

AIRCRAFT ACCIDENT REPORT No 2/2008

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**REPORT ON THE SERIOUS INCIDENT TO
AIRBUS A319-131, G-EUOB
DURING THE CLIMB AFTER DEPARTURE FROM LONDON HEATHROW AIRPORT
ON 22 OCTOBER 2005**

Registered Owner and Operator:	British Airways PLC
Aircraft Type and Model:	Airbus A319-131
Registration:	G-EUOB
Manufacturer's Serial Number:	1529
Place of Incident:	During the climb after departure from London Heathrow
Date and Time:	22 October 2005 at 1926 hrs

Synopsis

The incident occurred at 1926 hrs on 22 October 2005, to an Airbus A319-131 aircraft which was operating a scheduled passenger flight between London Heathrow and Budapest. The following Inspectors participated in the investigation:

Mr A P Simmons	Investigator-in-Charge
Ms G M Dean	Operations
Mr R G Ross	Engineering
Mr P Wivell	Flight Recorders

As the aircraft climbed to Flight Level (FL) 200 in night Visual Meteorological Conditions (VMC) with autopilot and autothrust engaged, there was a major electrical failure. This resulted in the loss or degradation of a number of important aircraft systems. The crew reported that both the commander's and co-pilot's Primary Flight Displays (PFD) and Navigation Displays (ND) went

blank, as did the upper ECAM¹ display. The autopilot and autothrust systems disconnected, the VHF radio and intercom were inoperative and most of the cockpit lighting went off. There were several other more minor concurrent failures.

The commander maintained control of the aircraft, flying by reference to the visible night horizon and the standby instruments, which were difficult to see in the poor light. The co-pilot carried out the abnormal checklist actions which appeared on the lower ECAM display; the only available electronic flight display. Most of the affected systems were restored after approximately 90 seconds, when the co-pilot selected

Footnote

¹ Electronic Centralised Aircraft Monitoring system - this comprises two centrally mounted electronic display units, which present the flight crew with aircraft systems information, warning and memo messages and actions to be taken in response to systems failures.

the AC Essential Feed switch to Alternate ('ALTN'). There were no injuries to any of the 76 passengers or 6 crew. After the event, and following discussions between the crew and the operator's Maintenance Control, the aircraft continued to Budapest.

The Air Accidents Investigation Branch (AAIB) became aware of this incident on 28 October 2005, through the UK Civil Aviation Authority's Mandatory Occurrence Reporting (MOR) scheme. The AAIB investigation team was assisted by an Accredited Representative from the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA, the French air accident investigation authority) and by the aircraft manufacturer.

Preliminary information on the progress of the investigation was published in AAIB Special Bulletins S2/2005 and S3/2006, in November 2005 and April 2006. Four Safety Recommendations were made in Special Bulletin S3/2006.

It was not possible to determine the cause of the incident due to a lack of available evidence, however, nine additional Safety Recommendations are made in this report.

Findings

Personnel

1. The flight crew were licensed and qualified to operate the flight.
2. The flight crew were in compliance with the applicable flight time and duty time limitations.
3. The flight crew had not received any formal training on how to operate A320-family aircraft by sole reference to the standby instruments.

4. The commander did not record the full details of the incident in the aircraft technical log, however he did record this information on the Air Safety Report which he filed.
5. The engineer in Budapest (who was not an employee of the airline), did not investigate the symptoms of the incident which were reported to him verbally by the commander and which were also recorded in the Air Safety Report.

The aircraft

1. The aircraft held a valid Certificate of Airworthiness and no relevant recorded defects were being carried.
2. The aircraft was maintained in accordance with an EASA-approved maintenance programme.
3. The aircraft suffered the loss of the left electrical network, for reasons which could not be established. A possible explanation is the detection of a false DP2 condition by the No 1 Generator Control Unit, but this could not be confirmed.
4. The loss of the left electrical network caused various systems powered by the left network to either cease operating, or become degraded. These systems included, most notably, the autopilot, the autothrust system, the captain's and co-pilot's Primary Flight and Navigation Displays, the upper ECAM display, most of the cockpit lighting, including the integral lighting to the instruments and standby instruments, the VHF 1 and VHF 2 radios and the ATC 1 transponder.

5. The majority of the aircraft systems were recovered after approximately 90 seconds, after selection of the AC ESS FEED switch, in accordance with the ECAM procedure. AC BUS 1 was recovered after approximately 135 seconds, by cycling of the No 1 generator switch.
6. This and other similar incidents show that there is at least one unforeseen failure mode on A320 family aircraft, which can cause the simultaneous loss of the captain and co-pilots electronic flight instruments and the upper ECAM display.
7. Aircraft equipped with an electromechanical standby horizon and not provisioned with the ISIS wiring configuration have a single power supply to the standby horizon, from the DC ESS bus. If this incident had occurred to such an aircraft, the standby horizon would have been unpowered and become unusable after approximately five minutes.
8. The A318/A319/A320/A321 MMEL allows the aircraft to be dispatched with the lower ECAM display inoperative. In this case, it was the only display available and presented the list of actions, which enabled the crew to recover most of the failed systems.
9. Trials showed that in night conditions, there may be insufficient light available to see the standby instruments following the loss of the left electrical network, particularly if the cockpit dome light is off.

Organisational

1. The information contained in the ASR raised by the commander should also have been reflected in the aircraft technical log. The technical log did not contain important details of the incident; as a result it reflected only minor defects which were rectified without appreciation of the importance of the serious incident which had occurred.
2. The faxed copies of the Air Safety Report raised by the commander were not received by the airline's Flight Operations Safety Department, or the department responsible for entering the incident data on to the electronic safety management database. As a result of this and of the minimal information contained in the Technical Log, the significance of the incident was not fully understood until the original copy of the ASR arrived in the post at London Heathrow.

Recorded flight data

1. Airbus has found a failure mode by which the co-pilot's ND and PFD could have been switched from the functional DMC2 to the failed DMC3 whilst leaving the lower ECAM linked to DMC2, however, no link has been found between this failure mode and the failure of power on the aircraft.
2. Because the mechanism by which the power failure on the captain's side resulted in the additional loss of the co-pilot's instruments is not known, it cannot have been considered when analysing failure modes for compliance with requirements.

3. The system BITE designs have been improved to better capture this type of failure. BITE is not recorded by the FDR. Detailed evidence may be lost in the event of an accident caused by the failures involved in this incident.
4. The display behaviour was not apparent from the recorded data. Only the crew observations revealed the extent of the problem. This evidence may be lost in the event of an accident.
5. A crash protected image recording of the instruments would have provided more detail to this investigation and provided crucial evidence that may otherwise have been missing had crew observations not been available.

Causal factors

The investigation identified the following causal factors:

1. The aircraft suffered the loss of the left electrical network, resulting in loss of the captain's PFD and ND, and the upper ECAM display, for reasons which could not be determined.
2. A co-incident failure caused the co-pilot's Primary Flight Display and Navigation Display to blank or become severely degraded, at the same time as the loss of the left electrical network. The origin of the co-incident failure could not be identified.

Safety Recommendations

The following Safety Recommendations were made during this investigation and were published in April 2006 in AAIB Special Bulletin 3/2006:

Safety Recommendation 2006-051

It is recommended that the aircraft manufacturer, Airbus, reviews the existing ECAM actions for the A320-series aircraft, given the possibility of the simultaneous in-flight loss of the commander's and co-pilot's primary flight and navigation displays. They should consider whether the priority of the items displayed on the ECAM should be altered, to enable the displays to be recovered as quickly as possible and subsequently issue operators with a revised procedure if necessary.

Airbus has responded to this Safety Recommendation stating that it would not be acceptable to change the priority of the ECAM action items for the following reasons:

- there are other failure modes in which the selection of the AC ESS FEED is not the most important action,
- the current ECAM action prioritisation was arrived at after taking into account many different safety analyses,
- Changing the priority of the ECAM items would require validation on all airframe engine combinations and could have an impact on other engine or electrical alerts,
- New priorities could introduce new operational issues which would need to be reviewed and approved by the regulatory authorities (EASA/FAA).

Safety Recommendation 2006-052

It is recommended that the aircraft manufacturer, Airbus, should review the A320-series aircraft Master Minimum Equipment List Chapter 31, INDICATING/RECORDING SYSTEMS and reconsider whether it is acceptable to allow the ECAM lower display unit to be unserviceable. They should amend the requirement, as necessary, to take account of the possibility of the simultaneous in-flight loss of both the commander's and co-pilot's primary flight and navigation displays and the ECAM upper display.

In response to this Safety Recommendation, Airbus has reviewed the content of the A318/A319/A320/A321 MMEL regarding dispatch with the lower ECAM display inoperative.

MMEL Sections 1 and 2 were updated in August 2006 to include the condition that an operational test of the AC Essential bus transfer function and indication must be performed once per day if the lower ECAM is inoperative. The Aircraft Maintenance Manual will also be updated to include the test procedure.

This Safety Recommendation was made to ensure that the operating crew would always have information presented on ECAM as to the actions required to recover the systems should a similar event occur. The response of Airbus to the recommendation did not address this problem, which is that if the Lower ECAM screen were not available, in the event of a similar failure, there would not be any information displayed to the crew as to what action they should take to recover the systems. Accordingly, Airbus propose to amend the A320 family MMEL section 2 regarding dispatch with the lower ECAM inoperative, to remind crews of the necessary recovery action should the AC ESS bus, and therefore all DUs be lost:

'In case of failure of AC Bus 1, all DUs are lost:

- Apply AC ESS BUS FAULT procedure of FCOM 3.02.24 (Select AC ESS FEED at ALTN) to recover AC ESS BUS'

Safety Recommendation 2006-053

The aircraft manufacturer, Airbus, should identify those aircraft with the single power supply to the standby artificial horizon and advise the operators of the potential implications of this configuration.

In response to this Safety Recommendation Airbus has advised operators through OIT 9SE999.0115/05/BB Rev 1, that for aircraft without the ISIS wiring configuration to the standby instruments, the standby horizon may be unusable after five minutes if the DC ESS bus is lost.

Safety Recommendation 2006-054

It is recommended that the aircraft manufacturer, Airbus, revises the information about the power sources for the standby artificial horizon provided in Flight Crew Operating Manuals for the A320-series aircraft to reflect the actual status of the aircraft to which they apply.

In response to this Safety Recommendation Airbus has updated A320 family Flight Crew Operating Manual Section 3.02.24 page 11, Section 1.34.20 page 1 and Section 1.34.97 page 1 to reflect the different power supply configurations for the standby horizon.

The following additional Safety Recommendations are also made:

Safety Recommendation 2007-062

It is recommended that the European Aviation Safety Authority should, in consultation with other National Airworthiness Authorities outside Europe, consider requiring training for flight by sole reference to standby instruments for pilots during initial and recurrent training courses.

Safety Recommendation 2007-063

Airbus should introduce a modification for A320 family of aircraft which have the pre-ISIS wiring configuration for the standby instruments, in order to provide a back-up power supply which is independent of the aircraft's normal electrical power generation systems.

Since the issue of Special Bulletin 3/2006, Airbus has advised that Modification 37317 has been introduced by Service Bulletin SB A320-24-1120 issued May 2007. This modification provides an automatic reconfiguration of the power supply to the AC ESS bus in the event of AC 1 bus failure. This modification largely satisfies the intent of Safety Recommendation 2007-063.

Safety Recommendation 2007-064

The European Aviation Safety Agency should mandate either Airbus Service Bulletin SB A320-24-1120 or the provision of a back-up power supply for the standby horizon which is independent of the aircraft's normal electrical power generation systems, on A320 family aircraft.

Safety Recommendation 2007-065

In order to ensure that the standby instruments on A320 family aircraft remain adequately illuminated following the loss of the left electrical network, Airbus should introduce a modification to provide a power supply for the standby instrument integral

lighting which is independent of the aircraft's normal electrical power generating systems.

In response to Safety Recommendation 2007-065 while it was still at the draft stage, Airbus advised that Service Bulletin A320-33-1057 had been issued in May 2007 to introduce Modifications 37329 and 37330. These modifications provide a backup supply to the cockpit floodlight above the standby instruments.

Safety Recommendation 2007-066

The European Aviation Safety Agency should mandate the provision of a power supply for the standby instrument integral lighting which is independent of the aircraft's normal electrical power generating systems, on A320 family aircraft.

Safety Recommendation 2007-067

Airbus should conduct a study into the feasibility of automating the reconfiguration of the power supply to the AC Essential bus, in order to reduce the time taken to recover important aircraft systems on A320 family aircraft following the loss of the left electrical network.

In response to this Safety Recommendation, while it was at the draft stage, Airbus issued Service Bulletin SBA320-24-1120 in May 2007. This introduced Modification 37317 which provides automatic reconfiguration of the power supply to the AC ESS Bus in the event of AC BUS 1 failure.

Safety Recommendation 2007-069

Airbus, in conjunction with the Generator Control Unit (GCU) manufacturer Hamilton Sundstrand, should modify the A320 family GCUs to provide the capability to record intermittent faults and to reduce their susceptibility to false differential protection trips.

Safety Recommendation 2007-070

The International Civil Aviation Organisation should expedite the introduction of a standard for flight deck image recording, and should encourage member states to provide legal protection, similar to that for cockpit voice recordings, for such image recordings.

Safety Recommendation 2007-071

British Airways PLC should review the advice given to flight crew concerning aircraft Technical Log entries, where an Air Safety Report (ASR) is also raised, to ensure that the aircraft Technical Log fully records the details of serious incidents and to ensure, as far as possible, that ASRs are received by the Flight Operations Safety Department in a timely a manner, irrespective of where the ASR is raised.