Australian Government
Australian Transport Safety Bureau

Publication Date: November 2009 ISBN 978-1-74251-004-0

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608
Australia
1800 020 616
+61 2 6257 4150 from overseas

www.atsb.gov.au

Nov09/ATSB30

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-070
Interim Factual No 2

In-flight upset
154 km west of Learmonth, WA
7 October 2008

Abstract

This report provides an update to the first Interim Factual Report on this occurrence that was released on 6 March 2009.[1]

The interim report should be read in conjunction with the first interim report. The contents of this second interim report focus on summarising new activities conducted since the previous report, providing information on relevant topics not released in the previous report, and updating information on relevant topics where there have been significant changes. Further details of new and ongoing activities will be provided in the Australian Transport Safety Bureau's (ATSB) final report.

The information contained in this interim factual report is derived from the ongoing investigation of the occurrence. Readers are cautioned that there is the possibility that new evidence may become available during the remainder of the investigation that alters the circumstances as depicted in this report.

The investigation is continuing.

Summary from first Interim Factual Report– released March 2009

At 0932 local time (0132 UTC) on 7 October 2008, an Airbus A330-303 aircraft, registered VH-QPA, departed Singapore on a scheduled passenger transport service to Perth, Australia. On board the aircraft (operating as flight number QF72) were 303 passengers, nine cabin crew and three flight crew. At 1240:28, while the aircraft was cruising at 37,000 ft, the autopilot disconnected. From about the same time, there were various aircraft system failure indications. At 1242:27, while the crew was evaluating the situation, the aircraft abruptly pitched nose-down. The aircraft reached a maximum pitch angle of about 8.4° nose-down, and descended 650 ft during the event. After returning the aircraft to 37,000 ft, the crew commenced actions to deal with multiple failure messages. At 1245:08, the aircraft commenced a second uncommanded pitch-down event. The aircraft reached a maximum pitch angle of about 3.5° nose-down, and descended about 400 ft during this second event.

At 1249, the crew made a PAN urgency broadcast to air traffic control, and requested a clearance to divert to and track direct to Learmonth, WA. At 1254, after receiving advice from the cabin of several serious injuries, the crew declared a MAYDAY. The aircraft subsequently landed at Learmonth at 1350.

One flight attendant and 11 passengers were seriously injured and many others experienced less serious injuries. Most of the injuries involved passengers who were seated without their seatbelts fastened or were standing. As there were serious injuries, the occurrence constituted an accident.

The investigation to date has identified two significant safety factors related to the pitch-down

1 http://www.atsb.gov.au/publications/investigation_reports/2008/AAIR/ao-2008-070.aspx

movements. Firstly, immediately prior to the autopilot disconnect, the air data inertial reference unit (ADIRU) in position 1 started providing erroneous data (spikes) on many parameters to other aircraft systems. The other two ADIRUs continued to function correctly. Secondly, some of the spikes in angle of attack data were not filtered by the flight control computers, and the computers subsequently commanded the pitch-down movements.

Two other occurrences have been identified involving similar anomalous ADIRU behaviour but in neither case was there an in-flight upset.

FACTUAL INFORMATION UPDATE

Aircraft systems

As outlined in the first Interim Factual Report, two significant safety factors have been identified with the aircraft's systems:

- an air data inertial reference unit (ADIRU) provided erroneous data that was not detected by the ADIRU itself
- the flight control computers did not filter spikes in angle of attack data in a specific situation.

The investigation is examining the context and origin of both of these factors.

In relation to the angle of attack data processing algorithm, the investigation is continuing to examine various aspects of the flight control primary computer (FCPC or PRIM) software development cycle including design, hazard analysis, testing and certification. The results of this activity will be presented in the final investigation report after further information has been obtained and analysed.

In relation to the ADIRU data spikes, the following sections in this report outline the nature of the investigation work conducted since the first Interim Factual Report.

Comparison with other A330 events

As advised in the first Interim Factual Report, there have been two other events with similar anomalous ADIRU behaviour:

- 12 September 2006, involving the same ADIRU in position 1 (serial number 4167) and the same aircraft (VH-QPA) as that involved in the 7 October 2008 accident
- 27 December 2008, involving a different ADIRU in position 1 (serial number 4122) and a different A330-303 (VH-QPG) operated by the same operator.

The first Interim Factual Report also discussed another event that occurred on 7 February 2008 involving the A330-200, VH-EBC and ADIRU serial number 5155. Although the post-flight report (PFR) of this event contained some similar cockpit effect messages and fault messages as the other three events, it also contained some significant differences.[2] In addition, in contrast to the 7 October and 27 December 2008 events, analysis by the ADIRU manufacturer has indicated that unit serial number 5155 experienced a failure that was validated by the built-in test equipment (BITE) data. Overall, this event is now considered unlikely to be related to the other three events, but investigation is continuing.

The first Interim Factual Report stated that various searches of maintenance records had not identified any other related events. Further searches have been conducted, including a detailed examination of the operator's maintenance records. No other similar events have been identified.

On 1 June 2009, an Airbus 330-200, operated as flight AF447, impacted the Atlantic Ocean on a flight from Rio de Janeiro to Paris. An investigation by the French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) is ongoing, and the reasons for the accident have not yet been determined.[3]

---

2 A PFR contains maintenance messages generated on an aircraft during a flight. A 'cockpit effect' message refers to an indication presented in the cockpit. A 'fault message' reflects the triggering of a monitoring process concerning the status or functioning of the system concerned.

3 The BEA has released an Interim Report on the accident which is available at:

http://www.bea-fr.org/docspa/2009/f-cp090601e1.en/pdf/f-cp090601e1.en.pdf

Although this accident occurred to the same basic aircraft type as the accident involving VH-QPA on 7 October 2008, there are several important differences between the two accidents:

- The ADIRUs on the two aircraft were different models made by different manufacturers.
- The cockpit effect messages and fault messages from both flights showed a significantly different sequence and pattern of events. For example, a series of maintenance messages transmitted by AF447 prior to the accident showed inconsistencies between the measured airspeeds as well as the associated consequences on other aircraft systems. No such messages were recorded by VH-QPA on 7 October 2008.
- The airspeed sensors (pitot probes) on the two aircraft were different models made by different manufacturers.

On 31 August 2009, the European Aviation Safety Agency (EASA) issued Airworthiness Directive (AD) 2009-0195. The AD required (as a precautionary measure) that, for A330/A340 aircraft equipped with pitot probes manufactured by Thales Avionics, these probes be replaced with units manufactured by Goodrich.

The aircraft involved in the 7 October 2008 in-flight upset (VH-QPA) and the operator's other A330 aircraft were already fitted with Goodrich probes and were not affected by AD 2009-0195.

Air data inertial reference units

As outlined in the first Interim Factual Report, the ADIRU (serial number 4167) and an exemplar unit were subjected to a range of tests and examinations, and no faults were found that provided any information relevant to furthering the understanding of the accident. Since that report, the following additional testing has been conducted:

- Unit 4167 was disassembled and the individual modules were tested separately. The goal of this testing was to establish the serviceability of each of the nine modules (circuit board assemblies), and to identify any malfunctioning circuitry that was not evident at the system level.
- A highly accelerated stress screening (HASS) test was completed on unit 4167, which involved operating the unit while subjecting it to rapid temperature and vibration changes.
- Several components of unit 4167 were examined under high levels of magnification for any defects or abnormalities.
- Additional electromagnetic interference (EMI) testing, beyond that specified in DO-160C[4], was conducted on the exemplar unit for selected frequencies and field strengths. The selected frequencies were those used by onboard equipment such as satellite communications, navigation systems and the in-flight entertainment system. The power levels used were approximately 2.5 times the design specification.

None of this additional testing identified any faults or problems relevant to furthering the understanding of the accident.

Further testing on units 4167 and 4122 is being considered, based on ongoing reviews of information from the previous testing and other activities.

Aircraft testing and examination

A test program was performed to check the electromagnetic environment around ADIRU 1 on the A330-303 aircraft. The aircraft was the same as that involved in the accident (VH-QPA), but with different serial number ADIRUs installed. The test program included:

- EMI measurements with the aircraft on the ground
- a check of correct ADIRU 1 installation and configuration
- a check of ADIRU electrical bonding (there should be a very low resistance between the ADIRU case and the aircraft structure)
- a check of ADIRU wiring isolation (there should be a very high resistance between a conductor and its shielding)
- a check of ADIRU connections (wires must go to the correct pin on the ADIRU connector).

4 DO-160C, *Environmental Conditions and Test Procedures for Airborne Equipment*, produced by the Radio Technical Commission for Aeronautics (RTCA). Issued 12 April 1989.

No faults or problems relevant to furthering the understanding of the accident were identified.

An assessment flight, using VH-QPA, was conducted on 17 May 2009 to perform in-flight EMI measurements. EMI sensors were installed near the wiring bundles at the rear of ADIRU 1 and measurements were logged by computer. Various aircraft systems were exercised during the flight, including the passenger in-flight entertainment system and radio communication systems. Thirteen passengers and crew were onboard during the assessment flight, including flight crew and engineering staff from the aircraft operator, safety and engineering representatives from Airbus, a technical support representative from the ADIRU manufacturer and engineering investigators from the ATSB.

The aircraft departed from Sydney, NSW, flew to Learmonth, operated in the vicinity of the Harold E. Holt Naval Communications Station near Learmonth for approximately 2 hours and returned to Sydney. The duration of the flight was 10 hours and 48 minutes. After the flight, the flight data recorder (FDR), quick access recorder (QAR) and logged test data were analysed. The analysis did not reveal any anomalous results. The communications station was confirmed to be operating at the time of the assessment flight.

ADIRU software analysis

An analysis of the ADIRU operational software (operational flight program) was conducted by the ADIRU manufacturer. This analysis included:

- memory map evaluation of all parameters that showed spikes to look for common storage area/addresses
- examination of central processing unit (CPU) partitions and how they contribute to the recorded elapsed time interval (ETI) parameter[5]
- how the ADIRU establishes, records and reads ETI
- analysis of the functional flow for representative air data reference (ADR) and inertial reference (IR) parameters, including analysis of data rates, hardware registers used, and program variables.

No problems relevant to furthering the understanding of the accident were identified.

ADIRU configuration and maintenance histories

Units 4122 and 4167 were manufactured in August/September 2002. Both units had the same part numbers for all modules at the time of their respective occurrences, except for the sensor processing module. Both units had the same software version during the October and December 2008 events, but unit 4167 had a different (previous) software version during the September 2006 event.

The investigation is continuing to examine whether there are any significant similarities and/or differences between units 4122 and 4167. This examination is considering hardware configuration, modification history and repair history of the ADIRU as a system and for each of its modules.

Aircraft configuration and operational comparisons

The operator advised there was nothing unique regarding the configuration of the two aircraft associated with the three known events (VH-QPA and VH-QPG) relative to their other Airbus A330 aircraft that entered into service in the same period.

Airbus advised there was nothing unique regarding the operator’s A330 configuration relative to A330s/A340s with the same model ADIRU used by some other operators.

As advised in the first Interim Factual Report, the three known events involving similar ADIRU faults all occurred off the coast of Western Australia, although there were significant distances between the locations of each event. A review of the three known occurrences has not identified any other commonalities in operational, environmental or maintenance aspects of the aircraft or flights which were unique.

Review of maintenance records and ADIRU performance

The investigation is conducting a review of ADIRU faults experienced by the operator’s A330 fleet to

5 As outlined in the first Interim Factual Report, the BITE data from the ADIRUs involved in the October and December 2008 occurrences showed anomalies in the ETI parameter.

determine if there are any pertinent patterns or types of faults that share relevant similarities with the three known events.

For the majority of the ADIRU faults reported by flight crew in the aircrafts' technical logs, no faults were subsequently found during the required maintenance troubleshooting activities and the aircraft were returned to service. The units then operated without any further problems.

One type of fault event associated with the ADIRU model is known as 'dozing'. Once 'dozing' commences, the ADIRU stops outputting data for the remainder of the flight.[6] On the ground, once power has been cycled on the affected unit, it resumes normal operation. The symptoms of dozing apparent to the flight crew are ECAM[7] messages of a NAV IR Fault and NAV ADR Fault associated with the affected ADIRU, but the associated fault lights on the overhead panel do not illuminate. Dozing events are also associated with incomplete records in the ADIRU BITE.[8] Several A330/A340 operators using the same model ADIRU have experienced 'dozing' events. The ADIRU manufacturer is continuing to investigate the reasons for these events, which the manufacturer reported have not been associated with the affected ADIRUs outputting any data spikes.

The investigation team is evaluating the 'dozing' issue to determine its relevance, if any, to the ADIRU fault that resulted in spikes being produced in ADIRU parameters.

Consideration of cosmic and solar radiation effects

There is a constant stream of high-energy galactic and solar radiation interacting with the Earth's upper atmosphere. This interaction creates a cascade of secondary particles. Some of the secondary particles, in particular neutrons, can affect aircraft avionics systems. A single event effect (SEE) is the response of a component caused by the impact of a single particle. The SEE can be:

- non-destructive, involving a soft error[9] where a logic state in a digital electronics component changes from a 1 to a 0 or vice versa but can be reset by cycling the power off and on; or
- a hard error, resulting in permanent damage of a component that is not recoverable, even by cycling the power off and on.

High density integrated circuits, such as memory devices and central processing units (CPUs), can be particularly susceptible to SEEs. SEEs have been suspected of generating some of the soft errors that occur in a wide range of different aircraft systems. Hardware and software design features such as redundancy, monitoring, error correction and partitioning can be used to mitigate the effects of SEEs.

The investigation team is evaluating the relevance, if any, of SEEs to the ADIRU fault that resulted in spikes being produced in ADIRU parameters.

Summary of ongoing activities

In summary, the investigation is still following several lines of inquiry to explain why the ADIRU started providing erroneous data (spikes). In addition, the investigation is continuing to examine various aspects of the flight control primary computer (FCPC or PRIM) software development cycle.

The investigation is also continuing to examine the performance of the ECAM and its effectiveness in assisting crews to manage aircraft system problems.

Cabin safety

Information obtained from passengers

Since the March 2009 report, further information has been obtained from a small number of passengers. A total of 98 passenger questionnaires have been completed and returned to the ATSB. These surveys provided

6 As there are three ADIRUs on the aircraft, the loss of data from one ADIRU is not normally operationally significant.

7 Electronic centralized aircraft monitor (see March 2009 report).

8 A characteristic of the 7 October and 27 December 2008 occurrences was incomplete records in the ADIRU BITE. No BITE was obtained for the 12 September 2006 occurrence.

9 A single event upset (SEU) is another term given to a soft error.

information about five children. Information was also obtained in writing or by interview from 21 other passengers. The information from surveys, interviews and other correspondence also included details on some key topics for many other passengers.

Posture and seatbelt use

Based on data from all the available sources, there were 147 passengers reported to be seated at the time of the first upset, with 87 wearing their seatbelts and 60 not wearing their seatbelts (a seatbelt use rate for this group of passengers of 59%). Twenty-three passengers were reported to be not seated at the time of the first upset.

Information on posture and seatbelt use was not available for 133 of the passengers. Information from several sources suggested that some of those passengers were seated without their seatbelts fastened.

Injuries to persons

The Western Australia Department of Health reported that 51 passengers and two crew members received medical treatment at a hospital, and that 11 passengers and one crew member were admitted to hospital with serious injuries. Injury information was also obtained from interviews, questionnaires and other means.

Based on the available information, the number of injuries from the accident is presented in Table 1.

Table 1: Number and levels of injuries

Injuries	Crew	Passengers	Other	Total
Fatal	-	-	-	-
Serious	1	11	-	12
Minor	8	99	-	107
None	3	193	-	196
Total	12	303	-	315

Information was not available on the injury status of 135 of the passengers. It is very unlikely that any of those passengers would have been admitted to hospital (seriously injured) or received hospital medical treatment soon after the event. However, it is likely that some of those passengers received minor injuries.

Injuries and seatbelt use

The injury rate for passengers reportedly wearing seatbelts (36%) was significantly lower than for those seated but not wearing seatbelts (92%) or for those who were not seated (100%) at the time of the first upset.

The proportion of seated passengers wearing seatbelts who received hospital medical treatment (11%) was significantly lower than for those seated but not wearing seatbelts (33%) or for those who were not seated (61%).

The most common type of in-flight upset is due to turbulence. Research into turbulence events has shown that aircraft occupants who are not wearing seatbelts are much more likely than occupants wearing seatbelts to experience injuries, and that the injuries experienced are generally more severe. Although the 7 October 2008 accident was not related to turbulence, the difference in injury rates between those wearing seatbelts and those not wearing seatbelts was similar.[10]

Seatbelt requirements

Australian Civil Aviation Regulation (CAR) 251(1) stated:

> ...seat belts shall be worn by all crew members and passengers:
>
> (a) during take-off and landing;
>
> (b) during an instrument approach;
>
> (c) when the aircraft is flying at a height of less than 1,000 feet above the terrain; and
>
> (d) at all times in turbulent conditions.

The operator's *Flight Administration Manual* outlined policies, procedures and standards for crew members. In addition to reiterating the regulatory requirements for seatbelts, the manual stated:

10 Advice for passengers on what they can do to minimise injuries due to turbulence (or other in-flight upsets) is provided by many sources, such as the ATSB Aviation Safety Bulletin AR-2008-034, *Staying Safe against In-flight Turbulence*. This document is available at: http://www.atsb.gov.au/publications/2008/AR2008034.aspx

> Seat belts (including full harnesses where fitted) shall be worn by all passengers and Cabin Crew whenever the Seat Belts sign is illuminated. The only exception to this requirement is when Cabin Crew are performing safety related duties. Seat belts, when worn, shall be properly adjusted and securely fastened.

The operator provided a pre-flight safety demonstration to A330 passengers by video. The audio track of the video stated:

> Having your seatbelt done up low and tight is absolutely essential during takeoff, landing and turbulence. It is a [operator] requirement that you keep it on at all other times.

The operator's procedures required that cabin crew provide a public address announcement to passengers after takeoff stating that:

> The Seat Belt sign is now off, however, for your safety keep your seat belt fastened whenever you are seated.

The operator's procedures also recommended that the flight crew provide passenger briefings at various times during the flight. It was common practice for the operator's flight crew to remind passengers during a briefing after takeoff, to wear their seatbelts when seated. The pilot in command of the 7 October 2008 flight reported that he provided the standard seatbelt reminder after takeoff, and this was confirmed by some passengers.

The operator's cabin crew were required to check that passengers were wearing their seatbelts before takeoff, before landing and, in some situations (where possible to do so), if the seatbelt sign was illuminated during flight. However, during flight when the seatbelt sign was not illuminated, there was no policy or procedure requiring cabin crew to check or enforce passenger seatbelt use. Cabin crew have advised that there are significant difficulties associated with attempting to enforce seatbelt requirements when the seatbelt sign is not illuminated.

The operator's procedures for seatbelt use were consistent with many other Australian and international operators, although most stated the wearing of seatbelts when seated (and the seatbelt sign was not illuminated) as a 'recommendation' rather than a 'requirement'.

Passenger understanding of seatbelt requirements

The passenger questionnaire asked passengers to report on their 'understanding of when you should wear your seatbelt'. Free text responses were coded as follows:

- at all times when seated (64 passengers)
- preferably or desirably at all times when seated (8 passengers)
- only during takeoff, landing or when the seatbelt sign was illuminated (13 passengers)
- unclear response or no response (13 passengers).

Most of the survey respondents who were wearing seatbelts at the time of the first upset reported that they understood seatbelts should be worn at all times when seated. However, many of those not wearing seatbelts reported that seatbelts should be worn only during takeoff, landing or when the seatbelt sign was illuminated. Further details are provided in Table 2.

Table 2: Survey respondents' understanding of when seatbelts should be worn

	Seated, belt on	**Seated, belt off**
All times when seated	75%	41%
Desirable when seated	7%	14%
Takeoff, landing, seatbelt sign illuminated	4%	38%
Unclear or no response	14%	7%

Previous seatbelt use

The questionnaire asked passengers to state whether they normally wore their seatbelts on previous flights. The question was asked for six different activities or phases of flight.

All passengers reported that they wore their seatbelts during takeoff, descent and landing. Ten passengers (10% of survey respondents) reported that they did not normally wear their seatbelts during one or more of the three cruise activities (meal service, reading/in-flight entertainment and sleeping). At the time of the first upset, those 10 passengers were seated, and eight of them were not wearing their seatbelts.

Reasons for not using seatbelts

Of the 98 passengers who completed the passenger questionnaire, 29 reported that they were seated without their seatbelt fastened. The questionnaire asked those passengers 'why you were not wearing your seatbelt'. None of those passengers reported any problems or difficulties with their seatbelts.

The most common reasons provided for not wearing the seatbelt were that the passenger was about to get up to go to the toilet or had just returned from the toilet (7 passengers), or that they had been to the toilet earlier in the flight and had forgotten to refasten their seatbelt (3 passengers). Most (9) of those 10 passengers stated that they understood seatbelts should be worn at all times when seated, and all reported that they normally wore their seatbelts when seated during the cruise activities.

For the other 19 passengers who were not wearing seatbelts, a variety of responses were provided. Some provided a reason (for example, trying to go to sleep and finding the belt uncomfortable), but most provided no particular reason. Ten of those 19 passengers also stated that they understood that seatbelts should be worn during takeoff, landing or when the seatbelt sign was illuminated. Many (8) of them also reported that they did not normally wear their seatbelts during one or more of the cruise activities.

Most (81%) of the seated passengers who were not wearing seatbelts reported that they had been on over 20 previous commercial airline flights. Only one passenger had been on less than six previous flights.

Potential for inadvertent seatbelt release

Six passengers reported to the ATSB that they were seated with their seatbelt fastened at the time of the first upset, but that the seatbelt became unfastened and did not restrain them in their seats. Three of those passengers advised that they had their seatbelts tightly fastened, and three advised that they had their seatbelts loosely fastened. None of the six passengers could provide details of how their seatbelts released.

As advised in the first Interim Factual Report, the investigation identified a scenario whereby seatbelts could inadvertently release. For this to occur, the seatbelt had to be loosely fastened and the buckle had to be positioned in a vertical orientation underneath the right armrest prior to an upward force being applied. The lift-latch could then catch on the armrest and the buckle release.

The ATSB has conducted further examinations of this inadvertent release scenario on one of the operator's A330 aircraft. Those examinations found that, for this scenario to occur on those aircraft, the seatbelt had to be adjusted so that there was at least 25 cm of slack in the belt (comparing the length of a firmly-fastened seatbelt with one that was loosely fastened to the minimum extent necessary to enable the inadvertent release scenario to occur).

The certification requirements for aircraft seatbelts required that the possibility for inadvertent release of seatbelts is minimised. However, design and testing requirements for seats and seatbelts are based on the principle that seatbelts are 'properly worn'.

It is widely recommended that seatbelts should be worn 'snugly' and low across the hips. Seatbelts worn with significant amounts of slack will increase injury risk relative to seatbelts that are firmly fastened. Aircraft passenger seatbelts are also designed to be worn so that the belt passes over the passenger's pelvis. More specifically:

> The safety belt should be placed low on your hipbones so that the belt loads will be taken by the strong skeleton of your body. If the safety belt is improperly positioned on your abdomen, it can cause internal injuries. If the safety belt is positioned on your thighs, rather than the hipbones, it cannot effectively limit your body's forward motion.[11]

Ongoing cabin safety activities

Further work is being conducted to analyse information obtained from passengers and review seatbelt requirements.

---

11 Federal Aviation Administration, *Seat belts and shoulder harnesses: Smart protection in small airplanes*. AM-400-91/2, revised May 2004.

SAFETY ACTION UPDATE

The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Previous safety action

In its first Interim Factual Report, the ATSB noted that the aircraft manufacturer had issued an Operations Engineering Bulletin (OEB) which provides procedures for crews of Airbus A330 and A340 aircraft to follow in the event of a similar anomalous ADIRU behaviour in the future. A revised version was issued following the 27 December 2008 event. The European Aviation Safety Agency (EASA) and CASA had subsequently issued these bulletins as Airworthiness Directives. The OEB was incorporated into the operator's flight crew procedures and training program.

The following safety action has been taken in addition to the safety action already outlined in the first Interim Factual Report.

New safety action

Flight control system

The aircraft manufacturer has introduced an interim modification to the flight control primary computer (FCPC or PRIM) software standard (P9A/M18A) and it has been promulgated using a Service Bulletin. The interim standard incorporates the modified monitoring and filtering of five parameters, including angle of attack. This interim standard will be retrofitted to the operator's fleet. The retrofit has commenced and is expected to be completed by the end of November 2009.

A later FCPC software standard to improve the treatment of all ADIRU parameters will be certified in the period mid–to-late 2010. This later software standard will be retrofitted to the world-wide fleet of A330/A340 aircraft.

Quick access recorder parameters

The aircraft manufacturer, ADIRU manufacturer and the operator examined the feasibility of recording additional parameters from ADIRU 1 on the aircraft's quick access recorder. This requires wiring changes to the operator's A330 aircraft to access an additional ADIRU 1 databus and modifications to the aircraft condition monitoring system (ACMS) software. The examination showed that the modification was feasible and, at the time of the publication of this report, the wiring change had been completed on all of the operator's aircraft. The ACMS software change has been incorporated on all of the operator's aircraft with one type of ACMS (7 aircraft), but not yet completed on the operator's aircraft with another type of ACMS (15 aircraft).

Summary of safety action

Despite extensive testing and analysis, the reason why the ADIRU started providing erroneous data (spikes) during the 7 October 2008 flight (or the 27 December 2008 flight) has not been identified to date. Nevertheless, the crew operational procedures that were provided by Airbus in October 2008 (and modified in December 2008 and January 2009)[12] significantly reduced the chance of another in-flight upset by limiting the time that a faulty ADIRU could output angle of attack spikes. Airbus is also modifying the FCPC software used in the A330/A340 fleets to prevent angle of attack spikes leading to an in-flight upset.

12 The Airbus procedures were subsequently mandated by Airworthiness Directives by EASA and the Civil Aviation Safety Authority.

MEDIA RELEASE

ATSB Second Interim Factual Report into the Qantas Airbus A330-303 in-flight upset, 154 km west of Learmonth WA, on 7 October 2008

The Australian Transport Safety Bureau has released a second Interim Factual Report into the accident involving the Qantas Airbus A330-303 in-flight upset, 154 km west of Learmonth WA, on 7 October 2008. The report summarises new activities conducted since the first Interim Factual Report that was released on 6 March 2009, and it should be read in conjunction with that previous report.

The aircraft (registered VH-QPA) was being operated on a scheduled passenger service (QF72) from Singapore to Perth. At 1240, while cruising at 37,000 ft, the aircraft experienced two uncommanded pitch-down events. The flight crew were able to quickly return the aircraft to level flight on each occasion and diverted to Learmonth, WA for a safe landing.

One flight attendant and 11 passengers were seriously injured, and eight other crew members and at least 99 other passengers received minor injuries. The injury rate and severity of injuries was significantly greater for those passengers who were not seated or not wearing seatbelts at the time of the first in-flight upset.

At least 60 of the 303 passengers were seated without their seatbelts fastened. Although there are legitimate reasons for passengers leaving their seats during a flight when the seatbelt sign is not illuminated, passengers are reminded to wear their seatbelts at all times when seated during a flight.

In addition to the initial procedures-based safety action taken by the aircraft manufacturer in response to this accident, Airbus is modifying the flight control primary computer (FCPC or PRIM) software used in the A330/A340 fleets to prevent any future similar problems leading to an uncommanded pitch-down event. An interim modification to the FCPC software standard is being installed in the operator's fleet, and the installation is expected to be completed by the end of November 2009. A later FCPC software standard to improve the treatment of all ADIRU parameters will be certified in mid to late 2010, and will then be retrofitted to the world-wide fleet of A330/A340 aircraft.

There has been speculation of a potential link between the QF72 accident off Learmonth on 7 October 2008 with the AF447 accident that occurred on 1 June 2009 on a flight from Rio de Janeiro to Paris. Although each of the accidents involved the same basic aircraft type, there are several important differences between the two accidents:

- The ADIRUs on the two aircraft were different models, and constructed by different manufacturers.
- The cockpit-effect messages and maintenance fault messages from both flights showed a significantly different sequence and pattern of events. For example, a series of maintenance messages that were transmitted by AF447 prior to the accident showed inconsistencies between the measured airspeeds and the associated consequences on other aircraft systems. No such messages were recorded by QF72.
- The airspeed sensors (pitot probes) on the two aircraft were different models made by different manufacturers.

The ATSB expects to release a final report into this accident in the second quarter of calendar year 2010. However, the ATSB will immediately bring any critical or significant safety issue(s)s to the attention of the relevant organisations best placed to address them, should any such issues arise. The ATSB will also publish details of any such issue(s).

Media Contact: 1-800-020-616