SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-ECOJ
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2008
Date & Time (UTC):	9 January 2017 at 1959 hrs
Location:	Newcastle Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 56
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Damage to tail strike switch/sensor fairing
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	4,732 hours (of which 4,559 were on type) Last 90 days - 221 hours Last 28 days - 68 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and the operator's internal investigation report

Synopsis

In the final stages of landing, the aircraft developed a high nose-up pitch attitude with a high sink rate. Intervention by the commander failed to prevent a firm landing and the rear fuselage contacted the runway. The damage was confined to the tailstrike switch/sensor fairing.

History of the flight

The crew were operating a scheduled flight from Southampton to Newcastle; the co-pilot was the handling pilot for the sector. The co-pilot completed his type conversion in November 2016 and had conducted 49 sectors on the aircraft as pilot flying at the time of the incident.

Weather conditions at Newcastle were reported as fine with a westerly wind of 13 kt. The crew briefed for an ILS approach to Runway 25 at Newcastle, with a planned Flap 15 landing. This was in accordance with the operator's recommendation of Flap 15 for runways of length greater than 2,000 m; the Landing Distance Available (LDA) for Runway 25 is 2,125 m.

The approach was flown with the autopilot engaged. Flap15 was selected and, at 1,000 ft and 500 ft aal, the required stable approach criteria were met. VREF for the approach was 118 kt.

The autopilot was disconnected at 200 ft aal. At 100 ft aal power was reduced on each engine from 15 % torque to 8 % torque. Over the next four seconds the speed reduced from 124 kt to 113 kt and the pitch attitude increased from 3.7° to 7.6°. The commander, sensing the aircraft sinking, advised the co-pilot to increase power and at 8 ft aal advanced the power levers himself. The aircraft touched down and bounced, the 'TOUCHED RUNWAY' caption illuminated and a triple warning chime sounded. The commander, aware that the tail had struck the runway, took control and landed the aircraft on the remaining runway.

The aircraft taxied to a parking stand where the passengers disembarked. Air traffic control were not immediately advised of the runway contact but were notified subsequently. The aircraft was inspected and minor damage to the Tail Strike Switch fairing was discovered. A subsequent engineering inspection revealed no structural damage.

Aircraft information

The Dash 8-400 aircraft has a high wing configuration with engines mounted on the wing. Three flap configurations are available for normal landing; 10°, 15° and 35°. The operator's policy for flap setting was stated in their Operations Manual (OM):

> *'15° Flap is recommended as the standard setting for a two-engined approach and landing for runways of 2000 m LDA or more. For runways of less than 2000 m LDA, 35° Flap is recommended and is mandatory when 1800 m or less.'*

An approach at Flap 15 will typically result in a touchdown attitude of 5° nose-up; tail contact with the runway will occur at between 6.9° and 7.5° nose-up, depending on the degree of main gear oleo compression. The operator's Standard Operating Procedure (SOP) requires the monitoring pilot to announce "PITCH FIVE" if the pitch attitude reaches 5° nose-up during the flare. If the pitch attitude reaches 6° nose-up or the aircraft starts to sink the expected response would be for the pilot flying to announce '*correcting*' and correct by increasing power and ensuring there is no further increase in pitch attitude, or to execute a go-around.

The high wing configuration of the aircraft is such that the power setting affects the airflow over the wing behind the propellers. A decrease in power will directly decrease lift, even if the airspeed remains the same. The operator's training guidance is to maintain a torque of 15% once established on the glideslope.

The OM contains a note concerning Reference Landing Speed (V_{REF}):

> *'Apart from short term fluctuations, the speed on the final approach must not be below VREF.'*

The OM contains specific guidance on the avoidance of tailstrikes during landing:

> *'Deviation from the normal landing procedure is the main cause of tail strikes. The most*
> *common mistakes are:*
> *• Allowing the airspeed to decrease well below VREF.*
> *• Inappropriate reduction in power.*
> *• Prolonging the flare for a smooth touchdown.*
> *• Starting the flare too high.'*

The aircraft is fitted with a touched runway detection system that includes a frangible switch/sensor located on the underside of the aft fuselage. In the event of a tail strike, a TOUCHED RUNWAY warning light illuminates on the Central Warning Panel. The Quick Reference Handbook action in the event of this warning occurring on landing is to '*Advise ATC and airport operations of the fuselage / runway contact',* this is due to the possibility of runway debris.

Following several in-flight tailstrike events the aircraft manufacturer issued Flight Operations Service Letter (FOSL) DH8-400-SL-00-020, dated 11 September 2008, to remind Operators of the importance of pitch attitude awareness for the Q400 during the landing flare and touchdown phase of flight. This letter advised:

> *'Descent rate control, below 200 feet agl, must be through power lever management rather than adjusting pitch.'*

In addition to DH8-400-SL-00-020 the manufacturer made available to operators a training video concerning the avoidance of tailstrike.

Organisational information

In November 2016 the operator reviewed the recent history of high pitch events through their Flight Data Monitoring (FDM) programme. Power management was identified by their analysis as the strongest factor during the 'high pitch on landing' events over the previous 6 months.

Previous similar events

The Australian Transport Safety Bureau (ATSB) reported on two occurrences of tailstrike during landings of DHC-8-402 aircraft, both of which occurred in late 2013[1]. A finding from the investigation was:

> *'The use of Flap 15 for landing results in a margin of 1.9° between the nominal landing flare angle and the tail strike angle, compared to a margin of 3.9° when using Flap 35 and a typical margin for other transport aircraft of over 5°.'*

Footnote

1 https://www.atsb.gov.au/publications/investigation_reports/2013/aair/ao-2013-201/

The ATSB found that in both cases in the last 50 ft of the approach to land the aircraft were in a declining energy state which induced the pilot to pitch up to control the descent rate, thereby exceeding the pitch attitude limit.

Analysis

The approach and landing took place in the hours of darkness, a time when there are reduced peripheral visual clues to judge height above the runway. When the aircraft was at around 100 ft aal the PF, who was relatively inexperienced on the aircraft, reduced torque to 8%, a level below the minimum of 15% recommended during approach. This put the aircraft into a low energy state leading to an increasing descent rate and a loss of airspeed. In order to counter perceived sink the PF increased the nose-up pitch instead of adding power, probably an instinctive reaction. The commander's verbal intervention in asking the co-pilot to increase power was not effective and his own action to advance the power levers was too late to prevent the tailstrike.

On the Dash 8-400 aircraft there is a relatively small margin between a normal flare angle and the tailstrike angle. Thus, if a pilot senses the aircraft is sinking in the final stages of landing the instinctive action to increase pitch attitude is likely to result in aft fuselage runway contact. Engine power management is critical on this aircraft during flare and landing because of its direct effect on the airflow over the wing and thereby on the available lift. Training programmes to address this emphasise the use of power to control rate of descent and not pitch attitude. However, inexperienced pilots are likely to take time to acquire the skill to judge landings and under pressure may revert to an instinctive response of increasing nose-up pitch when close to the ground.

Conclusion

The tailstrike occurred because of an inappropriate reduction in power during the latter stages of the approach which put the aircraft into a reduced energy state. When it started to sink the instinctive response of the pilot flying was to increase the pitch attitude, instead of the recommended trained response of increasing power.