SERIOUS INCIDENT

Aircraft Type and Registration:	Jetstream 4100, G-MAJA
No & Type of Engines:	2 Garrett Airesearch TPE331-14GR-807H turboprop engines
Year of Manufacture:	1994 (Serial no: 41032)
Date & Time (UTC):	18 July 2012 at 0835 hrs
Location:	In the cruise, 80 nm north of Newcastle
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 12
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	29 years
Commander's Flying Experience:	2,600 hours (of which 158 were on type) Last 90 days – 158 hours Last 28 days - 50 hours
Information Source:	AAIB Field Investigation

Synopsis

The flight crew experienced a period of EFIS screen blanking whilst passing through an area of electrostatic activity.

History of the flight

The aircraft was on a scheduled flight from Southampton International Airport to Aberdeen International Airport. The co-pilot was the pilot flying.

The flight was uneventful and flown clear of cloud for the first hour. The aircraft then entered cloud and an area of airframe icing, with some 'light chop' and an increase in icing. About 20 mins later, in the cruise at FL220 about 80 nm north of Newcastle, the commander's Attitude Direction Indicator (ADI) on the Electronic Flight Instrument System (EFIS) went blank and the autopilot (A/P) disconnected. The commander re-engaged the A/P and actioned the '*Symbol Generator Failure'* checklist from the QRH; this requires the selection of one of the two symbol generators. This had no effect so the commander changed the symbol generator reversion switch (SG REV) to the other symbol generator, still with no effect.

About 2 minutes after initial failure, the three remaining EFIS screens went blank. The commander took control and flew the aircraft with reference to the aircraft's main altimeter and standby instruments, situated left

Figure 1
G-MAJA cockpit

of centre on the main instrument panel (Figure 1). The co-pilot declared a PAN to ATC. After discovering that the current weather to the north was unfavourable for their situation, the crew elected to divert to Newcastle International Airport.

As ATC vectored the aircraft towards Newcastle the crew noticed that the standby compass appeared to be stuck and, as a result, they requested ATC to initiate, and then stop, any turns that were required. They then descended to 3,000 ft amsl, becoming visual with the sea and coastline. At about 39 nm from Newcastle, following the resetting of the avionic master switches, the EFIS screens turned blue and faded into the compass rose, and the speed tape appeared on the ADI.

Having remained clear of cloud over the sea the crew became visual with Newcastle and flew an uneventful visual approach and landing onto Runway 25.

During the flight the windscreen heaters were on at all times.

Weather information

An aftercast for the area where the incident happened was obtained from the Met Office. In summary it stated that the weather was driven by low pressure over Scotland and a very active frontal system, giving persistent, and at times heavy rain over much of the area. Satellite and radar imagery both suggested the presence of embedded convection. There was also evidence of medium-level instability, as described by the crew.

The Met Office commented that the medium-level instability could have led to high-based cumulonimbus forming in the area. Lightning had not been recorded over the area of interest but the system is optimised for detecting cloud-to-ground lightning and often misses cloud-to-cloud discharges. Given that the instability leading to convection was not surface-based, but probably based at about 10,000 ft, this would increase the chances of any lightning being a cloud-to-cloud discharge.

Aircraft information

This aircraft was equipped with electronic ADI and HSI as well as a standby attitude indicator, altimeter and ASI.

In 1993 Jetstream Aircraft Ltd (later BAe Regional Aircraft) published Service Bulletin J41-30-007 which called for the installation of electrostatic transient absorbers ('transzorbs') in the windscreen heat circuits to prevent EFIS screen blanking due to static charge accumulation on the windscreens. G-MAJA was modified to comply with the requirements of this Service Bulletin and the operator applied an operational life of 6,000 flying hours to the transzorbs, after which they are removed and replaced. The units fitted to G-MAJA had been installed for 3,921 flying hours.

Transzorbs are designed to 'fail' (short-circuit temporarily) when exposed to an abnormally high voltage. Failure of a transzorb with residual resistance will normally affect the function of the windscreen heat system, and thus provide an indication of the failure, and may not affect the ability of the transzorb to protect the avionics equipment from high-voltage static charge on the windscreen.

Operator's and manufacturer's comments

The operator commented that after this failure the Flight Management Computer and RMIs should have been available, giving NDB and VHF Nav information. The Standby Attitude Indicator would have provided ILS information. Stand-alone DME repeaters would provide DME information. Both radio management units should also have been available to tune the navigation frequencies required. The aircraft manufacturer commented that the RMIs should also have provided heading information.

Recorded data

The aircraft was fitted with a solid-state Flight Data Recorder (FDR) and a 30-minute CVR. The FDR recorded just over 51 hours of operation and the CVR captured the approach and landing at Newcastle. Although limited by the absence of EFIS parameters, the flight recorder data was consistent with the information provided by the flight crew.

Technical examination

The aircraft was inspected by the AAIB at Newcastle airport on the day after the incident and no evidence of a lightning strike was identified. Examination of the flight compartment maintenance panel showed that no failure indicators had been activated.

A test of the EFIS system confirmed that it functioned normally. The aircraft manufacturer provided detailed information to allow the windscreen anti-ice system transzorbs to be tested to determine if they had failed with residual resistance. Due to a lack of suitable test equipment, it was not possible to carry out this test on the aircraft and the transzorbs were removed for further testing. After replacement of the transzorbs, a function test of the windscreen anti-ice system confirmed that it operated normally. The aircraft was subsequently returned to service and no further defects regarding the EFIS system were reported.

Laboratory testing confirmed that the left inboard windscreen anti-ice transzorbs had failed, but retained residual resistance. This failure mode would not have been detected by the windscreen anti-ice controller.

Analysis

Failure of the any of the transzorbs in the windscreen anti-ice system would have resulted in an increased possibility for EFIS screen blanking when the aircraft

operated in areas of high electrostatic activity. The aircraft systems would normally detect the normal transzorb 'open circuit' failure mode but tests confirmed that, in G-MAJA, the left inboard windscreen transzorbs had failed with residual resistance, rendering the failure dormant and undetectable.

The transzorbs fitted to G-MAJA had achieved approximately 65% of their operational life. However, given the undetectable nature of the failure mode they could have failed a considerable time before the incident flight. Currently there is no method for the detection of failures of this nature during routine maintenance, hence the operator's life restriction of 6,000 flying hours.

During the incident the standby instrumentation continued to function normally and after leaving the area of electrostatic activity, both pilots' EFIS screens returned to normal operation.

Conclusion

When flying through an area of electrostatic activity both flight crews' EFIS screens failed, probably due to a failure of the left inboard windscreen transzorbs. The failure mode of the transzorbs rendered their failure undetectable to the windscreen anti-ice controller.

The aircraft's standby instrumentation, and main altimeter, continued to operate throughout the incident and the aircraft's EFIS screens began to operate normally a short time after leaving the area of electrostatic activity. The aircraft's safety was not, therefore, compromised.