
Department for Transport

AAIB Bulletin S2/2010

SPECIAL

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A321-231, G-MEDJ
No & type of Engines:	2 International Aero Engines V2533-A5 turbofan engines
Year of Manufacture:	2004
Location:	At FL360 over northern Sudan
Date & Time (UTC):	24 August 2010 at 0225 hrs
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 7 Passengers - 42
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	34 years
Commander's Flying Experience:	Approximately 7,500 hours (of which approximately 1,400 were on type) Last 90 days - 165 hours Last 28 days - 61 hours
Information Source:	AAIB Field Investigation

This Special Bulletin contains facts which have been determined up to the time of issue. It is published to inform the aviation industry and the public of the general circumstances of accidents and serious incidents and should be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

The investigation is being carried out in accordance with The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996, Annex 13 to the ICAO Convention on International Civil Aviation and EU Directive 94/56/EC.

The sole objective of the investigation shall be the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

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Synopsis

The aircraft suffered an electrical malfunction during a scheduled night flight between Khartoum (Sudan) and Beirut (Lebanon). The more significant symptoms included the intermittent failure of the captain and co-pilot's electronic displays and the uncommanded application of left rudder trim; the flight crew also reported that the aircraft did not seem to respond as expected to control inputs. A large number of ECAM¹ messages and cautions were presented. The uncommanded rudder trim caused the aircraft to adopt a left-wing-low attitude and deviate to the left of the planned track. Normal functions were restored after the flight crew selected the No 1 generator to OFF in response to an ECAM 'ELEC GEN 1 FAULT' message. The aircraft landed safely at Beirut.

History of the flight

The incident occurred as the aircraft was cruising at Flight Level (FL) 360 over northern Sudan, with the commander as pilot flying and the No 1 autopilot (AP 1) and autothrust engaged. The conditions were night Instrument Meteorological Conditions, with slight turbulence. The commander reported that, without warning, his Primary Flight Display (PFD), Navigation Display (ND), and the ECAM upper Display Unit (DU) began to flicker, grey out, show lines or crosses, and go blank. Concurrently, there was a "chattering" heard coming from the circuit breaker panels behind the two pilots' seats, which was thought to be relay operation. The abnormal behaviour ceased after a short time. The co-pilot checked the circuit breakers to see if

any had operated and to look for signs of overheating, but nothing was noted. The commander reviewed the ECAM electrical system page, which showed no abnormalities.

Some minutes later, the commander's PFD, ND, and ECAM upper DU began to flicker and grey out again, before blanking for longer periods. AP 1 disconnected and the commander handed control to the co-pilot, whose display screens were unaffected at this time. The abnormal condition was once again short-lived and once conditions had returned to normal, the commander reassumed control and re-engaged AP 1.

The symptoms returned shortly thereafter, with the commander's displays becoming mostly blank, or showing white lines. When the displays were visible, the airspeed, altimeter, and QNH/STD indications were erratic. The co-pilot's PFD, ND, and the ECAM lower DU began to flicker and were sometimes unreadable. The crew reported that the cockpit lights went off intermittently. The commander handed control to the co-pilot again, who flew the aircraft manually. Reference was made to the standby flight instruments, which operated normally throughout the incident.

During this period, the chattering sound resumed and was, at times, continuous. Numerous ECAM messages were presented and there were a number of master caution annunciations. Symbols indicating flight control system reconfiguration to Alternate Law² appeared, the flight directors were intermittent and the autothrust system went into 'thrust lock' mode. The aircraft rolled to the left and adopted an approximately 10° left-wing-low attitude, without any flight control

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.

Footnote

² Alternate Law is a mode of the flight control system in which certain protection features are unavailable.

input from the crew. The flight crew reported that the aircraft did not seem to respond as expected to their control inputs and shuddered and jolted repeatedly.

The flight crew became concerned that the aircraft was malfunctioning and that the ECAM was only sometimes visible and did not identify the root cause of the problem. Moreover, they were not aware of any procedure applicable to the symptoms experienced. The commander contemplated transmitting a MAYDAY, but considered that his priorities were to retain control of the aircraft and identify the problem.

After several minutes, the commander saw the ECAM 'GEN 1 FAULT' message and associated checklist, which required the No 1 generator to be selected to OFF. On doing so the juddering motion ceased, the chattering noise stopped, and all displays reverted to normal operation, although the aircraft's left-wing-low attitude persisted. The checklist directed that the generator should be selected ON again, and following discussion and agreement that it would be immediately deselected should the problems return, the commander selected it to ON. This caused the symptoms to return, prompting him to select the generator to OFF again.

The APU³ was started and its generator was selected to power the systems previously powered by the No 1 generator. Shortly thereafter, the flight crew noticed that the rudder trim display indicated several units from neutral, although they had not made any rudder trim inputs. When the rudder trim was reset to neutral, the aircraft readopted a wings-level attitude. The aircraft had deviated approximately 20 nm to the left of the intended track during the incident.

Footnote

³ Auxiliary Power Unit

The aircraft was flown manually for the remainder of the flight and landed at Beirut without further incident.

Engineering investigation

An investigation into the cause of the technical problem has been initiated, with the objectives of establishing:

- The source of the failure in the electrical system
- Why both the captain's and co-pilot's electronic instrument displays were affected
- The effects of electrical power interruptions on the flight control system

The aircraft manufacturer has indicated that a reset of the Flight Augmentation Computer (FAC), caused by an electrical power interruption, may cause a small incremental offset in the rudder trim. Multiple electrical power interruptions can result in multiple increments which could, cumulatively, produce a significant rudder trim input.

Flight recorders

Due to the late notification of the event to the AAIB, both the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR) data for the incident were overwritten. Flight data was obtained from the operator's Flight Data Monitoring (FDM) programme, which recorded a similar set of parameters to the FDR.

An initial review of the data has confirmed some of the crew reports, including the unusual behaviour of the aircraft in yaw. A detailed review of the aircraft performance data is underway with the aircraft manufacturer to gain a better understanding of the flight control behaviour.

Discussion

The symptoms experienced during the incident are believed to be attributable to an electrical power generation system fault. The incident appeared to have posed a number of challenges for the flight crew, in that they were presented with numerous and significant symptoms, including malfunctioning electronic displays and uncommanded rudder trim input, the cause of which was not evident. The ECAM did not clearly announce the root cause of the malfunction and no information or procedures were available to assist the flight crew in effectively diagnosing the problem.

The following Safety Recommendation is therefore made:

Safety Recommendation 2010-092

It is recommended that Airbus alert all operators of A320-series aircraft of the possibility that an electrical power generation system fault may not be clearly announced on the ECAM, and may lead to uncommanded rudder trim operation.

Safety Action

Airbus intends to notify A320-series aircraft operators of this incident and associated ongoing actions.

Progress

The AAIB is continuing to investigate this incident with the co-operation of the manufacturer, the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile and the operator. A final report will be published when the investigation is complete.