Accidents Investigation Branch

Aircraft Accident Report EW/B235

Operator: Falkland Islands Government Air Services (FIGAS)

Registered Owner: Falkland Islands Government

Aircraft: Type: Pilatus Britten-Norman Islander
Model: BN-2B-26
Nationality: Falkland Islands
Registration: VP-FBG

Place of Accident: Brookfield Farm, Falkland Islands

Date and Time: 24 June 1987 at 1535 hrs
All times in this report are LOCAL

Synopsis

The accident was notified to the Department of Transport Accidents Investigation Branch on 26 June 1987. The decision to participate in the investigation was made on 28 June and two Inspectors of Accidents were detached to the Falkland Island (FI) Government Service. The investigation began, in the Falkland Islands, on June 30 1987.

The accident occurred when the commander was attempting to take off from an area beside the licensed airstrip at Brookfield Farm. The ground was very soft and the take-off run was interrupted by a shallow depression in the ground. At or around the normal take-off distance, the aircraft rose into the air but, 70 metres later, the right wing dropped and the aircraft fell back to the ground. All 6 occupants escaped without injury and there was no fire.

The report concludes that the accident was the result of the commander carrying out the take-off from an unsuitable area alongside the designated strip and then allowing the aircraft to become airborne without the capability of continued climb or flight control. Contributory factors were lack of adequate supervision of the Company's flight operations and, probably, the psychological effect of passing abeam the end of the marked strip into an uncharted area.

1 FACTUAL INFORMATION

1.1 History of the flight

The aircraft VP-FBG (BG) was required to perform an inter-settlement service, beginning at Port Stanley and shuttling passengers, freight and mail between there, San Carlos, Port Howard, Pebble Island, Golding Island, Roy Cove, Dunnose Head, Foxbay East, Salvador and Brookfield Farm, thereafter returning to Port Stanley with 3 adult passengers, 2 children and 1 dog.

At 1200 hrs BG departed Port Stanley and successfully achieved the required flights as far as the landing at the strip known as Brookfield Farm, arriving there at 1530 hrs. Brookfield Farm has a 420 metre long, undulating, 'grass' strip, with one runway which is orientated 270°/090°M (Appendix 1). On the day in question, although it was not raining, the surface was very wet and there was a light WNW wind of less than 5 kt.

The arrival of BG was witnessed by the local farmer and the passenger who was to board the aircraft for the return flight to Stanley. Both witnesses state that the landing, on runway 27, was made in a normal manner except that the nose of the aircraft lowered to the ground somewhat sooner than usual and spray was thrown up from the surface by the wheels. One of the inbound passengers further commented that the wheels seemed to "dig into the surface" during the landing run. On completing the landing run, BG made a 180° turn on the strip and back-tracked up the strip, executing another 180° turn partially off the strip to its south, before realigning at the strip threshold heading west. In this position, the engines were shut down and the commander loaded one passenger and his baggage on board.

The commander then left the aircraft and walked down the south margin of the strip, as far as a substantial dip in the ground. The purpose of this was to inspect the surface smoothness and consistency, in order to assess whether it would be more suitable for take-off than the now severely rutted strip. Deciding that this was the case, the commander noted that although the first 200 metres or so of the intended take-off run was soft in places, it appeared generally firmer than the marked strip, as did the remaining 400 metres. Separating these two lengths was a shallow but sharply defined dip. Returning to the aircraft, the commander climbed aboard, started the engines and, having completed the appropriate aircraft checks, taxied forward to a point some 8 metres off the southern edge of the strip. He then opened the throttles fully and began the take-off run parallel to the defined strip. From this position on the field, there remained some 580 metres of take-off run available, at the end of which was a wire and post fence separating the field from a small valley.

The aircraft accelerated and, at 100 metres from the start of the roll, the pilot raised the nose in order to reduce the drag of the wheel. Whilst still ground-borne and approaching the depression, the commander decided that it would be beneficial to the safety of the aircraft to retard the throttles and lower the nose. Evidence suggests that, at this time, the nosewheel touched the ground and the mainwheels were braked momentarily shortly before the depression. Having

crossed it, he re-applied full throttle and again lifted the nose of the aircraft. BG continued along the ground for a further 232 metres before becoming airborne, leaving 138 metres to the wire fence.

The height to which the aircraft climbed is variously reported as 15-20 feet or skimming the surface. It was also reported that the aircraft nose-up attitude was greater than normal. The commander has since stated that the aircraft felt 'sluggish'. 80 metres later, the aircraft rolled to the right and fell to the ground, striking it with the right wingtip and the trailing edge of the aileron tip, followed almost immediately by the right mainwheel. The aircraft continued in this attitude, curving to the right with full throttle still applied, through a wire fence and into a small valley. The final impact into the far side of the valley, 50 metres after contacting the fence, was fairly severe and slewed the aircraft further around to face a north easterly (053°M) direction.

No fire resulted from the accident and the 5 passengers and the commander evacuated the aircraft from the starboard passenger door.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor/none	1	5	

1.3 Damage to aircraft

The aircraft remained substantially intact but sustained severe deformation of the fuselage, collapse of all three landing gear legs, and some damage to wings and propellers.

1.4 Other damage

A small section of wire-and-post fence was torn down by the passage of the aircraft.

1.5 Personnel information

Commander:	Aged 32 years
Licence:	F.I. Commercial Pilot's Licence. Issued 6 October 1979 - valid.
Aircraft ratings:	Pilatus Britten-Norman BN-2B, BN-2A, BN-2T. De Havilland DH(C)2 Mk. 2 Floatplane. Cessna 150, 152, 170, 172, 175 and 185 series BN-2B renewed 7 April 1987 - valid

Other ratings	Instructor's and examiners ratings on BN-2B, DH(C) 2 Mk 2 Floatplane
Instrument rating:	Renewed 7 April 1987 - valid
Medical certificate:	Renewed 2 February 1987 - valid. No waivers or restrictions.
Flying experience:	Total: 4000 hours On type: 2500 hours Previous rest period: 24 hours Take-off and landings in FI: 5840 Take-off and landings at Brookfield Farm: 4

Throughout training and subsequent flying examinations, the commander had proved satisfactory. During the accident investigation, it was noted that his attention to detail was very high and his knowledge of the aircraft, and its performance, profound. Furthermore he had clearly gone to considerable lengths to acquire all available subsidiary documentation relevant to the aircraft and its operation.

1.6 Aircraft information

1.6.1 Leading particulars

Registration:	VP-FBG
Type:	Pilatus Britten-Norman (PBN) BN-2B-26 Islander
Serial No:	2126
Certificate of Airwothiness:	Transport Category (Passengers) issued 31 March 1983
Total airframe hours:	2632
Maximum authorised : take-off weight:	6600 lb.
Maximum landing weight:	6600 lb.
Weight at the time of the accident:	5995 lb.
Centre of Gravity (CG) range at 5995 lb:	19.5 ins to 25.6 ins aft of datum. Datum is at the wing leading edge, co-incident with station 134.5 ins.
CG at time of accident:	25.69 ins aft of datum

1.6.2 Aircraft weight and centre of gravity

There are several factors affecting the calculation of these two parameters. The aircraft commander must accept that the freight weights supplied to him are correct, and he calculates the weight of passengers using the agreed standard weights. It is therefore reasonable that there may be a slight discrepancy between the weights which the commander used to calculate the CG, and those subsequently used, having weighed all freight and personnel. In the event, the discrepancy was insignificant.

1.6.3 Description

The BN-2B Islander is a high-wing monoplane plane of conventional layout powered by two wing mounted reciprocating engines driving constant speed two bladed propellers. VP-FBG was configured with two pilot seat and six passenger seats in three rows. An area of the cabin for baggage stowage was available behind the seats. The Islander cabin is approximately square sectioned with two doors in the left side, next to the pilot's seat and near the aft seat row, and with one door in the right side near the centre seat row. Main landing gear legs mount on the wing and aft ends of the engine nacelles, and the nose landing gear leg mounts on the fuselage forward of the cabin.

1.6.4 Maintenance History

Maintenance records indicated the following at the time of the accident:

Aircraft construction date:		1982
FIGAS Acceptance Flight Test:		1 April 1983
Flight time since new (TSN):		2632 hours, in approx. 8700 flights
Engine 1:	TSN:	616 hours
	Time since overhaul (TSOH):	616 hours
Engine 2:	TSN:	845 hours
	TSOH:	200 hours
Propeller 1 TSN & TSOH:		1050 hours
Propeller 2 TSN & TSOH:		1050 hours

The aircraft was reportedly maintained in accordance with PBN Schedule MS/1, second addition, revision 12. This was apparently not approved by the Falkland Islands Government, as required by the Air Navigation (Overseas Territories) Order (AN(OT)O). With this exception no evidence of deficiency in the aircraft's maintenance records was found, but inadequate time was available for more than a cursory examination. Records were reviewed in some detail for the

period 4 January 1987 until the accident. Events which could be considered to be of possible relevance were:

August 1985:	Left main landing gear displaced due to rough field.
10 February 1987:	Starboard engine magneto drop 300 rpm. Lower spark plugs changed.
4 March 1987:	Loss of power on right engine. Found No 2 magneto dead as a result of open circuited capacitor. Changed.

Records did not suggest any deficiencies or recent defects that could have had a bearing on the accident.

1.7 Meterological information

At 0800 hrs, the commander received locally observed weather reports for five stations around the Falklands Islands. From these, he was able to make a sensible estimate of the conditions and weather trends at his various destinations.

Visibility across the islands varied between 3 km and 10 km and the wind from calm to 20 kt. Light rain was prevalent over nearly the whole area.

When the aircraft arrived at Brookfield Farm, there was a slight mist, the temperature was about +2°C and the wind WNW at less than 5 kt.

1.8 Aids to navigation

Not relevant.

1.9 Communications

Normal practice is for the aircraft commander to maintain radio contact with the operators of the airstrips on the 2 metre band (14.51 MHz) radio. Contact is also maintained on the company HF radio on 5580 MHz and on the Guard frequency of Stanley airfield, 118.1 MHz.

1.10 Aerodrome information

Brookfield Farm has a licensed airstrip 420 metres long by 26 metres wide, marked with eleven inverted 'V' sheet metal markers down each side. The markers are white and those at either end have a red stripe in addition. The designated strip has, excluding the first 67 metres, an overall downslope of 0.9%. This is the portion of the strip which the aircraft paralleled during the take-off run. To the south side of the strip, where the aircraft took off, the average slope is 1.04% downhill over the strip length.

The surface of the relevant portions of the field comprises very short vegetation

on top of a peat layer, itself lying on a clay bed, and its firmness depends greatly upon the rainfall, temperature and wind. During the on site investigation commenced 5 days after the accident, the appearance of the area used for the take-off run was spongy and soft in places, but generally fairly firm, even after rain. 192 metres from the position at which the take-off run began, lay a fairly shallow but sharply defined depression in the surface.

The strip was surveyed on 22 May 1987. The surveyor's report stated that the runway surface appeared to be unsatisfactory and comprised rough grassland which seemed to need attention, "including rolling". Because the strip owner's field-roller had been lent to another farmer, this was never carried out. Nevertheless the strip was granted a licence on 9 June 1987.

On the day of the accident, the strip was wet and suffered considerable grooving and rutting as a result of the landing made by VP-FBG. The commander has stated that it was for this reason that he elected to take-off to the south side of the marked strip, where the surface was a little firmer, rather than to cause further damage to the strip itself.

1.11 Flight recorders

None were required to be fitted and none were fitted.

1.12 Wreckage and impact information

1.12.1 Site Markings

Ground marks clearly indicated that the aircraft made its take-off run to the left of, and parallel to, the edge of the marked runway 27 (Appendix 1). The run was made between 5-10 metres off the strip edge. Little rutting was caused by the wheels during the take-off run except for the first few metres. The surface characteristics appeared to be very similar to those of the marked strip.

The ground marks indicated that the aircraft first became aligned with the runway direction during its take-off run at a position approximately 67 metres from the start of the runway. The subsequent distances are referenced to this assumed start of take-off point and measured along the aircraft's track. The nose landing gear tyre left the ground after 38 metres. After a run of 192 metres the aircraft entered a shallow but sharp dip in the ground. Evidence was found suggesting that shortly before this dip the nose landing gear touched the ground and main wheels were momentarily braked hard. After the dip, main landing gear tyre tracks were virtually continuous up to a point 313 metres from the start of the run and then became intermittent, indicating that the aircraft was light on its wheels from this point but still effectively on the ground. Main landing gear tracks ceased completely at 445 metres, 89 metres past a point level with the end of the marked strip.

Approximately 79 metres from the lift-off point the right wing tip contacted the ground, together with the right aileron outboard tip. The aileron was substantially trailing edge down at this point. Shortly after wing tip contact, the right main landing gear tyres contacted the ground and after a short distance were braked hard. The aircraft continued substantially in this attitude, with its

track curving to the right, until it struck a substantial wire fence approximately 583 metres from the start of the run, as measured along the aircraft's track. The net slope over the take-off run was 1.06% down, and 1.46% down between the start of take-off and the fence. After passing through the fence the aircraft descended into a small valley with areas of very soft ground, contacted the ground heavily with all three landing gears, and yawed to the right. It came to rest on its belly near the base of the valley 50 metres beyond the fence at 51° 32.7' S, 58° 12.6' W.

Wreckage and ground mark characteristics indicated that at touchdown the aircraft was banked right in excess of 19°, and control wheel roll demand was at or near full left roll. Accurate determination of pitch angle was not possible, but neither the nosewheel nor the tail bumper contacted the ground prior to the aircraft's collision with the fence. The evidence indicated that at touchdown the aircraft was not significantly yawed, but the track was 11° right of its track at lift-off. The ground speed was estimated at between 35-55 kt. Right main landing gear wheels locked for a period shortly after first contact with the ground.

1.12.2 Wreckage examination

1.12.2.1 Airframe

The aircraft came to rest intact, with the exception of the right wing trailing edge fairing between the flap and aileron, and the mass balance weight from each aileron. The evidence indicated that the fairing detached as a result of contact with the fence and the mass balance weights detached as a result of inertia forces when the landing gears failed.

The fuselage was severely deformed, consistent with the effects of its under-surface ground contact while the aircraft was skidding to the left. The empennage was undamaged with the exception of slight buckling of the rudder and localised damage to the left elevator tip. The wings suffered localised damage in the area of main landing gear attachments, slight leading edge damage consistent with contact with the fence, and slight deformation and displacement relative to the fuselage.

The failure of the support structure for all three landing gear legs was consistent with the effects of combined upward , aftward and rightward overload. The evidence indicated that the only parts of the aircraft to contact the ground prior to collision with the fence were the right main landing gear wheels, the right wing tip navigation light fairing, the right wing undersurface at the outboard rib, and the right aileron tip trailing edge and mass balance.

1.12.2.2 Cockpit settings and instruments

A number of cockpit control selections had reportedly been made after the accident in order to make the aircraft safe. The following instrument readings and control settings of possible relevance, and reportedly not altered post-accident, were found:

Main altimeter sub-scale:	982 mb
Standby altimeter sub-scale:	980 mb
Circuit breakers:	All made
Pitch trim indicator:	Minus one division (nose down from neutral)
Rudder trim indicator:	Approximately neutral
RPM levers:	Both at max
Carburettor heat levers:	Both off
Parking brake lever:	Off

Calibration of the air speed indicator (ASI) using the FIGAS test set showed a significant over-reading, up to 9.5 kt over the range 40-70 kt. However, the tester had no calibration certificate and a test on another ASI showed a similar discrepancy. Calibration by RAE Farnborough Instrumentation Laboratory indicated that the ASI error was in fact limited to 3 kt under-reading and 1 kt over-reading in the range 40-70 kt.

1.12.2.3 Powerplant

Two Avco Lycoming O-540-E4C5 six cylinder engines driving 78 inch diameter Hartzell constant speed two bladed propellers were fitted. No evidence of pre or post impact damage to either engine was found. The lower sparking plugs from cylinders 3 and 4 of the No 2 engine showed evidence of having operated with a degree of over-rich fuel mixture, which reportedly is not a common feature.

Both propellers sustained localised blade damage, consistent with the blades having contacted the ground or the fuselage while turning, after the landing gear had collapsed. However, no evidence was available to indicate propeller speeds or pitch angles at this point.

Bending of one of the No 1 propeller blades precluded functional checks of this propeller by engine running, but both engines were run in situ on the site with the No 2 propeller fitted to each in turn. Checks included a few minutes sustained running at take-off power settings. No evidence of powerplant abnormalities was found.

1.12.2.4 Fuel system

The fuel system sustained no significant damage from the accident. Samples were taken from fuel tank sump and gascolator drain points on both sides of the aircraft. No evidence of water or debris was found. Fuel samples were analysed by the Directorate General of Defence Quality Assurance at Harefield, UK. The analysis did not indicate any abnormalities relevant to the accident, but could not dismiss this possibility, as a large portion of the samples was lost during transit to the UK. However, the engines ran satisfactorily on the fuel for a number of sectors prior to the accident and during test running after the accident.

Fuel tank total contents including an estimated allowance for usage during engine

test running were found to be:

Left	-	18 1G
Right	-	23 1G

1.12.2.5 Controls

All primary flying control surfaces were found after the accident to be connected to the cockpit controls and were free to operate. No evidence of pre-accident malfunction was found. Elevator and rudder trim tab positions appeared consistent with cockpit control settings.

Flaps were little damaged, and found close to the take-off position. Slight anomalies were found in the flap surface and flap system microswitch cam positions. It is considered that this was most probably caused by the effects of impact forces and slight wing deformation. The flap actuator was sent to PBN for checks of its brake.

1.12.2.6 Wheels and brakes

Main landing gear tyres were all hard. Pressures measured 6 days after the accident were:

Left inboard	-	34 psig
Left outboard	-	34 psig
Right inboard	-	33 psig
Right outboard	-	32 psig
Requirement	-	35 psig

Brakes on main landing gear wheels were found packed with mud and vegetation. When this was removed all wheels rotated freely. The type of vegetation generally corresponded with that growing beyond the final fence, rather than that growing on the area used for the take-off run. The possibility that some wheel binding occurred during the take-off run as a result of debris packed into brakes during the landing and taxi could not be dismissed.

1.12.2.7 General

None of the evidence from examination of the aircraft, with the possible exception of slightly over-rich operation of No. 2 engine, suggested that the airframe, engine or ancillary systems had contributed to the accident.

1.13 Medical and pathological information

The commander possessed a valid medical certificate and there was no evidence found to suggest that he was other than fit to conduct the flight.

1.14 Fire

There was no fire. It is, however, noteworthy that no fire fighting equipment was available at the airstrip. Under the conditions of licensing, as provided by the AN(OT)O of 1977, and by the licence document itself, there is no legal requirement for the provision of fire fighting equipment, although several of the licensed airstrips do provide this equipment.

1.15 Survival aspects

The final impact was survivable and the lap straps of all the passengers withstood the forces of the impact, as did the commander's full harness.

The commander's forward access door had stuck in the closed position, but he and the five passengers left the aircraft via the starboard side passenger door. They were subsequently taken by Landrover to the nearby farm house.

1.16 Tests and research

The take-off run made by BG clearly failed to achieve a normal lift-off and consequent climb. At attempt was therefore made to rationalise this event by comparing the distance used, during the run, with that indicated by the performance graphs provided in the Flight Manual (FM) and in Supplement 26 to it. The distance over which the aircraft travelled in crossing the dip, with the throttles closed (throttle pause), was estimated as 55 metres.

The Take-off Distance Required (TODR) when using a paved surface can be extracted from the FM, and a factor increasing this distance such that it is referenced to a grass surface can be extracted from a graph given in Supplement 26 to that manual.

Naturally, no factoring graph is available for a take-off made from '1 inch vegetation supported by wet peat', and so the graph for conditions considered closest to these has been used: That quoted for take-off on 'Long Wet Grass'.

Airstrip elevation:	50 feet amsl
Temperature:	+2 degrees C
Weight:	5995 lb
Calculated Lift-off speed:	50 kt
Average slope:	1.06% down
Throttle pause distance (zero thrust assumed):	55 m
Headwind component, unfactored:	4 kt

The TODR graph builds in a 25% safety factor, above the actual distances achievable, and the FM assumes that the Take-off Run Required (TORR) is no worse than 75% of the TODR.

Calculated performance:

Use of the FM take-off performance graph shows a TODR, for the above data, of 1225 feet. When the 25% factor has been removed, this gives an unfactored TODR for a paved surface of 980 feet.

The graph in Supplement 26, showing the penalty for long wet grass, increases this TODR to 1160 feet.

75% TODR of 1160 feet gives a TORR of not worse than 870 feet, or 265 metres. Adding to this the period of zero thrust, the calculated TORR under the prevailing conditions becomes 320 metres.

Achieved performance:

The last point at which the aircraft was in contact with the ground was measured as 445 metres from the assumed take-off point. However, before the aircraft became fully airborne, the ground marks became intermittent after 313 metres and the right wheel lifted off the ground at the 385 metre point.

1.17 Additional information

Many of the matters listed below appear, at first glance, to have little to do with the accident. However, deeper examination reveals connections which, albeit indirect, are contributory factors.

1.17.1 The Director of Civil Aviation (DCA)

This post is held by the same person who is the manager of the FIGAS airline.

It is the responsibility of the DCA to ensure that the operating companies comply with the statutory requirements of the AN(OT)O. It is clearly as difficult to fulfil this responsibility, if the DCA is also the Operator, as it is to fulfil that of the Operator without an independent authority.

1.17.2 The management of FIGAS

FIGAS has no Chief Pilot post, and control of the operations is directed by a non-flying manager. The investigation revealed that, whereas the required task of ferrying the island population was achieved, the necessary regulation of the flight operation was not.

The requirements for management of flight operations encompass the need for an understanding of the flight and engineering problems essential to the safe conduct of that operation. This is normally achieved through compliance with Regulations and a continuous meaningful dialogue with both the flying and engineering staff of the company. Neither of these was apparent during the investigations and this was evinced by the following facts:

(a) The company was being operated for the purpose of Public Transport without an Air Operator's Certificate. Such a Certificate is a legal requirement, as set out in the AN(OT)O Article 6.

(b) The company was operating without a published and approved Operations Manual, as required by AN(OT)O Articles 25, 26 and Schedule 11. Amongst other criteria, which must be laid down in this manual, are the minimum weather conditions in which the operation is allowed and the manner in which the aircraft must be operated.

(c) No copies of either the aircraft Loadsheets or the Technical Logs were being left on the ground, as permanent records, prior to the operation of another flight sector. This action is required by AN(OT)O Articles 10 and 24.

(d) The Maintenance Schedule for the aircraft had not, as required by the AN(OT)O Article 9 (1) (a), been approved by the FI regulating authority.

(e) Failure to comply with AN(OT)O Article 9 (1) (a) also renders the Certificate of Airworthiness invalid,

(f) The aircraft Weight and Balance Schedule was not authorised, as required by AN(OT)O Article 16(1), and the CG was not being determined for each flight, both of which were required for Performance Category C aircraft.

It was apparent that not only had FIGAS failed to meet the legally required standards but that the DCA had failed to ensure that these requirements were being met.

2 ANALYSIS

2.1 General

During the investigation, no evidence emerged which directly indicated the cause of the accident. Therefore the various possible factors are evaluated below, in order to arrive at the most likely cause.

2.2 The take-off

The aircraft became airborne for only a short distance before it descended, with its right wing dropping, and made contact with the ground. There are not very many factors which will cause an aircraft to behave in this manner, and such evidence as is available indicates that some of these are unlikely to have done so.

The possibility that the wing was lowered intentionally can be dismissed, both because of the commander's evidence and because of the evidence that left roll was being demanded at the time that the wingtip and aileron contacted the ground. Wing drop as a result of a sudden gust of wind may also be discounted as it was nearly calm at the time, and the witness, himself a pilot, stated that no such event occurred. A wing stall due to airframe icing is very unlikely as the aircraft had landed only a few minutes earlier and the weather was not conducive to the formation of ice. A stall induced by the unscheduled retraction of flap is also unlikely for three reasons: The commander has categorically stated that he physically checked the flap at the take-off position before beginning the take-off roll and it was found to be both selected and set in approximately this position following the accident. The stalling speed with full flap and that with take-off flap is 38 and 42 kt respectively, a difference of only 4 kt. Both of these speeds are significantly below the planned lift-off speed of 50 kt, which the commander is unlikely to have intentionally ignored. Finally, a wing drop following a sudden severe yaw, caused by an engine failure, cannot be totally dismissed because it might have been a transitory, thus unrepeatable, occurrence. However, this too is considered to have been unlikely, as there was sufficient fuel on board, the pilot states that he positively checked the engine parameters, and both engines performed normally when examined during the investigation. This evidence of normal engine parameters also suggests that significant power loss as a result of carburettor icing was not a factor.

The removal of these factors leaves three others which cannot be dismissed and are therefore considered in detail:

(a) Inadequate take-off run (TOR) available with respect to the field's surface drag and to the interrupted take-off run.

or

(b) Over-rotation* at the scheduled take-off speed.

or

(c) Rotation at less than the scheduled take-off speed.

2.2.1 Inadequate TOR available

It is apparent that, in the absence of any formal Loadsheet or means of calculating the aircraft's CG, and there having been no slope or surface drag figures available for the strip used, calculation of the TORR could not have been made. However, the evidence shows that the aircraft did become airborne well before the end of the available distance. Furthermore, examination of the TORR calculations given in paragraph 1.16 shows that taking all measurable, and one estimated (the surface drag), factors into account, the calculated TORR is quite similar to that achieved by BG. Therefore, in the face of this evidence, the hypothesis of an inadequate TOR available can be disregarded.

2.2.2 Over-rotation at the correct lift-off speed

It is standard practice, when operating out of rough surfaced fields, to raise the nose of the aircraft as soon as possible, in order to keep the nosewheel clear of the bumps. There is likely to be difficulty in keeping the wheel clear without allowing the pitch angle of the aircraft to exceed that required for take-off on a rough field. Furthermore, should the point of take-off coincide with either a bump or a hollow in the ground, over-rotation could result which would require immediate adjustment to prevent a stall.

It might be reasoned, however, that a pilot of normal skill and experience would be able to rectify this transitory disturbance, almost by second nature. For this reason, the evidence of the commander's considerable experience of flying this type of operation, in this type of aircraft, makes this hypothesis unlikely to have promoted the accident.

2.2.3 Rotation at less than the scheduled take-off speed

There are three possible reasons why the aircraft might have become airborne before the scheduled take-off speed. The aircraft could have been 'thrown' into the air by the reaction to rolling across a bump in the ground. However, when taking off from very rough ground, it is difficult to judge whether the take-off was due to being thrown into

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*Rotate: To change the pitch attitude of the aircraft during the take-off run, with the intent of lifting off the ground.

the air or because the aircraft is genuinely capable of flight. This, however, would not have been a situation new to a commander experienced in this type of operation. The remaining two possible reasons for taking off before the scheduled speed involve a positive intent by the commander.

It is possible that the unusually wet and perhaps abnormally soft surface prevented the aircraft from accelerating right up to the scheduled take-off speed. If this were the case, the commander, seeing a lower speed being maintained, might reasonably attempt to lift the aircraft off the ground in order to remove the drag on the wheels and accelerate when airborne, prior to establishing the climb. This too would not have been a particularly new situation.

It is also possible that, seeing the end of the designated strip passing by on his right side, the commander felt compelled, perhaps subconciously, to lift the aircraft off the ground before running into an uncharted or unacceptably rough area of ground. The area beyond a point adjacent to the end of the runway, where the aircraft became airborne, had not been surveyed and the commander on his walking inspection had had no reason to explore this far. Furthermore, the convexity of the surface obscured the ground beyond that point

2.3 The descent to ground impact

If the premise of the take-off having been made at too low a speed, for whichever of the above reasons, is correct, it can reasonably be assumed that the commander would wish to remain airborne. He would therefore have to raise the nose of the aircraft, in order both to prevent a descent back to the ground and to establish a normal climb. The angle to which the aircraft must be rotated in order achieve this is dependent upon the speed at which the manoeuvre is carried out: the lower the speed, the greater the angle. It is noteworthy that the witness commented upon a "higher than normal" nose-up attitude throughout the take-off. Unfortunately, unless further engine power can be applied, this manoeuvre is almost certain to cause the aircraft to stall. The consequent descent to the ground, when so promoted, is very likely to be accompanied by a wing-drop, which would have been greatly exacerbated by the down aileron.

2.4 The FIGAS operation

It would be difficult to disassociate this accident from the lack of leadership within the company and the consequently unprofessional operation allowed to develop within it. It must, however, be noted that this unprofessionalism had not been displayed either on all flights, or by all the company pilots.

Legal aspects of the operation, as stated in Pt I of this report, have been the subject of a separate report to HE the Governor, and therefore will not be discussed further, except where they were directly affecting the operation.

There can be little doubt that the somewhat cavalier approach to this operation, particularly into airstrips fraught with hazards, contributed to the accident. The absence of firm direction, in the form of an Operations Manual, did nothing either to guide the pilots in the performance of their task, or to prevent them from operating in an environment hazardous to it.

The justification for licensing the Brookfield Farm strip at all seems to be in some doubt, but this Public Transport flight take-off, from off the side of the licensed strip, was improper. There could be little argument with the fact that the correct decision would have been to not take-off until the ground had dried out. However, the practicalities of such a type of flying are that such a decision would frequently ground the whole operation and thus deprive the residents of an essential service. Notwithstanding the proper decision, the reason for the commander deciding to take-off from this portion of the field was made in the genuine belief that it would increase the safety of the operation. This may well have been the case had he inspected the entire length of the take-off run, including the area beyond the point at which he expected to become airborne. However, as he had not appreciated the significance of the depression in the ground, which evidently caused a change to the normal take-off profile, the decision to use this part of the field must be considered as contributory to the accident.

2.5 Summary

All factors of possible relevance to the take-off and uncontrolled descent have been considered and most dismissed on the available evidence. Of the remaining hypotheses, each involving rotation at too low a speed, the first two discussed in paragraph 2.2.3 are predicated on situations which are neither new nor very different from those regularly encountered in this kind of operation. It is therefore considered unlikely that either was the primary contributor to the accident, though both may have played a part in it.

The final hypothesis offered, to explain rotation before the scheduled speed, differs from the other two in that all the constituents are peculiar to this flight and therefore not ones with which the commander was used to dealing. It also accords closely with all the known facts. This is therefore considered to be the most likely factor influencing the take-off, but this does not preclude contribution by one or both of the other two factors and the selection of the take-off run area.

Regarding the descent to ground impact, the only logical explanation is a stall accompanied by a wing-drop. Again, this hypothesis fits all the available evidence.

Finally, the lack of constructive input by the company contributed to the accident, in that it provided no support or guidance to the operating pilots.

3 CONCLUSIONS

(a) Findings

(i) FIGAS had been operating without the authority required by the AN(OT)O.

(ii) The management of FIGAS had not been effective.

(iii) The commander was properly licensed and no evidence was found to suggest that he was other than medically fit to carry out the flight.

(iv) The aircraft was serviceable prior to the flight and had been well maintained.

(v) The aircraft was properly loaded within the weight and CG limitations.

(vi) The aircraft took off from an unlicensed airstrip on a Public Transport flight.

(vii) The decision to take-off from off the strip, albeit for sensible reasons, was incorrect.

(viii) The meteorological conditions were not a contributory factor to the accident.

(ix) Abnormally high wheel drag from the very wet ground may have been a factor, but no definite evidence was available.

(x) The TORA was greater than the TORR.

(xi) The TOR achieved was not significantly greater than the TORR calculated subsequent to the accident, but the take-off was most probably attempted at a speed below that scheduled.

(xii) The pitch angle maintained after take-off was too high to allow continued flight.

(xiii) The aircraft descended to impact as a result of a stall and consequent wing-drop.

(b) Cause

The accident was the result of the commander carrying out the take-off from an unsuitable area alongside the designated strip and then allowing the aircraft to become airborne without the capability of continued climb or flight control. Contributory factors were lack of adequate supervision of the Company's flight operations and, probably, the psychological effect of passing abeam the end of the marked strip into an uncharted area.

4. SAFETY RECOMMENDATIONS

It is recommended that:

4.1 The FIG review the Terms of Reference for the position of DCA and the qualifications required.

4.2 The DCA consider the requirement for restructuring FIGAS operations management.

4.3 The DCA review the requirements for the issue of an Aerodrome Licence.

4.4 The DCA require FIGAS to construct an Operations Manual

4.5 The DCA require FIGAS to construct a Technical Log/Loadsheet which complies with the requirements of the current AN(OT)O.

4.6 The grant of airstrip licences should include consideration of surface drag, established by measurement.

Operations

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