

SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JECJ	
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines	
Year of Manufacture:	2005 (Serial no: 4110)	
Date & Time (UTC):	23 October 2013 at 0540 hrs	
Location:	Manchester Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 4	Passengers - 20
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	51 years	
Commander's Flying Experience:	4,360 hours (of which 1,145 were on type) Last 90 days - 162 hours Last 28 days - 58 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries by the AAIB	

Synopsis

Whilst enroute, the crew experienced a number of cautions and warnings on the Central warning Panel (CWP). The number of these increased, and cabin and cockpit lights also started to fail. The aircraft diverted to Manchester, where an uneventful landing was made. It is suspected that there had been a failure of the right starter/generator or its Generator Control Unit (GCU) and that a further latent failure of a contactor had prevented automatic connection of the right DC bus to the left DC bus. The services normally powered by the right DC bus would now be powered by the main aircraft battery, which would progressively discharge.

History of the flight

During a flight from Edinburgh to Brussels at FL250, the crew received a PUSHER SYSTEM FAIL caution on the CWP. The commander and co-pilot reviewed the Quick Reference Handbook (QRH) and actioned the appropriate checklist. They disengaged the autopilot and agreed that they should continue to Brussels. A few minutes later, they received a call from the senior cabin crew member asking "Is everything all right in there?" since the cabin ceiling lights were going out progressively, starting from the front; eventually all these lights extinguished.

The commander replied that they had a technical problem but were continuing on route. The crew then received ELEVATOR FEEL and PITCH TRIM cautions on the CWP and decided to consult

the electrical section of the QRH. They brought up the electrical page on the Engine Display (ED) to review the status but, before any meaningful analysis could take place, the Co-pilot's Multi Function Display (MFD) failed and they received two further cautions on the CWP. Before any action could be taken, the Co-pilot's Primary Flight Display also failed.

Positive control was handed to the commander as TCAS and Yaw Damper failure messages were displayed. The co-pilot reviewed the QRH and noticed that, on the ED, the No 2 generator showed zero load. The cockpit lights then failed as well as the No 2 Audio Radio Control Display Unit (ARCDU) and, later, the emergency torch the crew were using. They agreed to divert to Manchester, broadcast a PAN call and were advised by ATC that they were about 60 miles from Manchester. There were several more cautions as the co-pilot switched the VOR display to the commander's side. On passing FL200, the Flight Director failed.

The co-pilot had to make several attempts to conduct the NITS (Nature, Intention, Time, Special instructions) briefing with the cabin crew as more cautions were appearing. He then addressed the passengers and explained that they would be diverting to Manchester due to electrical problems. During the approach, the flight crew had sufficient time to discuss the normal approach procedures as well as preparing for possible system malfunctions such as braking and anti-skid. The aircraft was configured for landing early in the approach to ensure landing gear and flaps were operational, since hydraulic system 2 was indicating zero contents. However, these systems worked normally and an uneventful landing was performed on Runway 23R, during which braking action was normal. The crew were unable to change from Tower frequency to the Fire Service frequency as requested by ATC, due to the failure of ARCDU 2 and a 'Follow Me' vehicle was used to guide the aircraft onto a remote stand. Since the hydraulic system 2 contents indication had recovered to 75%, the crew considered it was safe to taxi however during the taxi, the sidewall cabin lights failed and, upon arrival at the stand, the Auxiliary Power Unit (APU) would not start.

The crew recalled some 25 cautions and failures during the event.

Investigation

The Dash-8 400 has three 28v DC starter/generators associated with the left (No 1) and right (No 2) engines and the APU. In addition, the AC generation system can supply the left and right DC busses through Transformer Rectifier units. The system is designed to reconfigure automatically to cater for individual power source and bus malfunctions, by the automatic closing and opening of bus tie contactors (Figure 1)

Initial analysis of the available data (flight recorder and crew accounts) by the aircraft manufacturer suggested that there had been a malfunction of either the No 2 starter/generator, which powers the right main DC bus, or its GCU. In this condition contactor K2, which connects the No 2 generator to the right main DC bus, should open. Auxiliary contacts within K2 send a signal that this has happened to the Electrical Power Control Unit (EPCU), which closes contactor K21 and ties the right DC bus to the left, thus maintaining services supplied by the right bus. The auxiliary contacts also send a signal to the CWP to display a NO 2 DC GEN caution. It was considered likely that the auxiliary contacts within K2

had remained open either through severe pitting or interference by a foreign object. In this case there would be no indications to the EPCU or the flight crew that there was a problem, the bus tie contactor would remain open and the right bus would draw its power from the main battery, progressively losing services as the battery discharged. The series of failures reported by the crew was consistent with such an event.

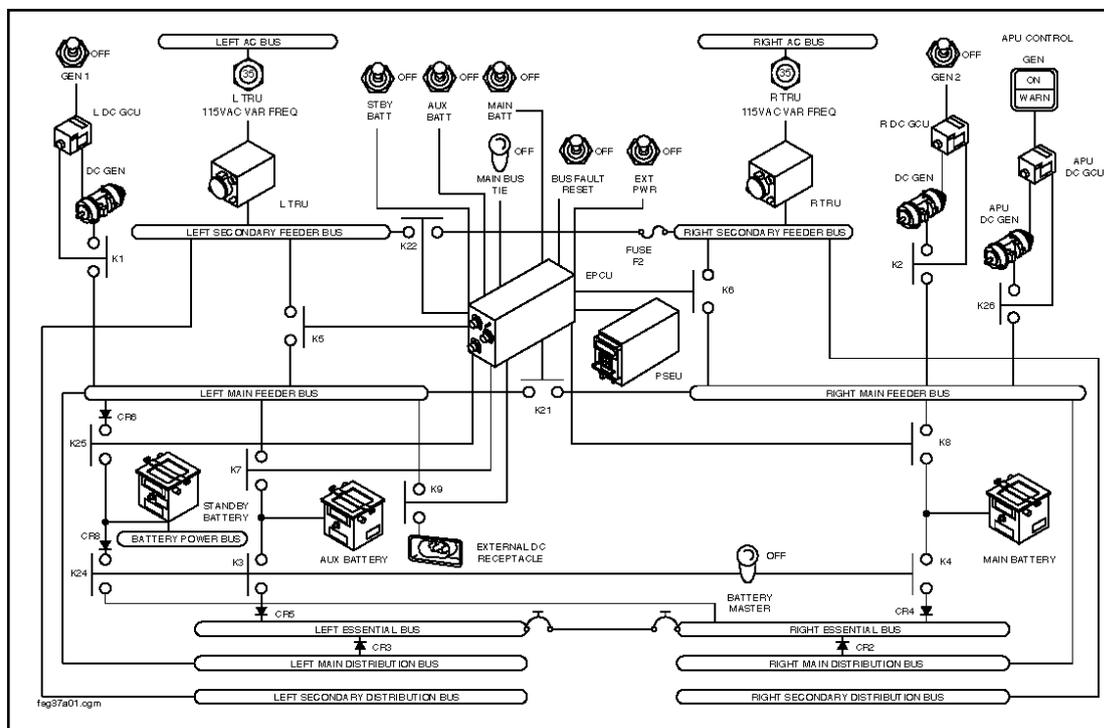


Figure 1

Dash-8 Q 400 DC generation schematic

The operator inspected the K2 contactor and found severe pitting on the auxiliary contacts and, as the manufacturer suggested, forwarded the unit, together with the starter/generator and GCU, to them for examination. At the time of preparation of this Bulletin, the manufacturer was continuing with their examination of the components and any significant findings will be reported in a later bulletin.