use LCY require approval from the airport operator, which must be satisfied that pilots of aircraft using the airport have received adequate training to do so. In particular, pilots are assessed on their ability to conduct the steep approaches required by the confined location of the airfield. Currently there is no requirement for pilots to be assessed on their ability to recognise and deal with the effects of magnetic anomalies.

Aircraft operators provide special briefings for their pilots, known as Category C briefings, for airports with unusual or challenging characteristics such as steep approaches, significant terrain or unusual operating requirements. All operators using LCY issue a Category C briefing to their pilots but the AAIB is not aware of any which contain information regarding magnetic anomalies.

Detection of magnetic north by the aircraft system

All modern commercial aircraft have magnetic flux detector correction systems that detect the earth's magnetic field and, using electrical signals, correct the aircraft's compass gyros. Part of this system are magnetic flux valves (also known as gates) which are usually mounted one under each wing tip to ensure that they are as free as possible from any magnetic influences from the aircraft systems and structure. This system corrects the aircraft compass gyros at a slow rate of heading change, which is generally set at 3º per minute.

Attenuation of the affect on the earth's magnetic field by airport infrastructure

There are four possible methods of removing or attenuating the affect of airport infrastructure on the earth's magnetic field.

1. Each magnetic anomaly be individually demagnetised making it magnetically neutral. This is a short term solution as over a period of a few years, the magnetic anomaly will return.

2. Each individual magnetic anomaly have a permanent demagnetising system installed with an individual magnetic field sensor to monitor the change in the magnetic effect of the anomaly over time and the demagnetising system adjusted accordingly.

3. A sheet of magnetically opaque material eg Mu-metal, being placed over the area of the magnetic anomalies.

4. Removal of the items that cause the magnetic anomalies.

Aerodrome regulatory background

National and international standards for aerodromes are contained respectively in CAA publication CAP 168 – *Licensing of aerodromes* and ICAO Annex 14 – *Aerodrome design and operations'*. Neither contains guidance regarding interference with the Earth's magnetic field by airport infrastructure.

CAP 729 – *'Guidance on Aerodrome Development Procedures'* concerns the effect of plant, equipment and cranes on electronic equipment, approach aids and aerodrome surfaces and CAP 738 – *'Safeguarding of Aerodromes'* refers to development outside the control of the airport operator. Both refer to the development process rather than prevailing or resulting long term characteristics and neither considers the existence of magnetic anomalies in the construction of aerodromes.

Dangerous Cargo Regulations

The ICAO Technical Instructions for the safe Transport of Dangerous Goods by Air specifies that magnetised material, which can include large masses of ferro-magnetic metals such as automobiles, are classified as Miscellaneous Dangerous Substances and Articles since they may affect aircraft instruments, particularly the compasses. Magnetised material will only be accepted when the magnetic field strength at a distance of 4.6 m from any point on the surface of the assembled consignment does not exceed 0.418 A/m^2 or produce a magnetic compass deflection of 2 degrees or less. Magnetised material must not be loaded in such a position that it will have a significant effect on the direct-reading magnetic compasses or on the master compass detector units.

Analysis

Crew procedures exist to address the effects of magnetic anomalies on aircraft heading reference systems. However, the available evidence suggests that the heading reference systems of some aircraft suffer a temporary residual deviation which continues to affect aircraft operation. In most cases, if the correct procedure is completed, the residual deviation may be sufficient to generate a heading comparator caution but would not seriously affect the ability of the aircraft to follow an assigned route. In cases where deviations from the assigned route became problematic for pilots and ATC, it is likely that the condition was exacerbated by the manner in which the crew dealt with the anomaly. For example, in the case of the flights observed by the AAIB, the crew did not complete the procedure before takeoff, with the result that the heading reference system was not in a mode which could provide meaningful heading information. On that occasion the pilots knew that they had not completed the procedure but, advised of landing traffic a short distance from touchdown, decided to take off anyway. It is possible that the pilots of aircraft involved in the most serious deviations from the assigned route perceived similar pressure.

The effect of the magnetic anomalies on the earth's magnetic field in the areas of the K, L and M Holds at London City Airport is severe and in some areas, where measurements could be made, altered the earth's magnetic field by 97º. Most aircraft have magnetic flux valves fitted on the undersides of the wingtips. These flux valves sense the earth's magnetic

Footnote

[2] 1 Ampere turn per meter (A/m) equals 1 x 4π x 10^{-7} Tesla.

field and, by electrical/electronic circuitry, realign the aircraft's compass systems. An electrical limiter is installed into the flux valve system that limits the rate of realignment of the aircraft's compasses to, generally, 3º a minute. This allows aircraft to transit areas of magnetic anomalies at airports without any significant realignment input into the compass systems. However, if an aircraft is stationary in an area of magnetic anomaly, then the amount of compass realignment is directly proportional to the length of time that the aircraft is stationary and the strength and orientation of the magnetic anomaly in that area. When the aircraft taxies to a magnetically neutral area the compass system will realign itself back to magnetic north, but at a rate of 3º a minute. At London City Airport an aircraft that is stationary at Hold M for 10 minutes could have both compasses realigned by up to 30º, the P1's 30º to the left and the P2's 30º to the right. Once the aircraft leaves the hold and enters the runway for departure it could take up to 10 minutes for the compasses to realign to magnetic north.

Although the events at London City Airport and similar occurrences worldwide were almost certainly initiated by local magnetic anomalies, currently there is no national or international requirement to assess or mitigate the effects of magnetic anomalies at aerodromes. Accordingly, the following two Safety Recommendations were made.

Safety Recommendation 2007-119

It is recommended that ICAO amend Annex 14 to highlight the importance of ensuring that no airport infrastructure is allowed to alter significantly the local earth's magnetic field density in areas where aircraft hold prior to departure.

Safety Recommendation 2007-120

It is recommended that the CAA amend CAP 168 to require airport operators to ensure that no airport infrastructure is allowed to alter significantly the local earth's magnetic field density in areas where aircraft hold prior to departure.

At present EASA does not oversee aerodrome standards in member states. However, EASA Notice of Proposed Amendment (NPA) 06/2006 – *'Basic principals and essential requirements for the safety and interoperability regulation of aerodromes'*, noted that the organisation "is set to become by 2010, the European authority with extended powers covering all aspects of civil aviation safety", including the safety of aerodrome operations. Therefore, the following Safety Recommendation was made.

Safety Recommendation 2007-121

It is recommended that EASA require airport operators to ensure that no airport infrastructure is allowed to alter significantly the local earth's magnetic field density in areas where aircraft hold prior to departure.

Safety action by airport operator

The airport operator issued the following NOTAM, valid from 19 January 2007 until 7 July 2007, intended to increase awareness of the magnetic anomaly in the area of the Runway 28 hold:

'When using Runway 28 hold some aircraft types may experience magnetic disturbances affecting the heading reference system. Pilots should ensure that when positioned for take off from Runway 28, the aircraft heading reference is checked against the runway alignment. Flight crew noticing a compass anomaly on departure should notify ATC.'

This NOTAM, designated C0248/07, was reissued on 27 June 2007.

NOTAMs may, where appropriate, be permanent. However, Chapter 9, section 4 of CAP 410 – '*Manual of Flight Information Services*' entitled *'NOTAM'* states:

> *'...operational information not covered by AIP Amendment or AIP Supplement will be issued as a NOTAM... ...including changes of operational significance (permanent or temporary) which need to be introduced at short notice. Such changes will be superseded, as soon as possible, by AIP Amendment or AIP Supplement as necessary.'*

Accordingly, the following Safety Recommendation was made.

Safety Recommendation 2007-122

It is recommended that the Civil Aviation Authority (CAA) should ensure that NOTAM C0248/07, relating to magnetic anomalies at London City Airport, is superseded by an appropriate amendment to the AIP in the form of a 'Warning' within the 'Local Traffic Regulations' section of the entry for London City Airport.

Safety action by aircraft operator

There were no further reports of such occurrences for several months after the aircraft operator issued advice to its pilots regarding the magnetic anomalies in the loop hold at LCY. However, two recent events indicate that the problem persists and that adequate remedial action is not always taken by pilots of affected aircraft.

Therefore, in order to maintain awareness of this phenomenon and the correct remedial action, the following Safety Recommendation was made:

Safety Recommendation 2007-123

It is recommended that the CAA should require each operator approved to operate at London City to include in its Category C brief for that airport an entry highlighting the presence of the magnetic anomaly and procedures for mitigating its effects.

Although operator awareness and the correct application of remedial procedures will help to mitigate the affects of the magnetic anomaly, the continued incidence of related occurrences suggests that the problem will persist until the anomaly itself is removed. Accordingly, the following Safety Recommendation was made:

Safety Recommendation 2007-124

It is recommended that the CAA should require London City Airport Ltd to mitigate the effects of the magnetic anomaly in the loop hold so that it no longer affects the normal operation of aircraft.