DHC-8-311, G-BRYO

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Aircraft Type and Registration:	DHC-8-311, G-BRYO
No & Type of Engines:	2 Pratt & Whitney PW-123 turboprop engines
Year of Manufacture:	1991
Date & Time (UTC):	1845 hrs on 1 March 2001
Location:	Plymouth Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - 5 - Passengers - 30
Injuries:	Crew - None - Passengers - None reported
Nature of Damage:	Skin damage and minor internal frame damage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	14,028 hours of which 541 hours were on type)
	Last 90 days 149 hours
	Last 28 days - 60 hours
Information Source:	AAIB Field Investigation

History of flight

The crew were on the fourth sector of a seven sector day and were operating from Newquay (St Mawgan) to Plymouth. The first officer was undergoing line training and had done all the previous landings during that period of duty. Within the cockpit, on the 'jump seat', was another first officer who was shadowing the operating first officer during the early conversion as required by the company procedures. The weather was good with the Plymouth 1850 hrs METAR recorded as follows: Surface wind 030°/02 kt; visibility greater than 10 km; cloud FEW at 3,000 feet amsl; QNH 1001 hPa.

The first officer was the designated pilot flying in the right seat and completed an uneventful departure from Newquay. Cruise was at 2,500 feet amsl for the short flight to Plymouth and the pilot flying joined the Plymouth circuit left downwind at 1,400 amsl for Runway 31. However, as he turned onto the base leg, he lost sight of the runway and the commander formally assumed the handling duties. Towards the end of the base leg, the first officer visually re-acquired the runway and re-assumed the handling duties. At the time, the aircraft was at the correct airspeed and fully configured, with flap 15, on the 3.5° ILS glideslope. Shortly afterwards, the 'jump seat' pilot saw that the Precision Approach Path Indicators (PAPIs) displayed 'Three whites and one red', indicating that the aircraft was above the glideslope. The commander called that the aircraft was high and the first officer adjusted the profile back to the glideslope. However, shortly afterwards the aircraft again went above the glideslope and the first officer again corrected the profile. All three pilots recalled that the airspeed on initial approach remained constant at approximately 120 kt; Vref had been calculated as 103 kt. Then, as the aircraft approached the threshold, the commander called twice for the first officer to "flatten the approach". The first officer flared the aircraft and touched down at the normal point. The landing was firm and shortly afterwards, the commander saw the red 'Touched Runway' warning caption on the CAUTION/WARNING LIGHTS panel. He asked the 'jump seat' pilot if she had seen the white 'LDG ATT 6 DEGREE' light illuminate on the ID802 Advisory Display Unit; she replied that she had seen a light illuminate momentarily in that location. The commander took control and taxied to the parking stand where damage to the underside of the rear fuselage was confirmed.

Airfield information

Plymouth Airport was designated as a Category 'B' airfield by the company in their operations manual. This indicates that there are some unusual characteristics and requires the pilot to be pre-briefed before operating into Plymouth. Before a first officer may operate as handling pilot with a line captain, he or she must have completed a satisfactory landing with a training captain; additionally, there are weather limitations on when first officers can land at Plymouth. In the situation involving G-BRYO, the commander was qualified to operate into Plymouth and the weather was good. The first officer was permitted to complete the landing as the commander was a training captain.

Runway 31 has a landing distance of 1,055 metres from the threshold and 905 metres from the glideslope; the runway width is 30 metres and there is a 0.95% upslope. The PAPIs were set at 3.5°. All the approach and runway lights were serviceable and were on at the time of the incident.

Operational information

Company requirements are for both pilots to select the red IAS 'bug' to Vref; this was correctly calculated for the flight conditions and set to 103 kt. The white IAS 'bug' should be set to Vref for

Flap 0°; this was correctly set to 126 kt. Threshold airspeed (Vat) at screen height should be Vref plus half the gust factor up to a maximum of Vref plus 10 kt. Company procedures are for the pilot to maintain 120 kt until decision height and then reduce airspeed to achieve Vat at screen height. However, if the first officer is handling, the minimum speed is Vref plus 5 kt. In the incident involving G-BRYO, none of the pilots in the cockpit considered that the airspeed had been below red 'bug' prior to flare.

The 'Touched Runway' and warning caption lights flash red to indicate that the 'rear outer fuselage surface below pressure bulkhead has touched the runway during landing or takeoff'. When the master caution light is pressed, the system is reset and the 'Touched Runway' light becomes steady. The white 'LDG ATT 6 DEGREE' is only illuminated whenever the aircraft attitude on the ground is at 6° or greater.

The Flight Manual contains the following two 'cautions' with respect to attitude management during take-off and landing:

1. Take-off (section 4.2.2): 'Nose-up pitch attitudes greater than 9° prior to lift-off may cause the tail to contact the runway.'

2. Landing (section 4.4.1): 'Pitch attitudes greater than 6° in the landing flare may cause the fuselage to contact the runway.'

The manufacturer provided the following information regarding the precise attitudes at which the fuselage would contact the runway assuming a rigid body (assuming no wing or fuselage flexing which could decrease the angles):

1. 'For the strut fully extended with the tyres just touching the ground (no tyre compression), the pitch attitude to hit the fuselage contact switch is 12.25°.'

2. 'For the strut and tyre fully compressed (strut stroke equal to 12.5 in and tyre compression equal to 6 in), the pitch attitude to hit the fuselage contact switch is 7.13°.'

Prior to this incident, there had been 8 other rear fuselage landing strike events reported on all series DHC-8 (series 100, 300 and 400).

Crew information

The first officer had joined the company in November 2000 and completed his simulator training in January 2001. His base training was completed on 12 February and he commenced his line training on 20 February. The incident occurred on his 19th line sector. He had 200 hours total flying with 23 hours on type.

The commander and first officer had operated together for two consecutive days and the first officer had been debriefed on his performance. On the day of the incident, the first two landings were in daylight and the third was at night into Newquay; this last landing, using Flap 35, was assessed by the commander as satisfactory.

Aircraft damage

Damage to the aircraft extended over an area of 24 inches wide by 49 inches long on. The frangible switch for the 'Touched Runway' caption and its associated fairing were also damaged. Additionally, there was some minor internal damage to the skin flanges of frame X642. Personnel from the airframe manufacturer completed the repair.

DFDR information

No data from the accident flight was recorded on the FDR. The 50 hour duration recording contained long periods during which only the internal frame counter was recorded. As neither time nor date information was part of the recorded data frame, it was not possible to determine when the recorder was last operational. Information from the aircraft manufacturer and from the flight data acquisition unit (FDAU) manufacturer indicated that the most likely cause of the absence of recorded data on the FDR was a failure of the analogue to digital converter circuits within the FDAU. Such a failure would not have caused the FDR 'fault' light in the cockpit to illuminate. The operator changed the FDAU and subsequently confirmed the integrity of the recorded data.

The CVR was clear, confirmed the recollections of the crew, and indicated that they were operating in accordance with company procedures. Throughout the flight, the commander gave appropriate advice and guidance to the first officer. On finals, the first officer re-assumed handling duties with the aircraft fully configured and on the runway glideslope and centre-line. Shortly after, the commander advised the first officer that he was high on the glideslope and instructed him to keep the aircraft "going down"; this message was then repeated with the added information that the aircraft was going into the 'Whites'. Then, prior to touchdown, the commander instructed the first officer to "flatten it out". There was no evidence from the CVR of a hard landing.

Discussion

The aircraft was fully serviceable apart from a fault with the DFDR, which precluded any useful information being available. Nevertheless, crew recollection was consistent and, together with the CVR, enabled a reasonable reconstruction to be made of the flight. The weather was good and the commander was entitled to allow the first officer to carry out the landing. The crew were on their second flying day together and the commander had observed the first officer handling the aircraft and had debriefed him on his performance. After a landing at Plymouth in daylight the previous day, the commander had debriefed the first officer that he had not flared enough and that he had not corrected the drift before touchdown. At the time, he had also advised the first officer that the upslope on the Runway 31 threshold required the use of a little more pitch change than normal on landing and emphasised the importance of landing at the right position.

It would be understandable for the first officer with his limited experience to be somewhat wary of landing at Plymouth, a Category 'B' airfield. His apprehension may have been heightened by the commander's understandable and reasonable debriefing following the previous landing at Plymouth. Then, during the circuit the first officer lost sight of the runway and the commander took the handling duties for the turn from downwind and for the base leg. Having briefed the first officer for the landing, the commander was keen for him to re-assume handling duties when he became visual with the runway. This occurred with the aircraft lined up on 'finals' and fully established. However, the aircraft soon diverted from the glideslope, recovered and diverted again. Subsequent discussions with the crew indicated that it was possible that the first officer's attention was concentrated on the glide slope and that the power levers were retarded during the attempts to

increase the rate of descent but were not advanced when back on the glide slope. This was indicative that the first officer was not really settled and a better option would have been for the commander to re-assume the handling duties for the landing. Nevertheless, although the landing was firm neither the commander nor the jump seat pilot considered that it was abnormal and both were surprised when the 'Touched Runway' caption illuminated.

Although this incident could be considered as a 'training incident', experience with the DHC-8-300 indicates that landing attitudes are critical. These aspects are covered during conversion and there are 'cautions' in the Flight Manual. Nevertheless, the manufacturer and the national authority have agreed that a training video will be produced to address the reasons for, and ways to avoid, fuselage strikes. In the light of this action, no recommendation is considered necessary.