SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402, Dash 8, G-FLBB
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2009 (Serial no: 4255)
Date & Time (UTC):	8 December 2016 at 0718 hrs
Location:	En route from Manchester to Jersey, overhead Dudley
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 23
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:	5,600 hours (of which 375 were on type) Last 90 days - 234 hours Last 28 days - 82 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries made by the AAIB

Synopsis

The aircraft was on a scheduled flight from Manchester to Jersey, in the cruise at FL250, when there was a loss in cabin pressure with an associated warning. The crew donned oxygen masks and carried out an emergency descent to FL100. The crew obtained ATC clearance to continue the flight to Jersey at FL100 and informed the passengers about the pressurisation problem and their intentions. The remainder of the flight was uneventful and the aircraft landed in Jersey. The loss of pressurisation was caused by a faulty outflow valve, which was replaced and the aircraft returned to service.

History of the flight

The aircraft departed at 0705 hrs on a scheduled flight from Manchester (EGCC) to Jersey (EGJJ) with four crew and 23 passengers. The aircraft had climbed to FL250 and was on autopilot. Then, approximately two minutes into the cruise, there was a loss in cabin pressurisation indicated by a master warning with associated triple chime alert. The co-pilot noted the warning and immediately called for oxygen and donned his oxygen mask. The commander handed control to the co-pilot, directed him to initiate a descent and inform ATC. The co-pilot started the descent using the autopilot and then disengaged the autopilot to manually fly a descent at 3,500 fpm. By this time the commander had donned his oxygen mask and re-took control, reengaged the autopilot and declared a

MAYDAY. The aircraft was stabilised at FL100. Satisfied there were no structural issues with the aircraft, the commander cancelled the MAYDAY and obtained clearance from ATC to continue to Jersey maintaining FL100. Whilst the crew were dealing with the situation the commander was having difficulties with his oxygen mask microphone so swapped masks. The crew completed the quick reference handbook (QRH) actions and removed their oxygen masks. They then informed and reassured the passengers about the situation over the PA. The flight continued at FL100 and landed at Jersey without further incident. A normal disembarkation was carried out and there were no injuries to the passengers or crew.

Recorded information

The aircraft was fitted with an FDR and CVR. The FDR captured the whole flight, including the climb to FL250 and the master warning. The cabin altitude warning remained illuminated for 7 minutes and 48 seconds and extinguished when FL100 was reached. The FDR showed that no other systems were affected. The CVR did not capture the event as it was not secured until about 1 hour and 40 mins after landing, thus overwriting the event.

Operator's Procedures

Part A of the operator's Operational Manual stated:

> ***'11.4.1 Preservation of FDR Data and CVR Recordings***
>
> *(a) Following an accident or serious incident involving a Flybe aircraft, the Commander or in his absence the First Officer shall ensure, to the extent possible, the preservation of all related flight recorder records and, if necessary, the associated flight recorders…*
>
> *(c) When appropriate, the relevant circuit breakers should be pulled and collared/ tagged and an entry made in the aircraft technical log…'*

This is also printed on the back of the QRH.

The commander commented that after shutdown he was "busy on the phone and did not consider it [securing the recorders]". He was later told by 'Maintrol' that the operators third-party maintenance company in Jersey had pulled the CVR circuit breaker.

Additionally, the operator's Maintenance Operations procedures stated:

> *'4.1 Whenever an incident is reported…the flight data recorder must be considered for removal and download in order to preserve or rapidly assess vital and important aircraft systems information. …*
>
> *4.2 On receipt of information advising of an incident, the Duty Maintenance Control Engineer will assess the incident type and arrange for the FDR, CVR and QAR preservation, removal or download.*

4.3 In an AAIB involved event, the aircraft, FDR and CVR should be isolated and quarantined, and not released to service until authorised by the duty Flight Safety representative.'

The operator commented that it was aware the procedure was not followed and this "has been highlighted as an error" in this incident.

Aircraft information

The Bombardier (De Havilland Canada) DHC-8-402 is an all-metal high-wing monoplane designed for medium range regional passenger flights. It has the capacity for 78 passengers, a range of approximately 1,100 nautical miles and a service ceiling of 25,000 feet.

Pressurisation and oxygen system

The aircraft cabin is pressurised by engine bleed air supplied to and distributed by the air-conditioning system. It is controlled by the cabin pressure control system modifying the rate of outflow from the cabin via a valve located on the aft pressure bulkhead, assisted by a safety valve in the same area. An additional controllable safety valve is fitted on the forward pressure bulkhead. For normal flight the outflow valve controller is set to AUTO and the cabin pressure is automatically maintained in a preprogramed pressurisation schedule by the outflow valve. Cabin altitude, differential pressure and rate of change of cabin altitude are indicated to the crew by analogue gauges. There is also a warning light which illuminates when the cabin pressure altitude is too high.

There is a fixed integral emergency oxygen supply for the flight crew in the cockpit. Oxygen is stored in a pressurised cylinder within the nose section of the aircraft and delivered via a regulator to three face masks stowed in holders on the cockpit rear bulkhead. Portable oxygen supplies are carried in the cabin for passenger use if required for depressurisation events where an immediate descent is not possible, or in the case of a medical emergency.

Aircraft examination

The aircraft was flown back to Manchester, unpressurised, for a system fault diagnosis which found the outflow valve to have been the cause of the depressurisation. The faulty outflow valve was replaced and the aircraft returned to service.

Component history

The operator's engineering team researched the history of the faulty outflow valve, serial number 00369, and found that it was originally fitted to G-ECOT at build. It was removed from G-ECOT in April 2015 as part of a pressurisation system fault diagnosis, where no specific faulty component could be identified, but the fault was eventually resolved after multiple component replacements. The same outflow valve was fitted to G-KKEV in September 2015. Whilst fitted to G-KKEV, during a climb at FL200, the crew experienced a sudden cabin altitude rate increase with a momentary fault light which appeared to

cure itself without intervention. This was a repeat of a similar occurrence three days before and after diagnosis the outflow valve was replaced. It was then fitted to G-FLBB on 7 December 2016 to cure a problem described as '*pressurisation erratic in descent*'. This work was carried out the day before the loss of cabin pressure en route to Jersey. The valve has now been removed from service and quarantined and is the subject of a reliability investigation being carried out by the spares provider and the original equipment manufacturer (OEM).

Cockpit crew actions and observations

The co-pilot was quick to react, understand the situation and take appropriate action. Concurrently the commander was completing a Technical Log entry and at this point the electronic flight bag (EFB) and its mounting fell off the windscreen. The commander saw the co-pilot was ahead of him in donning his oxygen mask and so instructed him to take control and carry out the emergency descent vital action drills, in accordance with the QRH. The commander discarded the Technical Log and moved the EFB out of the way before donning his oxygen mask. Although all of these actions only took a few seconds, both crew describe feeling slightly lightheaded. In the commander's own analysis, after the event, he realised that he was having difficulty completing the Technical Log, which was a relatively simple task and therefore considered that he was already slightly hypoxic when the pressurisation warning occurred. He also believes that this affected his performance and slowed his initial reactions to the situation.

Initially the descent was on the autopilot but the co-pilot felt the rate of descent was too low and disengaged the autopilot and manually increased the rate of descent from 2,000 fpm to 3,500 fpm. With hindsight the co-pilot felt that he should not have deselected the autopilot during the emergency descent. The EFB falling from the windscreen and the oxygen mask microphone difficulties added to the already heightened workload. With hindsight the commander considered all of this to have influenced the remainder of the flight and the final approach into Jersey which was "not up to the usual standard". After landing the crew realised the significant effects that hypoxia had had on their performance.

Cabin crew actions

During the event the senior cabin crew (SCC) member and cabin attendant felt the aircraft suddenly adopt a descent profile and saw the seat belt signs illuminate. Although they noticed their "ears popping" they did not associate this with a depressurisation and did not experience symptoms of hypoxia. Initially they were unable to contact the cockpit crew but realised there was a problem and secured the cabin anyway. The cabin crew were unaware of the difficulties the commander was having with his microphone in the early stages of the incident. Communication was eventually established as the aircraft descended through FL150. The cabin crew actions were taken without knowledge of the problem but good crew resource management (CRM) and training meant that cabin and passenger safety was maintained.

Technical Log

The commander had noted the Technical Log entry regarding the pressurisation problem on 7 December 2016. The SCC member was also aware of the problem on this aircraft as she had flown in it over the previous two days. With hindsight the commander felt that had time allowed he would have liked to brief his crew on the potential outcomes in the light of the Technical Log entries.

Conclusions

Technical cause

The cause of the pressurisation problem was the outflow valve, serial number 00369, which the evidence suggests had a history of being causal or contributory to pressurisation problems in other aircraft. It also appears that the problem did not manifest itself during post installation functional checks as, shown by its fitment to G-KKEV and G-FLBB. In this situation it is sometimes difficult for engineering staff to reject an item which, when subjected to normal checks detailed in the AMM, meets the requirements for release to service.

Effect on the commander and co-pilot

It is probable that the loss of pressurisation was gradual but maintained just within system limits during the climb to FL250. When the aircraft was established in the cruise at FL250 the cabin pressure altitude continued to climb over a period of two minutes until the warning level was reached. Although by no means debilitating in this case, it shows how quickly the flight deck crew appeared to suffer the early signs of hypoxia.

AAIB observation

The 'coincidental' detachment of the EFB with its holder from the windscreen was probably as a result of the ambient pressure surrounding the 'sucker' pad reducing its ability to support the weight of the EFB. Although in this case it had no bearing on the incident, it has the potential to create an additional alarming or stress raising feature during high workload situations. There is also the possibility that the EFB could fall into the rudder pedal area with the potential to cause a control restriction. However, the operator is introducing a lighter version of the tablet device on which the EFB is run, so that the risk of it detaching is reduced.

Safety actions

The operator has expressed concerns over the reliability of the outflow valve and has initiated a reliability investigation involving the spare part provider and the OEM. At the time of writing the results of the reliability investigation are not known.