Australian Government

Australian Transport Safety Bureau

Windshear-related hard landing involving Fokker 100, VH-NQE

Nifty Aerodrome, WA | 19 October 2012

Investigation

ATSB Transport Safety Report

Aviation Occurrence Investigation

AO-2012-137

Final – 6 February 2014

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

Page	Change	Date

Safety summary

What happened

On 19 October 2012 a Fokker F100 aircraft (F100), registered VH-NQE, was being operated on a passenger charter flight from Perth Airport to Nifty Aerodrome in the Pilbara region of Western Australia. The weather for the approach into Nifty included high-based cumulus cloud and isolated thunderstorms. The temperature on the ground was 38 °C.

As the flight crew were positioning the aircraft for a 5 NM (9 km) straight-in approach into a slight headwind, they received a windshear caution. In response, the crew increased the approach speed and extended the speed brake to stabilise the approach.

Aircraft touchdown markings

Source: Aircraft operator

The approach continued and apart from a few minor speed variances, the conditions appeared relatively benign. As the aircraft was in the final stages of the approach and descending from 80 ft to 30 ft above ground level, the airspeed dropped from 133 kt to 110 kt and the rate of descent increased to about 1,000 ft/min. The loss of airspeed occurred over a period of 3 seconds and by touchdown the aircraft was being affected by a 32 kt tailwind.

The aircraft touched down on the runway threshold, almost 300 m short of the normal touchdown point, and bounced. The high rate of descent at initial touchdown resulted in a hard landing with significant aircraft damage. There were no reported injuries to passengers or crew.

What the ATSB found

The ATSB found that when the aircraft was on approach to land at about 80 ft above ground level, the flight path almost certainly coincided with the strong outflow of a dry microburst, resulting in a performance-decreasing windshear that led to the rapid drop in airspeed, high sink rate, undershoot and a hard landing. Also, the aircraft was not fully configured for an approach in known or suspected windshear conditions, reducing the capability of the aircraft to recover from the high sink rate associated with a microburst event.

What's been done as a result

As a result of this occurrence, the operator sought to improve the weather information available at aerodromes serviced by their F100 fleet and modified its simulator training program along with consolidation of the windshear procedures/guidance. The operator also provided additional guidance in the use of flap following receipt of a windshear caution during approach and planned to introduce a new threat-based take-off and landing briefing model.

Safety message

The circumstances of this occurrence show that operators of transport category aircraft may need to review the guidance provided to crews to ensure that the risk of windshear associated with both thunderstorms and dry microbursts, is effectively managed.

Contents

The occurrence

On 19 October 2012, a Fokker F100 (F100) aircraft, registered VH-NQE, was being operated on a passenger charter flight from Perth Airport to Nifty Aerodrome in the Pilbara region of Western Australia (Figure 1). The flight was scheduled to depart at 1330 Western Standard Time[1] with 26 passengers, four cabin crew and three flight crew. The pilot in command (PIC) was the nominated pilot flying.

The flight crew began flight planning about an hour prior to the scheduled departure time. Their review of the applicable area and nearby aerodrome forecasts indicated that thunderstorms were predicted for the arrival into Nifty. Port Hedland, located about 340 km to the north-west, was forecast to be fine and, as Nifty did not have the required aerodrome forecast, was nominated as the alternate. The PIC reported that, as they only had 26 passengers, they were able to carry a full fuel load.

Figure 1: Location of Perth Airport and Nifty Aerodrome annotated

Source: Google Earth, modified by the ATSB

The flight proceeded normally and at about 1500 the flight crew began preparations for the descent and arrival into Nifty. Upon contacting the Nifty ground staff, the flight crew were advised that the surface wind was from the south-east at 10 kt and the temperature 38 °C. Based on that information, the PIC conducted a crew briefing for an arrival to runway 12. The briefing included reference to some weather in the area and that some diversions left and right of track would be required; however, the PIC anticipated visual conditions for the later stages of the approach. The landing was to be conducted with full flap at an approach speed of 128 kt.

Descent was commenced at 1507 with autothrottle and autopilot engaged. A short time later the crew was cleared to divert up to 5 NM (9 km) left and right of track to avoid weather and thunderstorms indicated on the weather radar. At 1525 the fight crew contacted Nifty ground staff

1 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

for an updated wind and reported the presence of a thunderstorm in the vicinity of the aerodrome. Ground staff advised that the wind was swirling but was currently north-easterly at 5 kt. The aircraft was now west of Nifty and on track to intercept a 5 NM (9 km) final.

The crew had selected Flap 25, disconnected the autopilot and commenced the turn onto final when, at 1525:55, a windshear caution (performance increasing) illuminated on the Primary Flight Display (PFD).[2] The crew selected full flap, then responded to the windshear caution by increasing the approach speed by 5 kt to 133 kt and extending the tail-mounted speed brake. With the speed brake deployed, the consequent increased engine thrust improved engine responsiveness in the event of a windshear encounter.

By 1,000 ft above ground level (AGL), the aircraft's speed, sink rate and track was within the operator's parameters for a stabilised approach. The crew continued the approach and at 440 ft the copilot made the 500 ft stabilised approach call (as required by the operator's procedures when in visual conditions). At that point the speed was 133 kt and the rate of descent 820 ft/min.

At about 350 ft, the copilot advised the PIC that the wind, as indicated on the PFD, was 140° at 12 kt and that the aircraft's rate of descent was 750 ft/min. At about 300 ft, the PIC asked the copilot to reduce the approach speed setting by 5 kt. As the speed change was being actioned, the copilot commented, '…here comes a bit of shear', and a short time later advised the PIC that they were on-speed with a sink rate of 900 ft/min. The aircraft was now at 150 ft and the airspeed was at or about the reduced approach speed of 128 kt.

At 130 ft, the aircraft's speed abruptly reduced to 124 kt and the copilot called 'speed'. The PIC advanced the thrust levers and the speed quickly recovered. At the same time the speed brake automatically retracted in response to the high thrust setting.

As the aircraft descended from 80 ft to 30 ft over a period of 3 seconds, the airspeed dropped from 133 kt to 110 kt and the rate of descent increased to 1,000 ft/min. At touchdown the aircraft was being affected by a 32 kt tailwind.

The aircraft touched down on the runway threshold, almost 300 m short of the normal touchdown point, and bounced prior to settling about 450 m along the runway. The PIC applied normal braking and full reverse thrust, bringing the aircraft to a stop well short of the runway end. After giving consideration to the aircraft's structural integrity and discussing the event with the cabin crew, the flight crew taxied the aircraft to the apron.

The high rate of descent immediately prior to touchdown and resulting hard landing resulted in significant aircraft damage. There were no reported injuries to passengers or crew. Table 1 lists the significant events as they occurred during the approach and landing.

[2] Performance increasing windshear is an increasing headwind or decreasing tailwind shear, which increases indicated airspeed and aircraft performance. Performance increasing windshear is frequently followed by performance decreasing windshear.

Table 1: Sequence of events

Time	Height AGL (ft)	Indicated airspeed (kt)	True[3] airspeed (kt)	Ground speed (kt)	Rate of descent (ft/min)	Recorded[4] wind direction/speed (deg M/kt)	Comments
1524:56							Copilot calls Camp Nifty for a wind update. Reported as swirling, currently north-easterly at 5 kt
1525:42	1,500	157				160/8-10	Radio call: start of turn onto 5 NM (9 km) final RWY 12
1525:53							Select Flap 25 call
1525:55	1,500	158				200/12-16	**Windshear caution** (performance increasing)
1526:18							Select Flap 42 call
1526:35							Approach speed increased to 133 kt
1526:47	1,100	134	142	137	740	140/8	Speed brake deployed
1527:45	440	133	141	131	820	126/12	500 ft stabilised approach call
1527:54	330	134	142	132	750	150/8	Copilot wind call-out from the PFD of 140/12, 10 kt headwind
1527:58	270	135	143	134	560	144/10	PIC asks copilot to reduce the approach speed setting by 5 kt
1528:11	150	129	137	133	880	130/8	Approach speed re-set to 128 kt, 4 kt headwind
1528:17	100	133	141	135	340	125/2	Copilot calls, 'sink rate 500, wind down the strip'
1528:18	80	133	141	137	750		4 kt headwind
1528:19	60	126	133	138	950		5 kt tailwind
1528:20	40	115	122	139	850		17 kt tailwind, copilot calls sink rate
1528:21	30	112	119	140	970	286/12	21 kt tailwind**,** copilot calls sink rate
1528:22	15	110	116	143	1,010		27 kt tailwind, **EGPWS 'SINK RATE'** call out
1528:23	0	108	114	146		290/23	32 kt tailwind, **EGPWS 'SINK RATE'** call out

3 True airspeed is indicated airspeed corrected for pressure altitude and temperature (density altitude).

4 Wind as calculated by the aircraft's flight management computers and recorded every 4 seconds. Due to calculation lag, the recorded wind may not have been a true indication of the actual wind existing at that time.

Context

Pilot information

Pilot in command

The PIC held an Air Transport Pilot (Aeroplane) Licence that was issued in 1990 and an F100 type rating issued in 2008. The PIC had a total of about 11,100 hours aeronautical experience, including about 1,250 hours on the F100.

The PIC's most recent windshear recognition and recovery training was conducted in November 2011 as part of the operator's cyclic simulator program. Windshear training was also conducted during the PIC's F100 type rating in 2008.

The PIC held a valid Class 1 Aviation Medical Certificate that required reading correction to be available while exercising the privileges of the licence.

Copilot

The copilot held an Air Transport Pilot (Aeroplane) Licence that was issued in 1997 and an F100 type rating issued in June 2012. The copilot had a total of about 11,400 hours aeronautical experience, including about 200 hours on the F100.

The copilot completed windshear recognition and recovery training in June 2012 as part of their F100 type rating training.

The copilot held a valid Class 1 Aviation Medical Certificate with nil restrictions.

Aircraft equipment

Windshear detection and recovery system

The aircraft was equipped with a windshear detection and recovery system that was operative from lift-off to 1,500 ft AGL, and during approach from 1,500 ft to 30 ft AGL. The aircraft's flight management computers estimated air mass motions (calculated wind direction and speed) by comparing air mass and aircraft accelerations. The calculated wind was displayed on the PFDs. Windshear cautions and warnings were reactive, not predictive as is the case with radar-based systems.

In the event of a performance-increasing shear, a windshear caution was displayed on the PFD. In the event of a performance-deceasing shear, the system would generate a windshear warning, which was displayed on the PFD, and an aural triple 'windshear' synthetic voice annunciation via the flight deck loudspeakers and headphones.

Windshear recovery was available from the aircraft's automatic flight control and augmentation system. Recovery guidance was provided by the flight director on the PFD and, if engaged, the aircraft's autopilot provided recovery control. During approach, and on detection and annunciation of a performance decreasing windshear warning, recovery control was activated by crew selection of TOGA (Takeoff/Go-around) or full throttle thrust. Application of such thrust would also command the aircraft's speed brake to retract, if deployed.

The system included self-test and self-monitoring functions that provided flight crews with visual and aural alerts in the event of a system malfunction.

Ground proximity warnings

The aircraft was equipped with an Enhanced Ground Proximity Warning System (EGPWS) capable of providing warnings for excessive sink rates close to the ground. If the sink rate exceeded a prescribed value, the system would generate an aural synthetic voice annunciation ‘sink rate’. The EGPWS system also synthesised the triple ‘windshear’ warning annunciations. Windshear warnings took priority over other EGPWS aural warnings.

Weather radar

The aircraft was equipped with a weather radar system capable of detecting precipitation droplets. The radar image displayed on the navigation display is a representation of the size, composition and number of water droplets. Due to the associated lack of precipitation, the aircraft’s weather radar was not capable of detecting dry microbursts.

Autothrottle System

The aircraft was equipped with an Autothrottle System (ATS) designed to reduce pilot workload. Above 50 ft and in indicated airspeed mode, the ATS automatically adjusted engine thrust to maintain the aircraft at the selected speed setting. Flight crew could override the ATS by manually adjusting the throttles and when manual control ceased, the ATS would return the aircraft to the selected speed.

Below 50 ft, the ATS transitioned from speed mode to retard mode and engine power was gradually reduced for landing.

Meteorological information

The area forecast[5] applicable to the approach and arrival into Nifty Aerodrome predicted isolated showers and thunderstorms until 2300. The wind at the lower altitudes was forecast to be from the west at about 10 kt.

Aerodrome forecasts[6] were not issued for Nifty. The nearest aerodrome where a forecast was provided was Telfer, about 65 km to the east. That forecast indicated mostly fine conditions with light southerly winds, and a 30 per cent probability of intermittent thunderstorms with variable-direction winds up to 40 kt.

Automatic weather observations recorded at Telfer indicated that, at the time of the aircraft’s arrival into Nifty, the surface winds were south-easterly between 10 and 15 kt with a temperature of 40 °C. While the type or amount of cloud was not indicated, no recent rainfall had been recorded.

Witnesses located at Nifty aerodrome reported that, as the aircraft was about to land a very strong gust of wind ‘…came from nowhere’. The witnesses described the wind as having changed in direction by 180° to a tailwind, and a swirling dust storm that came from nowhere and surrounded them. They indicated that the wind gust only lasted between a few seconds and about a minute.

The Bureau of Meteorology conducted an analysis of the weather conditions near Nifty aerodrome on the day of the occurrence. Relevant aspects of that analysis follow.

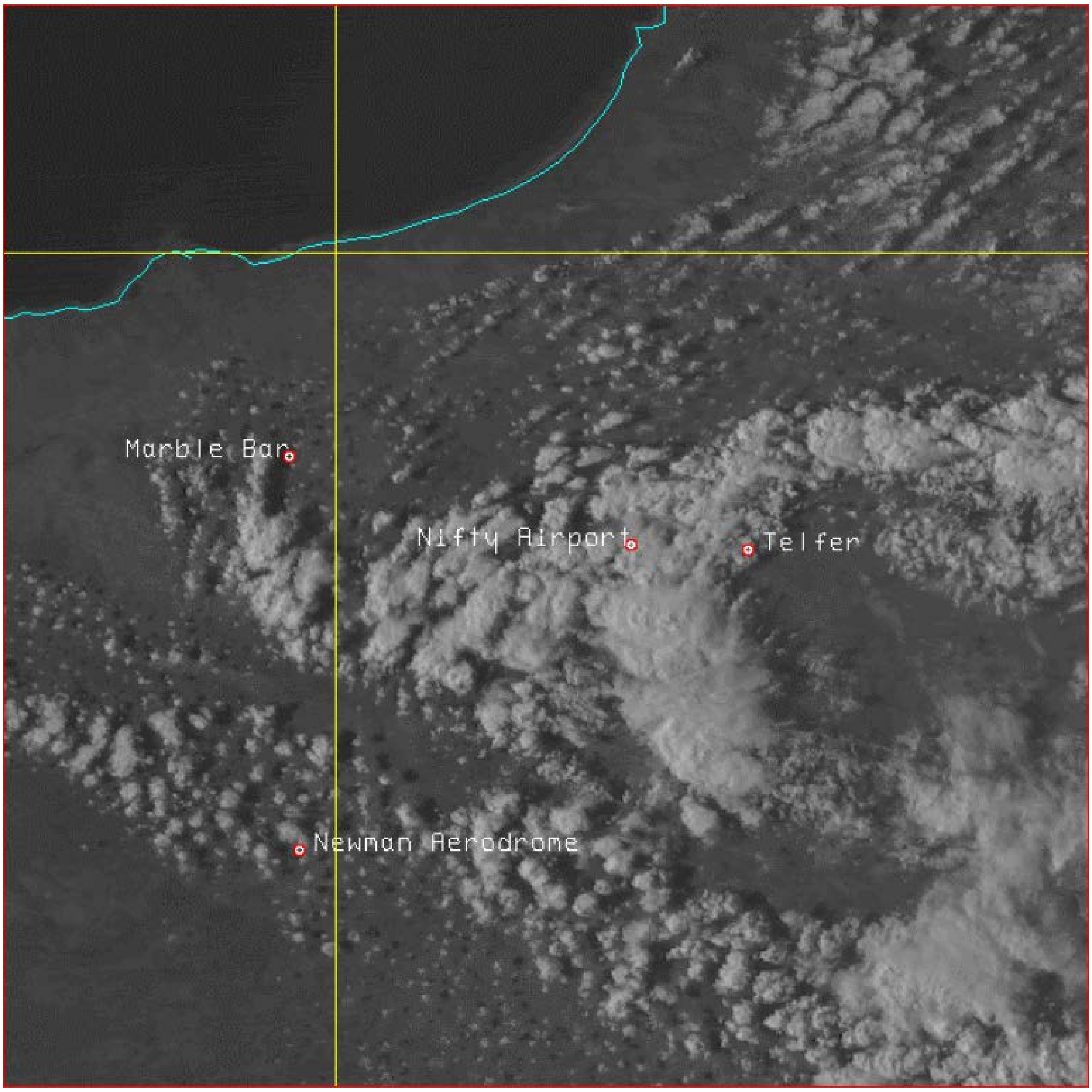
At the time of the occurrence there was a broad area of low pressure over the Pilbara region. Satellite imagery showed an area of active thunderstorms near Nifty before and after the occurrence (Figure 2). Recorded lightning data showed that, between 1430 and 1630, there were 16 lightning strikes within 20 km and 66 strikes within 30 km of the aerodrome. The closest weather radar facility, Port Hedland 340 km to the north-west of Nifty, did not indicate any precipitation in the vicinity of Nifty. However, high-based showers and thunderstorms typically don’t show strong radar returns.

---

5 An area forecast issued for the purposes of providing aviation weather forecasts to pilots. Australia is subdivided into a number of forecast areas. Nifty was in the north of area 66.

6 Aerodrome forecasts are a statement of meteorological conditions expected for a specific period of time, in the airspace within a radius of 5 NM (9 km) of the aerodrome.

Figure 2: Satellite image at 1530



Source: Bureau of Meteorology

Observations for Marble Bar, Telfer and Newman showed surface temperatures between 39 °C and 42 °C, and dewpoints[7] less than 2 °C, indicative of very hot and dry conditions. The large separation between surface temperatures and dewpoint temperatures suggested a cloud base around 12,000 ft. The combination of hot dry air in the low-to mid-level atmosphere and weak vertical windshear was conducive to the formation of dry microbursts.

Telfer recorded a maximum wind of 250° at 25 kt with gusts to 36 kt at 1724. While this gives some indication of expected wind strengths, it was possible that stronger winds could have been produced from the prevailing conditions at Nifty.

[7] Dewpoint is the temperature at which water vapour in the air starts to condense as the air cools. It is used among other things to monitor the risk of aircraft carburettor icing or likelihood of fog at an aerodrome.

The Bureau of Meteorology provided the following information extracted from the brochure, *Hazardous Weather Phenomena: Thunderstorms*, produced 12 June 2012, and available at www.bom.gov.au/aviation/knowledge-centre/:

> Downbursts
>
> The outflow from a storm's downdraft will occasionally produce winds of destructive force. When precipitation falls into drier air inside or below a thunderstorm, it immediately begins evaporating. This evaporation cools the surrounding air, increasing its density, causing it to accelerate downwards. A downburst is a concentrated downdraft, typically lasting five to fifteen minutes, and is of unusually high speed such that it can cause damage on, or near, the ground. The term microburst is used to describe a downburst which causes damage over an area with horizontal dimensions of less than four kilometres.
>
> Downburst winds originate from the cloud base and diverge when they make contact with the ground. The rapid change in wind speed and direction associated with downbursts poses a threat to aircraft during take-off and landing phases, during which an aircraft will first encounter a strong headwind, then a downdraft which is the vertically descending section of the downburst, and finally a region of strong tailwind. If a pilot was to over-compensate for the lift experienced in the headwind, a dangerous drop in altitude may occur when the lift disappears in the downdraft and tailwind regions.
>
> A microburst can be characterised as wet or dry. A wet microburst, which can occur with a range of thunderstorm types, is accompanied by significant precipitation at the surface. It develops in environments characterised by weak vertical wind shear and deep moisture capped by a dry layer.
>
> In a dry microburst, precipitation at the surface is either very light or does not occur at all, although virga (precipitation falling from a cloud but evaporating before reaching the ground) may be present. They develop in environments with weak vertical wind shear, dry low levels and moist mid levels. The dry microburst is initiated by evaporative cooling. If the air underneath a cloud is relatively dry then rain and ice crystals falling from the cloud will quickly evaporate and chill the air. The cooled air will be heavier than the surrounding environmental air and will therefore accelerate downward. Dry microbursts can develop in the absence of lightning and thunder. High-based cumulus and altocumulus have been observed to produce damaging dry microbursts.

Aircraft Damage

The aircraft's rate of descent immediately prior to touchdown was about 1,000 ft/min. The maximum recorded loading at touchdown was 4.23 g. As a result, the aircraft sustained significant damage to sections of the wings, main landing gear and fuselage.

The hard landing resulted in wrinkling to numerous skin panels, both forward and aft of the aircraft's centre section, and deformation to several structural beams (Figure 3). The main landing gear, inboard landing gear doors and skin panels on the aircraft's belly fairing sustained compression damage (Figure 4).

Figure 3: Aircraft skin damage, fuselage fore and aft

Source: Aircraft operator

Figure 4: Aircraft skin damage, underbelly and centre section

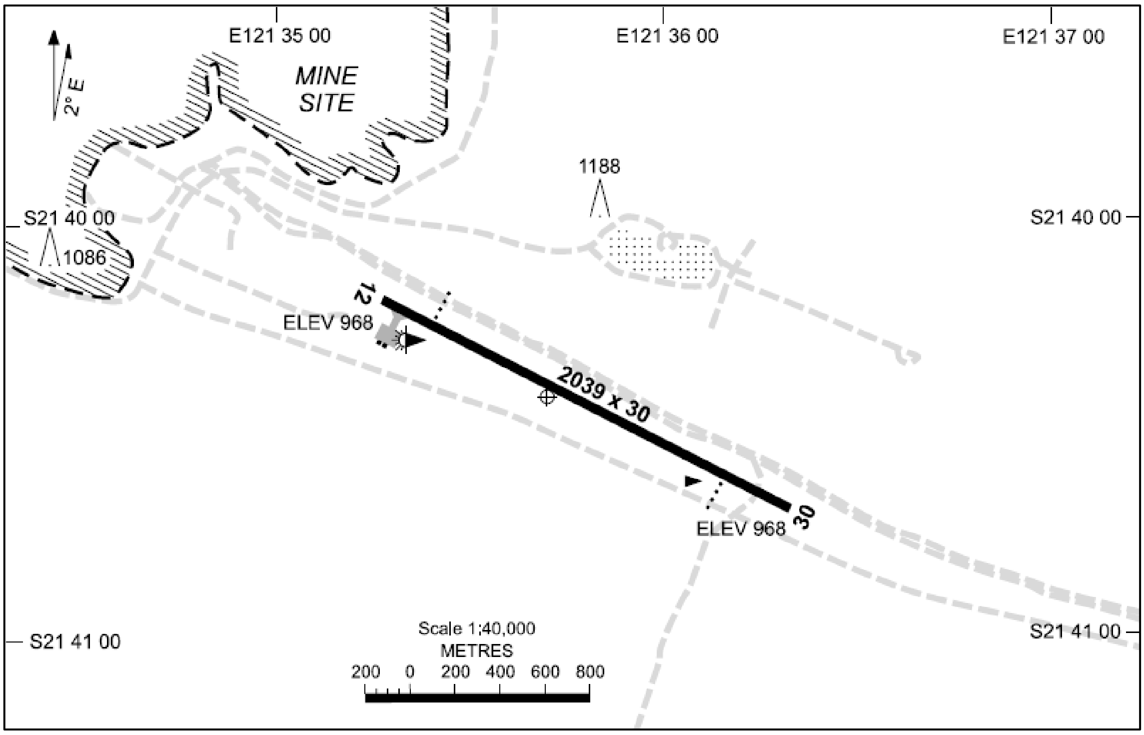
Source: Aircraft operator

Following consultation with the aircraft manufacturer and on-site repairs, the aircraft was ferried to Singapore where repairs were completed by an agent of the aircraft manufacturer.

Aerodrome information

Nifty Aerodrome, located about 1,300 km north-north-east of Perth, was privately owned and built to service the Nifty copper mine (Figure 5). The aerodrome was certified by the Civil Aviation Safety Authority (CASA) as being suitable for the operation of regular public transport or charter aircraft with more than 30 passenger seats.

Figure 5: Nifty Aerodrome



Source: Airservices Australia

The runway was sealed and aligned 115°/295° and designated 12/30. It was 2,039 m long and 30 m wide. A 60 m sealed stopway, with similar characteristics to the runway, was located at each end of the runway. While the purpose of a stopway is to support an aircraft that overruns the runway, in this case it may have been useful had the aircraft landed short of the runway threshold. Clearways, located beyond the stopways, provided an additional area that was free of obstacles for arriving or departing aircraft. Visual approach slope guidance was provided by precision approach path indicators and windsocks were located near the runway thresholds.

Terminal facilities, located on the southern side of the runway 12 threshold, were fitted with a wireless weather station that measured and displayed the local meteorological information digitally. A two-way very high frequency radio enabled ground personnel to relay operational information, including the displayed wind speed and direction, to aircraft flight crew.

Operator’s procedures

The operating procedures promulgated by the operator addressed the risk of operating in the vicinity of thunderstorms, including general advice to consider the options available when arriving at an aerodrome that had a thunderstorm within 15 NM (28 km), and to avoid thunderstorms by no less than 3 NM (5.5 km). Warnings were given about gust fronts and microbursts associated with thunderstorms and that turbulent wind reversal or windshear could occur.

The operator’s F100 manual described the causes and effects of windshear, and guidance for windshear recognition, avoidance and recovery. Essentially, expected or known windshear areas were to be avoided and if windshear was possible, there were a number of crew considerations for an approach and landing. These included:

- Fly a stabilised approach from at least 1,500 ft. This increases the ability to recognise unacceptable flight path trends as soon as possible.
- Use Flap 25 for landing as it provides the best overall recovery performance. The use of speed brake will increase engine RPM, and therefore thrust response.
- Conditions permitting, increase approach speed by 10-20 kt. An automatic approach with increased approach speed may result in automatic speed reduction and speed alerts. To prevent automatic speed reduction disconnect or override the ATS.

The manual noted that the use of autopilot and ATS was recommended because those systems relieved pilot workload and allowed more time to monitor instruments and weather. However, their use was only beneficial if properly monitored. If not properly monitored these systems could mask the onset of windshear through lack of pilot awareness of the control inputs.

Additional information

Other occurrences

Examination of Australian Transport Safety Bureau's (ATSB) occurrence database showed that, between October 2003 and September 2013, there were 61 windshear occurrences involving air transport category aircraft during the approach to land when at or below 100 ft. Of those, most resulted in a go-around. Nine occurrences were reported to have included a windshear warning.

Only the Nifty occurrence resulted in significant or greater aircraft damage. Events that were reported as having caused minor damage included:

Windshear on landing at Lord Howe Island, New South Wales

On 7 April 2007, a de Havilland Canada Dash-8 aircraft encountered severe windshear during the landing flare that resulted in the tail bumper making contact with the runway on touchdown.

Windshear on landing at Sydney, New South Wales

On 15 April 2007 a Boeing 747-400 aircraft was on a scheduled passenger flight from Singapore to Sydney, New South Wales. At about 100 ft during the approach, the aircraft encountered a significant and rapid change in wind direction. The aircraft touched down heavily and the windshear warning sounded in the cockpit. The crew conducted a windshear escape manoeuvre and made a second approach and landing. ATSB investigation AO-2007-001 found that the aircraft was influenced by outflow descending from a high-based storm cell that had developed into a microburst.

ATSB investigation reports are available at www.atsb.gov.au.

Safety analysis

Introduction

The flight proceeded normally until just before landing, when the airspeed dropped and the sink rate increased rapidly. In the limited time available, the flight crew reacted to the performance loss but were unable to prevent a hard landing with associated aircraft damage. The analysis following will consider the role of environmental factors and aircraft operating procedures in the occurrence and assess the safety implications for future operations in similar conditions.

Environmental considerations

The drop in airspeed and high sink rate just before landing were attributed to the sudden onset of a strong tailwind. This was detected by the onboard systems as a change from a 10 kt headwind at 300 ft to a 32 kt tailwind by the time the aircraft landed. With no apparent source of the wind reversal, consideration was given to the potential influence of the local topography, as well as the broader scale meteorological conditions on the occurrence.

Topography can influence local wind flow at low levels, primarily as a result of the physical interaction of wind flow with prominent surface features such as hills and valleys. In those situations the gradient wind direction and speed can be altered and turbulence generated. On a broader scale, adjacent land and/or water masses of different temperatures can generate local winds such as sea breezes. The topography of Nifty Aerodrome and environs was not considered to be a significant influence on local wind speed and direction.

In simple terms, the meteorological conditions generally experienced in the vicinity of Nifty Aerodrome were the product of the national pattern of atmospheric pressure (as represented by synoptic charts) that generated air flows known as gradient winds.[8] Interacting with the synoptic situation regionally was instability in the upper atmosphere and high surface temperatures. These conditions were forecast to generate significant convective activity and isolated thunderstorms with a relatively high base. As described by the flight crew and depicted on the satellite image and in lightning data, there were thunderstorms and other convective cloud formations in the vicinity of Nifty Aerodrome. Significantly, the meteorological conditions were conducive to the formation of dry microbursts.

It is almost certain that the aircraft's flight path on short final coincided with the strong outflow of a dry microburst in such a way as to create performance-decreasing windshear. This led to the rapid drop in airspeed, high sink rate, undershoot and hard landing.

Weather indicating and warning systems

The runway and other aerodrome infrastructure met the applicable standards and were typical of aerodromes constructed in support of remote mining operations. A windsock near each end of the runway provided an indication of wind speed and direction for touchdown. On this occasion, the windsock was influenced by the windshear after the aircraft had been affected and was therefore not a useful warning of the impending shear. The same limitation applied to the equipment monitored by the ground personnel.

The aircraft's windshear warning system was reactive, and able to identify windshear only after it had affected the performance of the aircraft. Although the system was probably serviceable, there was insufficient time for the system to register the effect on the aircraft and generate an effective warning. Predictive windshear alerting systems are available, but in these circumstances would not necessarily have provided an effective alert.

---

8 A steady, horizontal wind flowing along curved isobars.

One of the functions of the enhanced ground proximity warning system fitted to the aircraft was to provide a warning when the sink rate was excessive relative to the aircraft's height, speed, and trajectory (towards the ground). While sink rate warnings were generated late in the sequence, the situation had already been recognised and responded to by the crew.

During descent, the onboard weather radar showed isolated thunderstorms in the general area including a storm about 10 NM (18 km) south of the aerodrome. Although there were no radar returns to indicate any weather hazards near the aerodrome, the radar was not capable of detecting dry microbursts.

Aircraft operation

The crew did not specifically address windshear risk in the pre-arrival briefing and they were not explicitly required by the operator to do so. The crew did increase the approach airspeed following the windshear caution early in the approach, consistent with one of the considerations for suspected windshear. From that point until when the aircraft was affected below 100 ft, there were no indicators to the crew of any impending windshear and no additional measures to protect the aircraft were implemented.

In the context of no close thunderstorms and no salient indications of windshear, the decisions and actions of the crew were consistent with the applicable guidance. However, with the benefit of hindsight, it would have been preferable for the aircraft to have been configured with Flap 25 and 10 to 20 kt of additional speed when it encountered the windshear. Had the aircraft been fitted with a predictive windshear alerting system, that system may not have generated an alert in sufficient time for the crew to have initiated a go-around.

The effectiveness of the operator's guidelines relied on crew judgement of the potential for windshear, but the ability of crews to anticipate windshear was limited to knowledge of typical behaviour of thunderstorms and visual cues such as windsock indications and blowing dust. While crew judgement supported by onboard reactive alerting systems is generally effective, it does not provide a high level of assurance that this type of event will not occur again.

The circumstances of this occurrence show that operators of transport category aircraft may need to review the guidance provided to crews to ensure that the risk of windshear associated with both thunderstorms and dry microbursts, is effectively managed.

Findings

From the evidence available, the following findings are made with respect to the hard landing involving a Fokker 100, registered VH-NQE, which occurred at Nifty Aerodrome, Western Australia on 19 October 2012. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- On approach to land at about 80 ft above ground level, the aircraft's flight path almost certainly coincided with the strong outflow of a dry microburst, resulting in a performance-decreasing windshear that led to a rapid drop in airspeed, high sink rate, undershoot, and a hard landing.

Other factors that increased risk

- The aircraft was not fully configured for an approach in known or suspected windshear conditions, reducing the capability of the aircraft to recover from the high sink rate associated with a microburst event.

Other findings

- The aircraft was equipped with a reactive windshear warning system, but on this occasion the aircraft was below 100 ft when affected by the microburst, such that there was insufficient time for the system to generate a warning.

Safety issues and actions

The ATSB did not identify any organisational or systemic issues that might adversely affect the future safety of aviation operations. However, the following proactive safety action was reported in response to this occurrence.

Proactive safety action

Aircraft operator

The operator advised that as a result of this occurrence their flight operations safety and standards sub-committee was targeting ways of reducing the risks associated with windshear and that a number of safety actions had been implemented. This included a recommendation to owners of aerodromes serviced by their F100 fleet that they equip their aerodromes with weather stations capable of providing an automated aerodrome weather information service and windsocks at each runway threshold.

The operator also modified its simulator training program to include windshear events that did not include a windshear warning. The number of windshear training events was doubled and a consolidation of the operator’s and aircraft manufacturer’s windshear procedures and information was undertaken.

In addition, the operator issued a flight standing order advising that when a windshear caution is received prior to entering the circuit area, flap 25 was to be used for landing subject to performance limitations. Where a windshear caution is received during the approach (below 1,500 ft above the aerodrome) the approach was to be discontinued and, subject to performance limitations, the aircraft reconfigured for a flap 25 landing.

A new threat-based take-off and landing briefing model is planned for introduction in early 2014.

General details

Occurrence details

Date and time:	19 October 2012 – 1528 WST	
Occurrence category:	Accident	
Primary occurrence type:	Hard landing	
Location:	Camp Nifty Aerodrome, Western Australia	
	Latitude: 21° 40.42' S	Longitude: 121° 35.68' E

Aircraft details

Manufacturer and model:	Fokker B.V. F28 Mk 100	
Registration:	VH-NQE	
Serial number:	11457	
Type of operation:	Charter	
Persons on board:	Crew – 7	Passengers – 26
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- aircraft flight crew and operator
- aircraft manufacturer
- Bureau of Meteorology (BoM).

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the flight crew and operator of the aircraft, the Civil Aviation Safety Authority, the Dutch Safety Board and the BoM.

Submissions were received from the operator, Dutch Safety Board and the BOM. The submissions were reviewed and where considered appropriate, the text of the draft report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

24 Hours 1800 020 616
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation

Windshear-related hard landing involving Fokker 100, VH-NQE
Nifty Aerodrome, WA on 19 October 2012

AO-2012-137

Final – 6 February 2014