INCIDENT

Aircraft Type and Registration:	BAe 146-300, G-OINV
No & Type of Engines:	4 Lycoming ALF502R-5 turbofan engines
Year of Manufacture:	1990
Date & Time (UTC):	8 November 2006 at 2100 hrs
Location:	Descent into Inverness
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 71
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	10,566 hours (of which 4,800 were on type) Last 90 days - 153 hours Last 28 days - 50 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and analysis by the aircraft manufacturer

Synopsis

During the descent into Inverness the APU was started and subsequently there was a loss of electrical power to all the Primary Flying Displays, Navigation Displays, and cockpit lighting with no warnings being shown. The commander managed to regain electrical power about 15 seconds later. The subsequent investigation, which involved the manufacturer, was inconclusive.

History of the flight

The aircraft was inbound to Inverness from London Gatwick at FL70 and was above cloud. The APU was started as part of the approach checks when, approximately five seconds into the APU start procedure, there was a loss of electrical power to all the Primary Flying Displays, Navigation Displays, and cockpit lighting, with no warnings being shown. A 'MAYDAY' call was made to Inverness to report the loss of electrics, and the reply from ATC was heard by both pilots. The aircraft was maintained above cloud in Visual Meteorological Conditions.

The commander then 'worked backwards' and switched the APU off. Generator 1 (GEN 1) and Generator 4 (GEN 4) were then reset and electrical power to all the flight deck displays returned to normal. The cabin crew confirmed that the cabin lighting had remained illuminated but that galley power had been temporarily lost. It was estimated that the electrical power was lost

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for around 15 seconds. The approach to Inverness was continued and, once the aircraft was established on the ILS and the airfield was in sight, the 'MAYDAY' was cancelled. After landing a Ground Power Unit (GPU) was requested and there was no attempt to start the APU. At no stage were any circuit breakers found to be tripped.

Aircraft information

The BAe 146 has three electrical generators; GEN 1 and GEN 4 are mounted on engine No 1 and engine No 4, and these supply the AC1 and AC2 busbars respectively. There is also a generator on the APU (APU GEN). The two AC busbars can be linked by two bus tie contactors, and there are also contactors which can link the APU GEN to the AC1 and AC2 busbars. The captain's displays are supplied from busbars fed from GEN 1, and the co-pilot's displays are supplied from busbars fed from GEN 2.

Each of the three generators has a Generator Control Unit (GCU), which is designed to lock out if a fault is detected. There is also a daily check carried out by the flight crew to ensure that a dormant lock-out has not already occurred.

Subsequent maintenance activity

On the ground, the only fault which could be identified was a possible problem on the ground service bus, and hence the operator replaced the No 1 bus tie contactor. This contactor allows the APU, the GPU or GEN 4 to supply power to the AC1 busbar. This did not rectify the fault. Attention was therefore focussed on the No 1 GCU as potentially being the cause of the failure, and this was replaced. This resulted in the fault being cleared and the aircraft was returned to service, from which time it has continued to operate without any recurrence.

Both the contactor and the GCU were sent for a strip inspection. No fault was found with the GCU. The contacts in the contactor were found to be worn to varying levels, and there was an out-of-limit voltage drop across all three sets of contacts. However, there was no evidence of the contacts melting or fusing. Tests were also carried out under hot and cold conditions in an attempt to find an intermittent fault, but no such fault was found.

Bus bar faults - Service Information Leaflet (SIL) 24/47

The aircraft manufacturer has issued SIL 24/47 to assist operators in troubleshooting AC1 and AC2 busbar faults. In SIL 24/47 it is noted that typical causes are an open phase in the contactor or wiring chafes in the generator circuit (from the engine to the electrical bay).

Previous incident

On 18 August 2006 this aircraft suffered a failure of the No 1 Generator at FL240, and this resulted in the AC1 busbar tripping off-line and hence the loss of the captain's displays. An air turnback was made and the fault was attributed to the No 1 GCU, which was replaced.

Subsequent analysis

The AAIB and the manufacturer undertook an analysis of the electrical system and this included comparison of the reported events with the electrical wiring diagrams. The most likely explanation for the incident is that GEN 1 dropped off-line, in part because of the current supplied for the APU start. Either coincidentally or beforehand, the bus fail relay on GCU 1 locked out the bus transfer. It is believed that, prior to the recovery actions, the Battery, Emergency DC and AC2 busbars were all powered; however Essential DC, DC1, DC2,

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the warning lights bus bar and AC1 busbars were all unpowered.

Safety actions

In view of the inconclusive outcome of the investigation, the manufacturer has recommended that the operator carries out a series of more detailed tests on the system including the requirements of SIL 24/47. These are scheduled for the aircraft's next deep maintenance check.

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