SERIOUS INCIDENT

Aircraft Type and Registration:	Fokker F50, OO-VLF
No & Type of Engines:	2 Pratt and Whitney Canada PW 125B turboprop engines
Year of Manufacture:	1991
Date & Time (UTC):	15 January 2009 at 1008 hrs
Location:	Ronaldsway Airport, Isle of Man
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 20
Injuries:	Crew - None Passengers - None
Nature of Damage:	No reported damage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	6,500 hours (of which 4,950 were on type) Last 90 days - 120 hours Last 28 days - 9 hours
Information Source:	AAIB Field Investigation

Synopsis

Selection of a high reverse power setting while landing on a wet runway, in a crosswind which was close to the maximum demonstrated limit, resulted in the aircraft departing from the paved surface. No injuries or damage resulted.

History of the flight

Following a routine flight from London City Airport, the aircraft made an approach to Ronaldsway, Isle of Man Airport. The commander was the pilot flying and had briefed for a radar vectored ILS approach to Runway 26. The brief included the surface wind and that the runway was wet.

At 1005 hrs the aircraft was cleared to land and ATC reported that the surface wind was from 180° at 24 kt. The commander disconnected the autopilot and continued to fly the approach manually with a crab angle of 20° ie aircraft heading 245° versus runway centreline of 265°. At about 50 ft agl, the commander began to decrab the aircraft by applying right rudder and left (into wind) aileron. The aircraft touched down on a heading of 253°, bounced and, as it landed a second time, the commander applied and held full right rudder. He was aware that the aircraft immediately began tracking towards the left side of the runway and thought that he had selected the engines to ground idle power as well as applying the wheel brakes. The aircraft continued to deviate from the runway centreline and the commander recalled that he then selected maximum reverse power

shortly before the aircraft departed the left side of the paved surface. The aircraft came to a stop with the nose and left main gear off the paved surface. The aircraft's speeds during final approach and at touchdown were consistent with its weight, configuration and the weather conditions.

After the aircraft came to a stop the commander made a brief call on the intercom to the Senior Cabin Crew Member (SCCM), who confirmed that everyone in the cabin was secure and unharmed. The commander then attempted to taxi the aircraft back onto the paved surface; however, the left main landing gear would not move and the aircraft slewed further to the left, away from the runway. The Airfield Fire and Rescue Service (AFRS) Watch Officer had observed the aircraft in difficulties and the AFRS deployed to provide assistance and fire protection. ATC advised the commander to call the AFRS on 121.6 Mhz. Once two-way communications were established, the AFRS advised the commander that shutting the engines down was the most sensible course of action, as the aircraft was becoming increasingly bogged down. The commander accepted this advice and shut the aircraft down. The passengers were deplaned using the rear right exit which had remained above the paved runway surface (see Figure 1). Several passengers commented that the height of the door sill above the runway caused difficulties as they jumped down from the aircraft.

Weather conditions

The 0950 METAR meteorological observation (recorded 18 minutes before the incident) reported a surface wind of 180°/26 kt, 8 km visibility with few clouds at 700 agl.

At the time of landing, the airport Automated Weather Observation System (AWOS) showed a two minute average wind of 170°/25 kt, with a maximum gust in the previous ten minutes of 34 kt. The maximum gust recorded in the ten minutes following the incident was 37 kt.

Figure 1

Aircraft and runway examination

Examination of the aircraft confirmed that there were no defects with the braking and anti-skid systems. Tests confirmed that both the nosewheel steering and rudder operated freely through their operating range. No faults were recorded on the Electronic Engine Controls (EECs), which indicated that there had been no disparity recorded between the commanded and achieved engine power.

Runway 26 had recently been resurfaced and fully grooved. A surface friction test completed on 26 December recorded an average friction coefficient of 0.9, which is greater than that required. This was verified by a friction test carried out on the day after the incident. No abnormalities were observed on the surface of the runway and there was no evidence of the application of heavy braking or anti-skid operation by the aircraft.

Recorded information

The aircraft was fitted with a 30-minute, four-channel Cockpit Voice Recorder (CVR) and a solid-state Flight Data Recorder (FDR). Both were successfully downloaded at the AAIB and captured the incident landing. The FDR contained just over 25 hours of operation and was time-aligned with the CVR recording.

The data showed that the approach to the Isle of Man was stable, with an ATC "WINDCHECK" 35 seconds prior to touchdown of "180, 24 KNOTS". The aircraft touched down at an indicated airspeed of 91 kt on a heading of 253°M. Over the next few seconds, the heading increased and full right rudder was applied, together with control wheel inputs into wind. Just over two seconds after touchdown, the engine torque and propeller rpm on both engines increased, suggesting that reverse was engaged. Analysis of these rpm and torque values by the aircraft manufacturer confirmed that they corresponded to maximum reverse power.

Five seconds after touchdown, at an indicated airspeed of 77 kt, the commander handed control of the control column to the co-pilot, which was acknowledged. During the next three seconds, the control wheel position moved from commanded left roll to commanded right roll. The maximum recorded control wheel position was +56° [1], as the indicated airspeed reduced through 63 kt.

As the speed continued to decrease, the control wheel was returned to command left roll and the rudder position remained at full right deflection, as it had been since the beginning of the touchdown. Fifteen seconds after touchdown, the aircraft departed the left side of the paved surface, signified by an increase in normal acceleration and slight roll to the left. Groundspeed was not recorded and recorded airspeed is not accurate below 50 kt, so the speed at which the aircraft left the runway could not be established precisely. Approximately six seconds after departing the runway, the aircraft stopped on a heading of 258°M.

After stopping, an attempt was made to return the aircraft to the paved surface. FDR data showed that the torque on the left engine increased but with no associated change in heading, until there was a further increase in torque on this engine together with a torque increase on the right engine. At this point, the aircraft swung further to the left, signified by a decrease in heading from 258°M to 230°M over a seven second period. Just less than four minutes after the aircraft came to a stop, both engines were shut down and FDR and CVR recordings ceased.

Footnote

[1] Maximum range of control wheel deflection recordable on FDR is ± 122° but maximum in-flight range from this flight was +34° to -31°. Positive control wheel position corresponds to commanded right roll.

The number of FDR parameters recorded limited the analysis that could be performed on the runway excursion. Nosewheel steering commands and positions, braking, drift and localiser deviation parameters were not recorded.

Commander

Following the incident, the commander stated that he had selected ground idle after touchdown and, once he realised the aircraft was going to depart the paved surface, selected maximum reverse power. Following review of the data, which indicated that maximum reverse was selected just over two seconds after touchdown, the commander commented that if the data was correct then that was not what he had intended to happen as that was not the standard operating procedure (SOP). He recalled seeing the power levers at reverse once the aircraft had come to a stop and thought he had selected reverse just before entering the grass. The commander considered that the airflow effects of reverse power could have caused the directional control issues.

Operations manual

The operator's Operations Manual Part B Section 2.12.1 states:

> *'The rudder is not effective for directional control with reverse'*

Airflow effects

Following touchdown, directional control at high speed is mainly provided by airflow over the rudder. The manufacturer commented that high reverse power disrupts the airflow around the rudder, which may then become less effective. The manufacturer further considered that the main use of aileron in a crosswind was to prevent the upwind wing from lifting. However, in this case the use of reverse power effectively destroyed the lift produced by the wing, therefore the aileron had no effect.

The amount of reverse power generated is determined by propeller blade angle, engine torque and rpm. The engine control system is designed to ensure the engine generates sufficient torque to turn the propeller at the commanded rpm. The torque required is dependant on local airflow around the propeller. In a strong crosswind the fuselage alters the airflow into the downwind propeller. This can lead to a difference in the torque developed by each engine.

Limitations

The manufacturer's Aircraft Operating Manual (AOM) states that the recommended maximum crosswind component for takeoffs and landings on runways with '*good*' braking action is 33 kt.

Manufacturer's AOM operating technique

Landing (AOM 5.05.01 page 3 version 01 issue 009)

> *'Initially keep the aircraft straight with the rudder*
>
> *Select ground idle with uninterrupted movement*
>
> *Use reverse when required.*
>
> *NOTE*
>
> *1 Do not select ground idle until nose wheel is on the ground.*
>
> *2 The rudder is not effective for directional control with reverse.*
>
> *At approx 60kt when PNF calls "60 kt" cancel reverse and release the control column.'*

Crosswind landing

> *'-On final approach maintain runway alignment by crabbing into the wind*
>
> *-When crossing the threshold, apply rudder to align aircraft with the runway centre line and bank into wind to counteract drift (3deg – 5deg bank angle)*
>
> *-Do not delay touchdown after decrabing is complete*
>
> *-After landing keep straight initially with rudder and counteract the tendency of the upwind wing to lift by decisive use of aileron*
>
> *-If reverse is required, apply reverse slowly and symmetrically. If problems with directional control reduce reverse or select ground idle.'*

Worldwide accident data 1995-2008

Statistics provided by the UK CAA show that runway excursions accounted for 417 commercial aircraft accidents, resulting in major or substantial damage, between 1995 and 2008. Around 24% of all turboprop accidents in this period were runway excursions. Turboprops had a greater risk of excursions off the side of a runway, whereas jet aircraft had a higher risk of overruns.

Analysis

The approach was flown in challenging conditions, with a crosswind which was close to the aircraft's recommended limit for landing on a runway with good braking action. The two minute average surface wind, which is that commonly quoted by ATC, was within limits. However, the data did show the possibility of wind gusts up to or slightly beyond the maximum recommended crosswind limit, although the fidelity of this data was insufficient to match it exactly to the aircraft responses. The aircraft's heading during the initial touchdown was 12° to the left of the runway centreline. Although the aircraft began to turn to the right, it never achieved the runway heading. The divergence increased slightly during the bounce, as the rudder was centralised, before correcting sharply to the right as right rudder was reapplied. This correction appears to show that, at this point, the rudder was effective and was capable of countering the crosswind. At the same time, the FDR torque and propeller rpm recordings indicated the application of high levels of reverse power. When the reverse power reached a maximum level, the heading decreased over the following three seconds. This heading change was consistent with the manufacturer's expected response of the aircraft in a crosswind, when the use of high levels of reverse power disrupts the airflow over the rudder.