Accident
Investigation Board
Norway

Issued June 2012

# REPORT SL 2012/05

## REPORT ON SERIOUS INCIDENT DURING DESCENT TO SØRKJOSEN AIRPORT, NORWAY ON 21 FEBRUARY 2006 WITH BOMBARDIER DHC-8-103, LN-WIE OPERATED BY WIDEREØES FLYVESELSKAP AS

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**Photos: AIBN and Trond Isaksen/OSL**

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## REPORT ON SERIOUS AIRCRAFT INCIDENT

| | |
|---|---|
| Aircraft: | Bombardier Aerospace Inc. DHC-8-103 |
| Nationality and registration: | Norwegian, LN-WIE |
| Owner: | Widerøes Flyveselskap AS, Norway |
| User: | Same as owner |
| Crew: | 2 + 1 |
| Passengers: | 17 |
| Incident site: | During descent towards Hestvik NDB near Sørkjosen, Troms, Norway (69°55’N 020°48’E) |
| Incident time: | Tuesday, 21 February 2006, at approx 1940 hrs |

All hours stated in this report are local time (UTC + 1 hour) unless otherwise indicated.

## NOTIFICATION

On 23 February 2006, at 0824 hours, the Accident Investigation Board's officer on duty received notification from Widerøes Flyveselskap that two days earlier, one of the company's DHC-8-103 aircraft had landed at Tromsø airport Langnes (ENTC) with one engine out of operation. The damage found and the information from the crew indicated that the incident was serious. The Accident Investigation Board decided to carry out an investigation. In accordance with ICAO Annex 13, Aircraft Accident and Incident Investigation, the AIBN notified the accident investigation authorities in the state of manufacture, Transportation Safety Board (TSB) Canada, about the incident. TSB appointed an accredited representative to assist in the investigation.

## SUMMARY

Widerøe’s flight WIF922 from Tromsø to Sørkjosen airport encountered heavy turbulence during the descent. To adjust the aircraft's speed to the turbulent air, the Commander reduced engine power by pulling both Power Levers back towards the lowest possible power setting when the aircraft is airborne (Flight Idle). Unintentionally, both Power Levers ended up aft of the flight idle gate, and this was not prevented by the built-in safety protection. As a result both propellers overspeeded, reaching uncontrollably high rotation speeds. The right engine was severely damaged and the control of the aircraft was partly lost. After the aircraft had lost 760 feet of altitude and changed course, the crew gradually managed to achieve control over the right propeller and shut down the engine. The crew decided to return to Tromsø where they performed a single engine landing without additional problems.

Mere chance meant that the left engine avoided similar overspeed and damage. The aircraft was accordingly close to losing all power. Widerøe has decided to modify the relevant aircraft so that the possibility of the incident recurring has been significantly reduced. However, Canadian aviation authorities seem to be satisfied with the original design of the protection system on the Power Lever and have not implemented relevant measures. The Accident Investigation Board has issued a safety

recommendation to Transport Canada and EASA regarding the safety risk relating to some DHC-8 models.

# 1. FACTUAL INFORMATION

## 1.1 History of the flight

1.1.1 Widerøes flight WIF922 from Tromsø airport Langnes (ENTC) to Sørkjosen airport (ENSR) took off from runway 19 at approx. 1915 hours. The aircraft climbed to flight level (FL) 100. It was dark, moderate winds from the northwest, little turbulence and no icing. The Commander flew the aircraft (Pilot Flying – PF) and the autopilot was engaged.

1.1.2 During the first part of the descent towards Hestvik NDB (Non Directional Beacon), engine power was reduced from 85 % to 55 % torque. At the same, the aircraft experienced light turbulence. The Commander was very experienced with flying in the area and knew that they could expect unpleasant turbulence due to the mountainous terrain below. Accordingly, they flew 1,000 – 2,000 feet higher than necessary. A short time before, they had set the altimeters to QNH and turned on the “Fasten seat belt” sign in the cabin. The indicated speed was approximately 225 KIAS (Knots Indicated Air Speed).

1.1.3 Suddenly, the aircraft was exposed to heavy turbulence. The Commander gripped the Power Levers (which adjust the engine power) with his right hand to pull them back to "Flight Idle” (lowest power setting when the aircraft is airborne) and thus reduce speed down to the maximum speed in turbulence (Rough Air Penetration Speed) of 180 KIAS. Soon, the crew found that they lost control of the aircraft as it banked severely and pitched the nose steeply down. Dust in the cockpit was thrown up in the air and looked like smoke in the glare from one of the lights that suddenly came on, and there was a smell of oil. A completely deafening noise arose from the propellers, preventing all communication in the cockpit. A large number of warning lights came on. Before the Commander could level out the aircraft, it had lost about 1,000 feet of altitude and changed heading about 30° to the right in relation to its original course of 060°.

1.1.4 Information from the aircraft's flight data recorder (FDR) shows that over the course of four seconds, the vertical acceleration (g) varied from 1 through 0.2 to 2. For a brief moment, it reached -1.07 g. At the most, the aircraft banked 58.4° to the right and the nose was pointing downwards at 19.9°. The RPM on the right propeller rose from 911 to the highest recordable value of 1,500 over the course of 7 seconds. During the same period, the RPM for the left propeller rose from 916 to the highest recorded value of 1,483. The information from the FDR also shows that the problems started at an altitude of 8,870 feet and that the loss of altitude was 760 feet. Computed airspeed was initially 225 kt, but increased significantly to 243 kt during the last 10 seconds before the propeller speed started to rise.

1.1.5 Even with full engine power from the left engine, the speed dropped towards 140 KIAS and the Commander could not maintain altitude. However, as the speed fell, it became possible to communicate again, and the Commander became aware that the right propeller's rotational speed was too high. He therefore shouted ”propeller overspeed”. After verifying that the problem was with the right engine, the first officer executed the action items for ”Propeller Overspeed” based on memory (by heart items). However, the propeller continued to rotate with a too high rotational speed. The Quick Reference Handbook (QRH) was therefore consulted and the items for ”Propeller Overspeed” and ”Engine Shutdown Procedure” were carried out. It then became clear that the item ”Alternate Feather” had been forgotten in the first attempt. The propeller blades feathered and the propeller only stopped when the switch for ”Alternate Feather” was set to ”Feather”. Three minutes and 34 seconds had then passed since the rotational speed of the right propeller came out of control. The aircraft was at 7,728 feet at the lowest, but started to climb immediately when the propeller was set to ”Feather”.

1.1.6 While this was going on, the Commander turned left and set course back to Tromsø. Landing at Sørkjosen with one propeller out of control was not an option. When the AFIS[1] representative at Sørkjosen contacted the aircraft to ask for verification of the aircraft's position, the first officer replied by declaring an emergency and explained that they were heading back to Tromsø as they had trouble with a propeller.

1.1.7 The return to Tromsø was without further problems. The passengers were told that problems had occurred with a propeller during heavy turbulence, and that they therefore were returning with only the left engine in operation. On the way back, the crew saw that loose objects in the cockpit, such as clothing and pilot bags, had been thrown around. The action items for landing with one engine were reviewed, and the landing at Tromsø was without problems. The airport was at full emergency alert during the landing. The aircraft then taxied to the terminal and the passengers left the aircraft in the normal manner. Following the landing, the passengers were gathered and given a briefing. At this time, the crew did not know why the right propeller’s rotation speed had been out of control.

## 1.2 Injuries to persons

*Table 1: Injuries to persons*

| Injuries | Crew | Passengers | Others |
|---|---|---|---|
| Fatal | | | |
| Serious | | | |
| Minor/none | 3 | 17 | |

## 1.3 Damage to aircraft

The right engine suffered considerable damage. Refer to Items 1.12 and 1.16 for details.

## 1.4 Other damage

None

## 1.5 Personnel information

### 1.5.1 The Commander

1.5.1.1 The Commander, male, 51 years' old, received a private pilot's certificate at Sandefjord airport Torp in 1978 and later completed commercial pilot training in the US. He became an employee of Widerøes Flyveselskap in 1982 and started flying as a first officer on deHavilland DHC-6 Twin Otter. He later flew DHC-7s and DHC-8s, the latter as a Commander from 1995.

[1] AFIS, Aerodrome Flight Information Service

1.5.1.2 The Commander had an ATPL(A) valid until 31. January 2011 and valid class 1 medical license. The most recent Proficiency Check (PC) was completed on 5 December 2005 and the most recent Operator Proficiency Check (OPC) on 28 October 2005.

1.5.1.3 The Commander had had a normal night's sleep and stayed at his home until about 1430 hours before travelling by car for two hours to work in Tromsø on the day in question. The flight was the first following a seven-day free period. The Commander felt rested and alert before the flight started.

*Table 2: Flying hours Commander*

| Flying hours | All types | Relevant type |
|---|---|---|
| Last 24 hours | 0:35 | 0:35 |
| Last 3 days | 0:35 | 0:35 |
| Last 30 days | 49 | 49 |
| Last 90 days | 118 | 118 |
| Total | 11,800 | 4,410 |

1.5.2 <u>The first officer</u>

1.5.2.1 The first officer, male, 29 years' old, completed commercial pilot training in the US from 1997 to 1998. After having worked as a pilot in the US and Norway, he was employed by Widerøes Flyveselskap in August 2005 as first officer on DHC-8s.

1.5.2.2 The first officer had a CPL(A) valid until 1 June 2011 and valid class 1 medical license. He was approved as a first officer on DHC-8s in the company (Final Release) on 21 December 2005. The most recent PC was carried out on 5 February 2006.

*Table 3: Flying hours first officer*

| Flying hours | All types | Relevant type |
|---|---|---|
| Last 24 hours | 0:35 | 0:35 |
| Last 3 days | 6 | 6 |
| Last 30 days | 45 | 45 |
| Last 90 days | 113 | 113 |
| Total | 1,680 | 126 |

1.5.3 <u>The cabin crew member</u>

The cabin crew member, female, 32 years old, had a valid cabin license and medical license at the time of the incident.

## 1.6 Aircraft information

1.6.1 <u>General</u>

DHC-8 is a high-wing, twin-engine turboprop passenger aircraft. Its maiden flight took place in 1983. The aircraft is manufactured in different versions with 37 to 78 passenger seats. At the time of the incident, Widerøe operated a fleet of the versions DHC-8-103, DHC-8-311 and DHC-8-402. DHC-8-103 received a type certificate by the state of manufacture's aviation authority, Transport Canada, on 20 July 1987. Based on the

Canadian certification, the aircraft type was type accepted by the European aviation authority EASA[2] on 27 January 1988.

1.6.2 Data

| | |
|---|---|
| Manufacturer: | deHavilland Canada, now Bombardier Aerospace |
| Type/model: | DHC-8-103 |
| Year of manufacture: | 1993 |
| Serial number: | 371 |
| Total flight hours: | 24,197 |
| Total number of landings: | 52,120 |
| Engine type: | 2 x Pratt & Whitney PW 121 |
| Serial number left engine: | PC-E121313 |
| Serial number right engine: | PC-E121280 |
| Total time, left engine: | 22,106 hours |
| Total time, right engine: | 21,599 hours |
| Time since overhaul, left engine: | 10,826 hours |
| Time since overhaul, right engine: | 11,112 hours |
| Maximum take-off mass: | 15,649 kg |
| Fuel type: | JET A-1 |
| Maximum operating speed (Vmo): | 242 KIAS |

Maximum operating speed in turbulence (Rough Air Penetration speed) is 180 KIAS.

1.6.3 Maintenance

The most recent dates for the respective maintenance inspections and the related flight hours were as follows:

| | | |
|---|---|---|
| D check | 10 March 2003 | 18,042 hours |
| C check | 24 May 2004 | 22,814 hours |
| A check | 25 January 2006 | 24,023 hours |
| L check | 13 February 2006 | 24,137 hours |

[2] then called JAA

S check 18 February 2006 24,173 hours

At the time of the incident, there were no remarkes in the aircraft documents relevant to the incident.

1.6.4 Aircraft mass and balance

The aircraft had a calculated mass upon departure from Tromsø of 13,743 kg. This included 1,453 kg of fuel. The planned landing mass at Sørkjosen airport was 13,516 kg. Accordingly, the mass was somewhat above 13,500 kg when the incident occurred. The centre of gravity was calculated to be within the permitted limit (31.1 – 48.5) for the entire flight, and was at about 33.8 when the incident took place.

1.6.5 Description of the aircraft propeller adjustment system

1.6.5.1 The blades of a propeller are comparable to the wings of an airplane. This means that the propeller blades, within certain limits, create increasing lift with an increasing angle of attack. The angle of attack is the resultant between aircraft speed and the rotational speed of the propeller in relation to the blade angle[3] (see Figure 1). When air speed increases, the angle of attack will decrease if the blade angle and rotational speed remain constant. An increase in the angle of attack requires more power to the propeller shaft to keep the rotational speed constant. Somewhat simplified, you can say that the propeller's rotational speed is controlled automatically in accordance with this principle when the aircraft is in the air. The power transmitted to the propeller in relation to the blade angle decides the rotational speed as long as the air speed is the same.

1.6.5.2 On the DHC-8-103, the propeller control unit (PCU) uses hydraulic oil pressure to adjust the blade angle to maintain a rotational speed set by the pilot(s), up to a maximum speed of 1,212 RPM. To prevent propeller overspeed conditions, the rotational speed is monitored by an overspeed governor (OSG). The OSG will increase the blade angle (and thus slow the propeller) when the rotational speed exceeds 1,236 RPM. If this is not sufficient, the OSG has an additional backup pneumatic system that will reduce engine fuel supply at rotational speeds above 1,308 RPM. On the ground, the PCU controls the blade angle to a schedule that is set by power level (PL) position. Under normal conditions, during ground operations, the rotational speed is not controlled by the PCU, becoming instead a result of the chosen blade angle and associated amount of fuel supplied (rotational speed is controlled via the engine control unit (ECU) that uses fuel flow to maintain a predetermined propeller rotational speed). This is called the Beta (β) range.

1.6.5.3 If the angle of attack (result of the propeller's rotation speed, air speed and blade angle) becomes negative during flight, then the propeller will be turned by the airflow like a windmill. This means that the propeller derives energy from the airflow and the rotational speed will increase. This must be avoided and may result in a propeller overspeed. The propellers can be feathered by setting the propeller blades at the maximum high blade angle (coarse pitch). The blades are then positioned with the leading edge directly into the airflow to achieve minimum air drag and low rotational speed.

[3] Blade angle also known as pitch

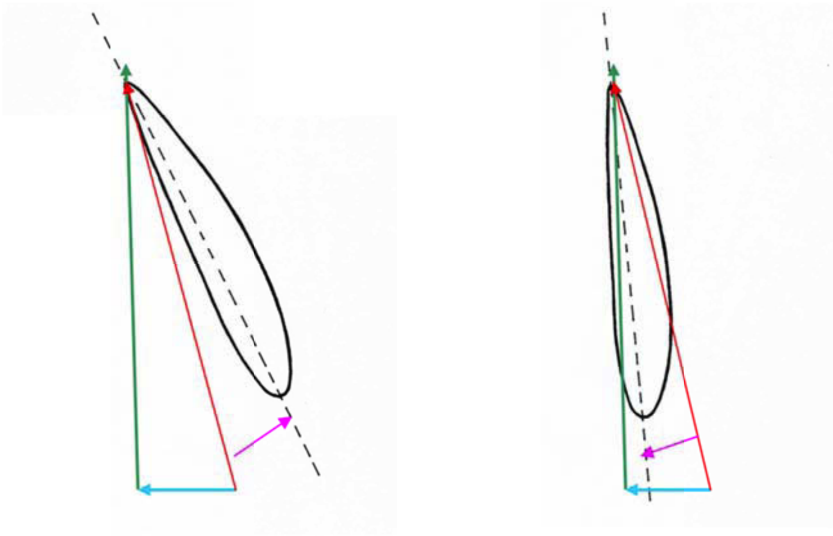

*Figure 1: Cross-section of a propeller blade. Vectors rotation speed, aircraft speed and relative wind have been indicated with arrows. The figure on the left shows the situation during normal flight. The propeller blade's angle of attack is positive and the propeller provides a pulling force. The figure on the right shows the situation when the propeller blades are moved towards revers. The propeller blade's angle of attack becomes negative and the propeller extracts energy from the airstream (works like a windmill). The blade angle (pitch) is the angle between the blade chord (dotted line) and the rotation plane (green arrow).*

1.6.5.4 The engine power and propeller rotational speed are controlled by separate levers (handles) on the cockpit centre pedestal. Two Power Levers (left and right engine) and two Condition Levers (left and right propeller) (see Figure 2):

- The Power Lever (PL) controls the power generated by the turbine, in all range of movement. To enter the area for ground operations (also called the Beta-range), the power lever trigger mechanism must be lifted and associated Power Lever moved aft through the flight idle gate (see Figure 3). Propeller operation with PL aft of FLT IDLE is controlled to a pre-determined point, beyond which the PCU speed governing is shut-off, and the hydraulic portion of the OSG is locked out. At PL positions aft of this point, the blade angle is reduced appropriate to the PL position. At DISC, the blade angle is almost 0° and the resultant propeller drag is high. By moving the Power Lever further aft, the blade angle becomes increasingly negative and the airflow through the propeller is reversed. As the PL is moved from DISC towards MAX REV, the fuel supply is elevated to increase engine power output, as the blade angle changes. When all the way back at MAX REV, the engine/propeller gives maximum reversal (the air passes forward through the propeller).

- The Condition Lever (CL) sets the desired maximum propeller governing speed when operating with the Power Lever forward of FLT IDLE (when the aircraft is airborne – not in Beta-range). When the Condition Levers are brought back to START&FEATHER, the propellers are feathered (see Figure 2). Moving the lever further back cuts off the fuel supply to the engine.


*Figure 2: Power Levers marked 1 and 2 in the centre of the photo and condition levers in the bottom right corner (Fuel Off).*


*Figure 3: The Power Lever trigger mechanism shown must be lifted by the pilot on order to allow the Power Levers to pass through the FLT IDLE gate while moving aft into the ground Beta-range. The trigger for the right engine (left in picture) has been disengaged. The picture is taken from the instrument panel looking aft. The black lever in front is the flight control lock. The measuring tape is attached by AIBN.*

### 1.6.6 Protection mechanisms on the Power Levers (Power Lever Flight Idle Gate Release Triggers)

Any movement of the Power Levers behind Flight Idle while the aircraft is airborne has an element of risk. The propeller rotational speed can exceed permitted values and at worst cause mechanical damage. Furthermore, the aerodynamic drag increases severely, which might cause loss of control of the aircraft. To prevent unintended moving of the Power Lever into the Beta-range, each Power Lever has protection and warning mechanisms. To enter the Beta-range, a small release trigger must be lifted about 5 mm to disengage a mechanical stop (se Figure 3).

1.6.6.1 Widerøe has measured the power required to lift this to about 1.4 kg. Then, an extra power of 2 kg must be used to overcome the increased resistance as Flight Idle is passed on the way back. The release trigger can be lifted to bypass the stop while the Power Lever is in any position between Maximum Power and Flight Idle. When the aircraft is airborne, an intense warning sound will be triggered when lifting the levers.

1.6.6.2 Widerøes Flyveselskap had about 330 take-offs and landings every day in 2006. The majority of these landings take place on what in Norway are termed “short runways”[4]. In order to reduce the landing distance, it is crucial to pull the Power Levers behind Flight Idle after landing, and that the propellers quickly reach the Beta-range. If this happens before there is any weight on the wheels, the warning sound will be triggered.

1.6.6.3 An existing modification is available (referred to by the term Beta Lockout) on DHC-8-100, 200 and 300 that can only be bypassed via weight on wheels (WOW) or when the aircraft radar altitude (RAD ALT) is 20 ft or less. DHC-8-Q400 series has a different engine installation from the versions mentioned above, and the Power Lever protection function is therefore also different. Widerøe believes that the protection function on the Q400 is significantly safer against unintended operation than the other model versions in the company's fleet.

### 1.6.7 Aircraft Flight Manual (AFM)

The AFM contained the following limitation in section 2, item 2.5.8 “Engine airborne limitations”:

> *“In-flight operation of the POWER levers aft of the FLT IDLE gate is prohibited. Failure to observe this limitation will cause propeller overspeed, possible engine failure and may result in loss of aircraft control.”*

### 1.6.8 Checklist

The following checklist was valid when the incident took place.

---

[4] 800 m

### 3.4.4.7 Propeller Overspeed

Crew Coordination

The checklist is considered to be a memory item; Any prop that cannot be controlled must be treated the same as an overspeed. The checklist procedures are essentially the same as "Engine Shutdown" except with the clear understanding that the Condition Lever remains in the "Start Feather" position until the propeller feathers. The pilot who first observe Propeller Overspeed calls "PROPELLER OVERSPEED ENG # _"

**Note:** If propeller overspeed in take-off (below 400 ft AGL) wait for 400 ft AGL.

| PF | PNF |
|---|---|
| | Announces **"PROP OVERSPEED #1 (or #2)"** |
| Retards **POWER** lever (affected engine) to **FLIGHT IDLE** and reduces airspeed<br>Commands **"FULL POWER"**<br>(non-affected engine) | Sets condition lever (non affected engine) to MAX, sets power to cerified torque (non affected engine).<br>Calls **"CONDITION LEVERS, FULL POWER # __ SET"** |
| **If Unable To Control Propeller RPM** | |
| Commands **"SECURE PROPELLER #1 (or #2) "**<br><br>Responds **"CONFIRMED, #1 (or #2)"** | Calls **"CONDITION LEVER #1 (or #2) START FEATHER"**<br><br>Selects Condition Lever to START/FEATHER<br>Confirms propeller feathers |
| **If Propeller Does not Feather** | |
| | Calls **"NO FEATHER" / "ALTERNATE FEATHER #1 (OR #2)"**<br>Selects appropriate Alternate Feather switch-light to FTHR |
| **If Propeller Does Not Feather** | |
| Condition lever remains at START/FEATHER<br>Continue remainder of the flight at minimum practical airspeed and altitude and land as soon as possible | Do not Shut Down Engine |
| **If Propeller Feathers** | |
| Commands **"ENGINE FAILURE SHUT-DOWN ENGINE #1 (OR #2)"** | Completes Engine Shutdown procedure and calls **"Memory Items Complete"** |
| Once propeller RPM is under control and at a minimum of 1000 feet AGL | |
| Commands **"PROP OVERSPEED CHECK-LIST"** | Completes **"PROP OVERSPEED CHECK-LIST"**<br>Calls **"PROP OVERSPEED CHECKLIST COMPLETE"** |

## 1.7 Meteorological information

### 1.7.1 Terminal Aerodrome Forecast (TAF)

ENTC 211400Z 211524 20015KT 9999 FEW010 BKN030 PROB30 TEMPO 1524 26020KT 4000 RADZ VV012=

ENTC 211700Z 211803 18015KT 9999 FEW008 BKN020 PROB30 TEMPO 1803 26020KT 4000 RADZ VV010=

### 1.7.2 Meteorological Aerodrome Report (METAR)

ENSR 211520Z 09005KT 9000 -DZ FEW010 BKN020 M00/M01 Q1015=

ENSR 211550Z 12004KT 060V200 9000 -DZ FEW010 BKN020 M00/M01

ENSR 211620Z VRB06KT 9000 -DZ FEW012 BKN020 01/01 Q1015=

ENSR 211650Z 27006KT 170V340 9000 -RA FEW012 BKN020 01/M00

ENSR 211720Z 27011KT 240V320 9000 -RA SCT015 BKN025 03/01 Q1015=

ENSR 211750Z 29011 KT 240V330 9999 -RA SCT017 BKN025 02/M00

ENSR 211820Z 28013KT 240V310 9999 -RA SCT017 BKN025 04/01 Q1015=

ENSR 211850Z 29011 KT 250V320 8000 -SHRA SCT015 BKN025 03/01

### 1.7.3 Icing forecast

1.7.3.1 Icing forecast valid from 1303 – 1900 hours (UTC):

LOC MOD ICE FCST BLW FL130 N OF N 6600 AND W OF E 02200, 0-ISOTHERM: SFC-200FT

1.7.3.2 Icing forecast valid from 1903 – 2400 hours (UTC):

LOC MOD ICE FCST BLW FL170 N OF N 6600 AND W OF E 02240, 0-ISOTHERM: 1 000FT-FL060.

### 1.7.4 Light conditions

It was night (dark). The crew has explained that there were few or no visual references outside the cockpit.

### 1.7.5 Wind observations

1.7.5.1 No turbulence forecast (SIGMET) had been issued for the area.

1.7.5.2 The Commander has told the AIBN that he perceived the wind to be about 30 knots from the northwest just prior to the incident. This was based on information from the aircraft's flight management system (FMS).

### 1.7.6 Assessments by the Norwegian Meteorological Institute (MI)

The internal investigation committee at Widerøe ordered a weather analysis from MI. The analysis concluded as follows:

*"Based on the available observations and models, it can be assumed that the general weather situation on 21 February 2006 was not uncommon for the area or season. Wind speeds were not abnormally strongly or with abnormal wind shear. In addition, the temperature distribution was not uncommon.*

*However, the available data cannot preclude that there were minor areas with strong shear and subsequent turbulence in connection with the incoming warm front."*

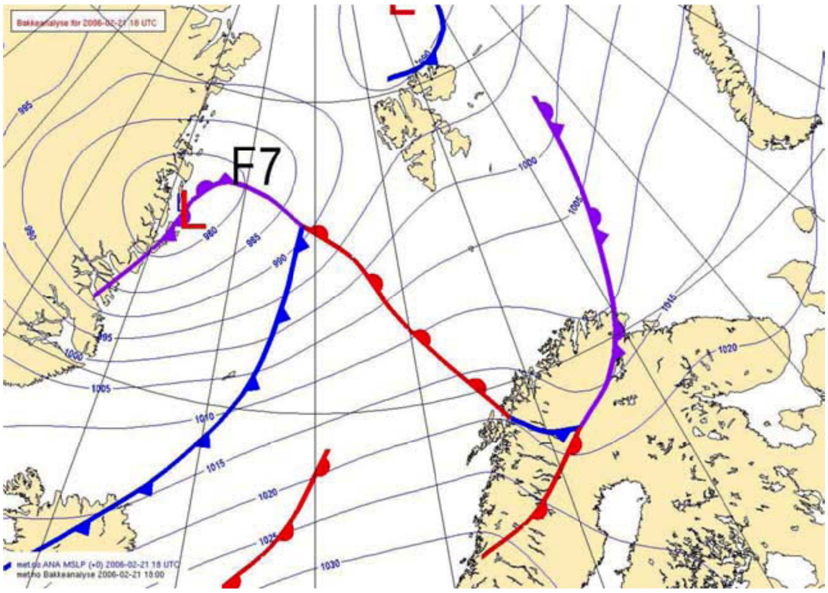


*Figure 4: The general weather situation in the northern region on 21 February 2006 at 1800 hours (UTC).*

## 1.8 Aids to navigation

1.8.1 The approach to Sørkjosen airport takes place via Hestvik NDB (Non-Directional radio Beacon), HTK at 379 kHz. HTK lies 8.1 NM north-northeast of the airport.

1.8.2 A localiser and distance measuring equipment have been installed for circling for both runways (15 and 33).

1.8.3 No faults or deficiencies have been reported for the navigational aids for Sørkjosen airport at the time of the incident.

## 1.9 Communication

Normal two-way radio communication had been established between the crew of WF922 and the relevant air traffic control units. It must, however, be noted that the noise level in the cockpit was so high at times that communication was impossible, either internally or externally.

## 1.10 Aerodrome information

1.10.1 Sørkjosen airport lies innermost in Reisafjorden, 5 km northwest of the village of Storslett (69° 47.2 N 020° 57.6 E). The airport lies 16 feet above sea level and is surrounded by several steep mountains reaching up to 3,200 feet. The asphalt runway is

30 metres wide and has a landing distance available (LDA) of 799 m in both directions (15 and 33). Both runways have been equipped with PLASI (Pulsating Light Approach Slope Indicator) of 4.5°

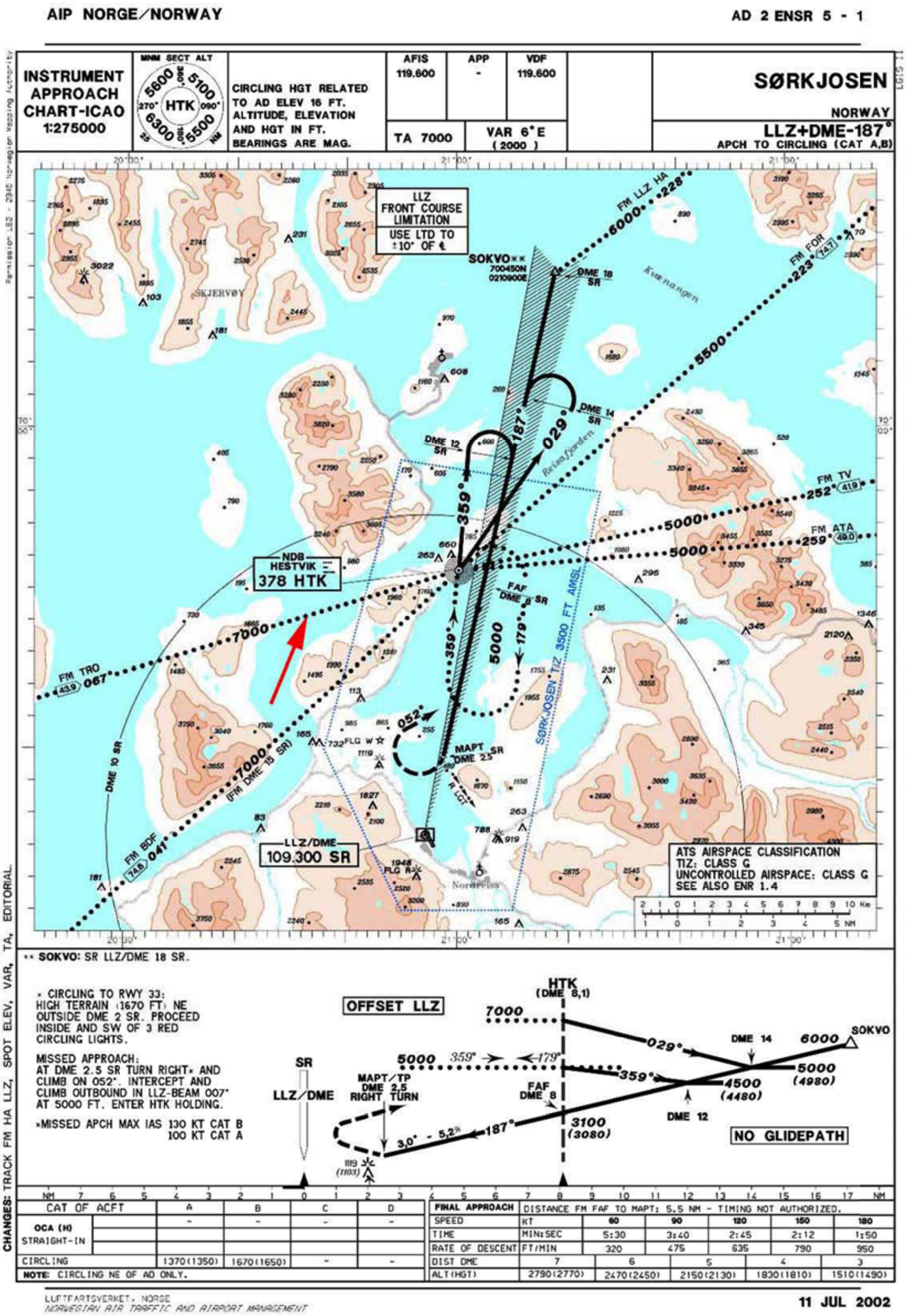


*Figure 5: Approach chart with assumed incident site marked with red arrow.*

1.10.2 The highest mountain peak in the area where the incident took place was about 3,600 ft.

1.10.3 The information on the airport given in Aeronautical Information Publication (AIP) says the following under the heading ENSR AD 2.23 Other:

> *"Flight operators must set special requirements to limitations as regards upper wind."*

There are no other specific warnings as regards wind.

1.10.4 Widerøes Flyveselskap's Airport Briefing for Sørkjosen included the following information:

> ***"RESTRICTION:***
>
> *FMS wind check must be performed before starting approach. Max wind in sector 250°-280° at 7000 ft. for starting approach: 50 kt.*
>
> ----------------------
>
> ***CAUTION:***
>
> *Upper Wind from SW-NW above 30 kts or above indicates that turbulence can be expected during approach."*

## 1.11 Flight recorders

1.11.1 LN-WIE was equipped with a cockpit voice recorder (CVR) of the type Allied Signals SSCVR, part number 980-6020-001 and serial number 0462. This was in accordance with the current equipment requirements in JAR-OPS 1[5]. The CVR was taken to the Accident Investigation Branch (AAIB) at Farnborough, England for playback. However, it turned out that the recorder did not contain information relating to the incident and return flight. The recording was probably deleted because the aircraft was left connected to power after the landing in Tromsø.

The following is quoted from the current requirements in EU-OPS 1.160:

***"Preservation, production and use of flight recorder recordings***

*(a) Preservation of recordings:*

> *1. Following an accident, the operator of an aeroplane on which a flight recorder is carried shall, to the extent possible, preserve the original recorded data pertaining to that accident, as retained by the recorder for a period of 60 days unless otherwise directed by the investigating authority.*
>
> *2. Unless prior permission has been granted by the Authority, following an incident that is subject to mandatory reporting, the operator of an aeroplane on which a flight recorder is carried shall, to the extent possible, preserve the original recorded data pertaining to that incident, as retained by the recorder for a period of 60 days unless otherwise directed by the investigating authority."*

1.11.2 LN-WIE was equipped with a flight data recorder (FDR) of the type Allied Signals SSFDR. It has part number 980-4700-001 and serial number 0918. This was in accordance with the current equipment requirements in JAR-OPS 1. Data from FDR of

[5] Following the incident, JAR-OPS was replaced with EU-OPS

good quality were downloaded at Widerøe's premises. The following provides detailed information on the incident:

- Seven seconds elapsed from the Commander started to reduce engine power from 55 % torque to both engines until the engines were down to 0 % torque.

- Before the Commander reduced engine power, the right propeller had a rotational speed of 911 RPM. Seven seconds later, the propeller's rotational speed had exceeded the highest recordable value of 1,500 RPM. During the same period, the RPM for the left propeller rose from 916 to the highest recorded value of 1,483. Two seconds later, the left propeller had, however, returned to the normal RPM of 914. The right propeller continued with a rotational speed exceeding 1,500 RPM for 17 seconds and did not return to a normal rotational speed until the propeller was feathered more than three minutes later.

- After the rotational speed on the right propeller came out of control, the values for the engine's rotational speed (NL and NH) and fuel flow (FF) sank towards zero for the next 10 seconds.

- 34 seconds passed from the engine power was reduced on the left engine until it was up to full effect (98.8 % torque)

- Vertical accelerations were recorded in accordance with the graph below. The lowest value of -1.07 g was recorded in the same second that the torque on the right engine fell from 42.6 % to 6.1 %.

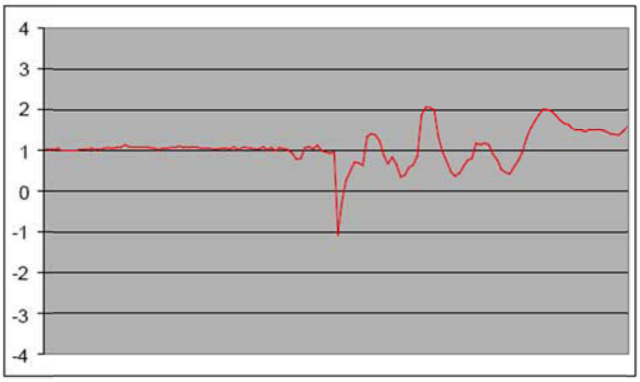


*Figure 6: Vertical acceleration forces (g) over a period of 20 seconds.*

## 1.12 Damage to the aircraft

1.12.1 Following the landing, it was discovered that the right engine had suffered considerable damage. For example, it was discovered that the shaft between the engine and the gear box had thrown fragments through the shaft housing and into the air intake.

*Figure 7: Damage to the air intake on the right engine which arose when the shaft between the engine and gear box separated.*

1.12.2 As the scope of the incident was studied by using the FDR information, Widerøe decided to investigate the following in more detail:

Left engine. The engine was removed and sent to Pratt & Whitney Canada (UK) Ltd, Service Centre in Southampton (UK). No fault or damage was found to connect the engine to the incident.

Left propeller. The propeller was examined by Widerøe's technical department. They found no faults or damage on the propeller that can be connected with the incident.

Left propeller control unit (PCU). The component was examined at H&S Aviation in Portsmouth (UK) without any faults or damage being found.

Left overspeed governor. The component was examined at H&S Aviation in Portsmouth (UK) and function-tested without any faults being found.

Right engine. The engine was removed and sent to Pratt & Whitney Canada (UK) Ltd, Service Centre in Southampton (UK). The findings are described in Item 1.16.1.

Right propeller. As a result of the loads that the propeller had been exposed to during the incident, it was scrapped without further examination.

Right propeller control unit (PCU). The component was examined at H&S Aviation in Portsmouth (UK) without any faults or damage being found.

Right overspeed governor. The component was examined at H&S Aviation in Portsmouth (UK) and function-tested without any faults being found.

Wings, fuselage and engine installation. The mentioned areas were examined by Widerøe's technical department in accordance with the manufacturer's descriptions. No other damage than that mentioned in Item 1.12.1 was found.

## 1.13 Medical and pathological information

Not applicable.

## 1.14 Fire

There was no fire as a result of the incident.

## 1.15 Survival aspects

The crew and passengers were in their seat belts when the incident took place and no-one was physically injured.

## 1.16 Tests and research

### 1.16.1 Examination of the right engine

1.16.1.1 The engine was removed and sent to Pratt & Whitney Canada (UK) Ltd, Service Centre in Southampton (UK) for more detailed examination. The information below has been obtained from a report prepared on the basis of the examination of the engine.

1.16.1.2 With the exception of the damage to the engine's air inlet, the engine was externally intact. However, the internal damage was extensive. Of the more serious damage, we mention:

- The engine-to-gearbox shaft had separated
- Significant damage to the compressor due to metal fragments passing through it
- The low pressure turbine shaft had separated and partially melted (see Figure 9)
- The high pressure turbine shaft had separated and partially melted
- Major damage to the vane rings for the power turbine's second stage (see Figure 8)
- Most of the turbine blades on the power turbine's second stage had been completely destroyed
- Considerable damage in several places due to contact between rotating and stationary parts

*Figure 8: Damage to the power turbine's second stage.*

*Figure 9: The low pressure turbine shaft had separated and partially melted.*

## 1.17 Organisational and management information

### 1.17.1 The airline

Widerøes Flyveselskap ASA was established in 1934 and has its main base in Bodø. At the time of the incident, the company had approximately 1,470 employees and operated a fleet of 17 Bombardier DHC-8-103, 9 DHC-8-311 and 3 DHC-8-Q402. The company has a valid AOC based on BSL JAR-OPS 1.

### 1.17.2 Training

1.17.2.1 Periodic training in Widerøe took place at SAS Flight Academy (SFA). However, the company used its own instructors for proficiency checks. The training was based on the company's Pilot Training Manual, which is based on the manufacturer's Program Support Manual (PSM), Chapter 1-8-1 Operating Data for DHC-8 series 100. This describes how the propeller works and what happens when the Power Lever is pulled behind Flight Idle. It also describes protection and warning functions on the Power Lever. It is assumed that the Beta-range is only used on the ground.

1.17.2.2 The company's internal investigation committee has in its report stated that ”*The company should, through training and education, strengthen the pilots' awareness as regards the consequences of ”in-flight-reverse-beta”.”*

## 1.18 Additional information

### 1.18.1 Other comparable incidents/accidents

1.18.1.1 The Accident Investigation Board knows that a number of similar incidents and accidents have occurred where the propellers of turboprop aircraft have entered reverse (Beta-range) while airborne. This applies to aircraft types such as Embraer 120, Fokker 50, SAAB 340 and DHC-8.

1.18.1.2 An incident that has much in common with the incident on the approach to Sørkjosen took place on 1 April 1996 with a DHC-8-100 during the approach to Quesnel in Canada. In heavy turbulence, the crew pulled back on the Power Lever and a high bang was heard. The right engine lost power and the crew chose to shut down the engine completely. The crew then interrupted the approach and continued to Williams Lake where they landed without further problems. The company later read the data from the flight data recorder. Based on these data, it was concluded that the Power Levers had been pulled behind the Flight Idle stops during turbulence, and that the propellers therefore achieved a rotational speed exceeding 1,500 RPM, well above the maximum permitted, which is 1,210 RPM. As a result of the excessive rotational speed, the right engine gear box was destroyed[6].

1.18.1.3 Two accidents with Fokker 50 that were probably caused by reversal of the propellers in the air resulted in EASA issuing Airworthiness Directive No. 2009-0049. The Airworthiness Directive orders the installation of an automatic system that prevents airborne reversal. The order is explained as follows:

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[6] Bombardier gave the following comment during the draft review of this LN-WIE report: “Bombardier was advised of this after the fact. During a Transport Canada review of the event there were indications that the flight crew intentionally moved the power levers aft of the flight idle gate and into the ground Beta range. They believed this was an appropriate way to slow the aircraft during approach for landing.”

*"This condition, if not corrected, could lead to further events of inadvertent propeller reverse selection during flight, resulting in loss of control of the aeroplane. Even though the potential for this kind of event is primarily driven by operational (human) factors, corrective (AD) action is nevertheless considered justified.*

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*To improve the overall reliability of the flight-idle stop system, making the system less sensitive to intentional and inadvertent power lever selections below flight-idle, Fokker Services has developed a modification that meets the latest requirements."*

1.18.1.4 The Accident Investigation Board touched upon the topic of reversal in the air when a DHC-8-103 operated by Widerøe crashed during landing at Hammerfest airport on 1 May 2005 (SL Report 2009/22). During the approach, the crew heard something they likened to birds twittering without knowing what it meant. In retrospect, it became clear that this was the warning sound for pulling the Power Levers into the Beta-range. Although this did not have any bearing on the accident, the report made a safety recommendation to the effect that "*Widerøe should consider whether the pilots' knowledge and awareness of this system can be improved."* (Safety recommendation SL No. 2009/27T). The serious incident with LN-WIE at Sørkjosen on 21 February 2006 (which this report deals with) resulted in an increased focus on the issue. This, combined with modifications carried out on the company's aircraft, resulted in the Civil Aviation Authority closing the recommendation on 12 November 2009.

1.18.1.5 An accident to a DHC-8-103 (P2-MJC) took place near Madang, Papua New Guinea 13 October 2011. The Accident Investigation Commission of Papua New Guinea has issued preliminary report AIC-11-1010 to the accident (http://www.atsb.gov.au/media/3482404/png%20aic_11_1010%20p2-mcj%20preliminary%20report_1.pdf). The following is quoted from the report:

*The flight progressed normally and MCJ was transferred to Madang Air Traffic Control (ATC) at 1710 with on descent into Madang. The descent profile on this sector was steep because of the proximity of the Finisterre Ranges to Madang and the pilot-in-command (PIC), who was the handling pilot, was hand-flying the aircraft because the autopilot was unserviceable. He was manoeuvring the aircraft visually to avoid cloud and thunderstorms. At 1712, in response to a request from Madang Tower, the flight crew stated the aircraft was 24 NM from Madang, leaving 13,000 feet on descent.*

*At approximately 1715, the aircraft's overspeed warning horn sounded. Very shortly afterwards, both propellers simultaneously oversped and exceeded their maximum permitted revolutions per minute (rpm) by in excess of 60 percent. Witnesses on the ground reported hearing a bud `bang' as this occurred.*

*At 1717, the crew made a MAYDAY call to ATC and indicated that they were experiencing an in-flight emergency and that both engines had stopped. Madang Tower declared a DISTRESS SAR PHASE, believing the aircraft was about to ditch in the ocean.*

*The aircraft force-landed on sparsely timbered terrain on the northern side of the Buang River, 33 km south east of Mandang township. During the impact* *sequence, it was severely damaged while colliding with trees on the ground, and an intense fuel-fed fire began."*

Twenty-eight passengers were fatally injured during the impact and subsequent fire.

1.18.2 Interim safety recommendations

1.18.2.1 On 22 June 2006, the AIBN sent a letter to the accredited representative in Canada (TSB) and gave an account of the findings of the investigation. The course of events and the crew's handling of the incident were also described. Furthermore, it was specified that the incident was considered to be serious, as only chance prevented both engines from being destroyed. The letter announced that interim safety recommendations would be issued and encouraged the initiation of a dialogue regarding the topic.

1.18.2.2 No objections were raised to issuing immediate safety recommendations in the reply letter that the AIBN received on 27 February 2007. This was read as an acceptance of a safety recommendation. The following interim safety recommendation was therefore sent to TSB on 28 February 2007:

> *"The AIBN recommends that Bombardier evaluate all DHC-8 models with respect to inadvertent airborne reversing. All models that can be reversed unintentionally during pull back of Power Levers should be modified in such a manner that dangerous inadvertent airborne reversing is unlikely to happen. Until a modification is implemented operators should be informed about the hazard in an appropriate way. (Interim safety recommendation no. 06/120-9)"*

1.18.2.3 On 7 May 2007, the Accident Investigation Board received an answer from TSB where reference is made to comments from the aviation authority Transport Canada and Bombardier. In brief, the mentioned bodies were not concerned that unintended airborne reversal would occur. Bombardier concluded as follows:

> *"Bombardier appreciates the opportunity to review and comment on the above referenced safety recommendation. We have thoroughly reviewed the existing power lever flight idle gate design and find that inadvertent airborne reversing is unlikely to occur. In our opinion, further modification to the installation is not necessary."*

1.18.2.4 The final part of the Accident Investigation Board's recommendation to inform operators of the risk of unintended reversal was not addressed in the reply letter.

1.18.3 Measures implemented by Widerøe following the incident

As it became clear to Widerøe what had happened, the company installed warning signs near the Power Levers of all aircraft of the types DHC-8-103 and DHC-8-311 in May/June 2006 (seeFigure 10).

1.18.3.1 The installation was based on Bombardier Service Bulletin 8-11-103.


*Figure 10: Warning sign installed near the Power Lever.*

1.18.3.2 The warning sign was considered a temporary solution, and Widerøe attempted to find a solution that entailed a type of mechanical barrier. On the basis of Bombardier Service Bulletin 8-76-28, Widerøe prepared a technical work order (8TO76-109) for installation of a modified protection function on the Power Lever. The modification necessitates pulling the Power Lever all the way back to Flight Idle before the blocking devices can be passed. The first aircraft had this modification installed in February 2010 and the plan calls for all aircraft to be modified by 2012.

### 1.19 Useful or effective investigation techniques

No methods qualifying for special mention have been used in this investigation.

# 2. ANALYSIS

## 2.1 Introduction

2.1.1 The Accident Investigation Board has classified the incident as serious because the aircraft nearly lost power on both engines. In the dark, considering the altitude and distance from Sørkjosen, it is unlikely that the crew could have managed a safe emergency landing had they lost all engine power.

2.1.2 The incident was not caused by shortcomings in operational procedures, but by the Power Levers unintentionally being pulled back so that the propellers entered the Beta-range. That this happened in spite the crew being familiar with the hazard shows that the protection and warning functions were insufficient. There is nothing to indicate that technical malfunctions caused the incident. Below are analyses of what happened during the descent towards Sørkjosen, challenges inherent in changing the current construction and how similar incidents can be avoided.

## 2.2 The course of events

2.2.1 The Accident Investigation Board is of the opinion that the course of events has been properly clarified by the crew's explanations and information obtained from the aircraft's flight data recorder. The crew chose to fly somewhat high towards Hestvik NDB to avoid mechanical turbulence from the mountains. Furthermore, the passengers had fastened their seat belts. These were operative precautions based on experience and the company's warnings (see Item 1.10.4). The Accident Investigation Board is of the opinion that the crew in this way took into account the possibility of turbulence in the area and that they

2.2.2 Followed the applicable procedures. As the crew entered heavy turbulence, they had to pull back the Power Levers to bring the aircraft's speed down to the Rough Air Penetration speed of 180 KIAS.

2.2.3 There may be at least two reasons why the Power Levers unintentionally ended up behind Flight Idle. The company's pilots perform a large number of landings on short runways. Such landings require the propellers to be brought to DISC, or possibly further on to reverse, as soon as the aircraft wheels hit the runway. To achieve this, the release triggers on the Power Levers must be lifted. This means that the handles are lifted routinely in connection with landings, and the action cannot be considered unusual or exceptional. It is therefore understandable that the triggers might be lifted unintentionally, as cancelling the blocking function is a routine action performed several times each day. It may be particularly understandable when the action is performed under some time pressure, as was the situation in this case.

2.2.4 It might be said that it requires more precision to grip the Power Levers without the fingers closing around the handles than it does to grip the entire mechanism. This factor is especially relevant when the aircraft is subjected to turbulence. The Accident Investigation Board can therefore understand how the Commander came to grip the entire mechanism, including the release triggers, when he suddenly had to pull back the Power Levers to Flight Idle. In this period, the g values were as low as -1.07[7]. This can also result in a need to grip the handles extra hard. If the fingers grip the release triggers, the mass of the Commander’s right hand may itself provide enough force to release the stop function at a load of -1g. It is therefore understandable that the release triggers may have been lifted by accident when the Commander pulled the Power Levers to Flight Idle. A force of 2 kg, which is required to pass Flight Idle, cannot be said to represent certain assurance against the Power Levers being pulled too far back. This is especially true when the aircraft is being shaken hard in turbulence.

2.2.5 The AIBN is of the opinion that the warning sound that is turned on when the triggers are lifted and the aircraft is airborne has a limited function to prevent passing the Flight Idle detent. Depending on the position of the Power Levers when the triggers were lifted, the warning sound may have lasted from slightly more than a second to only a fraction of a second.

2.2.6 The AIBN believes the Commander acted rationally when he gripped the Power Levers and pulled them back. He expected them to stop at Flight Idle, but ended up pulling them too far back. It is not possible to establish how far back they came before he instinctively pushed them forward again as he realised something was seriously wrong. The fact that

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[7] This means that the aircraft was exposed to negative g-forces corresponding to flying upside down.

damage was limited to the right engine can indicate that the right Power Lever was pulled somewhat farther back than the left. This may be due to pure chance or that the hand, due to the geometry of the arm, was twisted a little when the handles were pulled back. A factor can also be how long the Power Levers stayed behind Flight Idle. The existence of rigging differences between the two engines is also possible. Furthermore, the AIBN cannot see any significant differences between the two engines or their ability to withstand propeller overspeeding.

2.2.7 When the Power Levers were pulled back to Flight Idle, the propeller blades started to move towards fine pitch (so that the angle of attack in relation to the relative wind was going towards zero - see Item 1.6.5.3). This resulted in the power required to turn the propeller falling towards zero. This means that all power requirements from the engine disappeared. As the propeller blades, through the Power Lever, had been ordered towards reversal, the angle of attack became negative and the propellers derive energy from the airflow like a windmill. This power forced an increase in the rotational speed of the propellers, gear box and power turbines. As the propellers at the time were adjusted in accordance with the parameters in the B-range, the propeller control unit had no direct control over the propeller's blade angle. The rotational speed of the power turbines and propellers therefore increased beyond the maximum permitted and the overspeed governor cut off fuel supply. This had no function either, as the propeller was driven by the airflow and not by the engine.

2.2.8 In reality, the rotational speed of the propellers was totally out of control. A turbine engine with a free turbine rotates with relatively little resistance, and the rotational speed of the propellers depended mainly on the blade angle and the aircraft speed. The result was that both propellers, over the course of seven seconds, had an increase in rotational speed that was completely out of control. The right propeller reached a rotational speed so high that the low-pressure turbine shaft sheared and partly melted (see Figure 9), while major damage was caused to the power turbine. The load on the shaft between the gear box and engine was so great that it was twisted off. The high rotational speed most likely resulted in the propeller tips reaching supersonic speed, creating an intense noise. Thereafter, the right propeller and right gear box rotated almost freely until the propeller was stopped more than three minutes after the rotational speed came out of control.

2.2.9 In the view of the AIBN, it was purely by chance that the left engine/propeller did not reach the same degree of propeller overspeed as the right engine and thus escaped serious damage. Both engines were thus very close to being destroyed.

2.2.10 In a matter of seconds, the flight crew experienced a sudden change from a routine descent to a dramatic situation. The noise from the propellers prevented communication, and a negative g-load, smoke and a number of warning lights made the situation difficult to assess. As this took place while the aircraft was banking severely and pitching the nose down, it is understandable that the crew for a while had enough to do regaining control of the aircraft and analysing the situation. When the aircraft had achieved level flight again, the air speed started falling and the rotational speed of the right propeller declined as a result. When it had been verified that the problem related to the right propeller, the first officer started to secure the engine/propeller. That he in the first attempt forgot to perform Alternate Feather had, in the opinion of the Accident Investigation Board, no major significance for the extent of the damage as long as the right actions were carried out after the Quick Reference Handbook had been consulted. The memory items in the checklist must, however, be remembered, and forgetting can have far more grave operative consequences than in this case.

2.2.11 A propeller that is in Beta-range will create so much drag that it might be difficult to maintain altitude or critical speed with one engine. It can therefore be questioned whether the aircraft could have flown all the way to Sørkjosen with the propeller out of control. It is not known how high the rotational speed of the right propeller was, as FDR could not record values exceeding 1,500 RPM. Accordingly, it is not known how large the margins were from the propeller blades coming loose. Both these aspects emphasise the severity of the incident and the importance of the crew regaining control of the propeller through use of Alternate Feather. When the propeller came to Feather, the aircraft's performance improved to the extent that it was unproblematic to fly back to Tromsø for a safe landing.

2.2.12 The control problems experienced by the flight crew were of relatively short duration and the loss of altitude was limited to slightly less than 1,000 feet. The distance to the terrain below was substantial and even the clearance to the highest mountain tops in the area exceeded 4,000 feet. Although loss of control of an aircraft is a serious matter in itself, the Accident Investigation Board believes that the control problems and loss of altitude in this case were of a less serious order.

## 2.3 Improvement of the protection function on the Power Lever

2.3.1 A propeller that functions as a windmill, i.e. where the propeller blades' angle of attack is negative, will cause high drag and may reach dangerously high rotational speeds. An uncontrollable propeller is therefore one of the most serious situations that can occur in a propeller driven aircraft. For this reason, variable pitch propellers are equipped with various mechanisms to prevent this.

2.3.2 Many propellers are equipped with reversal systems for braking and manoeuvring on the ground. To prevent reversal from taking place while airborne, the transition from air to ground operations is blocked with various mechanisms. These protection systems can be relatively simple, as in DHC-8-103 and 311. They can also be more complicated, for example requiring weight on the wheels to cancel the blocking function. There are also systems based on radar altimeters that prevent reversal over a certain altitude above ground. The more complicated systems all have a tendency to delay reversal and they are vulnerable to malfunction. A fault in the blocking functions, resulting in one or more propellers not reversing, can have serious consequences on the ground. The issue is especially relevant for Widerøe, with many landings on short, often slippery, runways where quick and precise operation of the propellers in the Beta-range may be necessary. Widerøe had not previously experienced similar serious incidents with DHC-8, and had not until the incident considered it necessary to modify the protection system.

2.3.3 The challenge facing the company was finding a protection system which did not inhibit daily operations while ensuring safety. The Accident Investigation Board is of the opinion that Widerøe, by modifying the aircraft in accordance with technical order No. 8TO76-109, has significantly reduced the possibility of a recurrence. Given that the incident seems to be a one-off incident in the company, and that the pilot corps has gained an increased understanding of the issue, the Accident Investigation Board believes that the safety in the company has increased significantly in this area.

2.3.4 Experience has shown that accidents can takes place on several aircraft types in connection with unintended airborne reversal of propellers. The Accident Investigation Board sees that EASA has looked into the issue in connection with accidents involving Fokker 50s, and that EASA has issued an Airworthiness Directive for this aircraft type. The Accident Investigation Board notes that the Canadian aviation authorities seemed to be satisfied with the design of the original protection function on the Power Levers in 2007 and believed further modifications was unnecessary. However, the Accident Investigation Board is of the opinion that the safety problem is real and issues a safety recommendation.

# 3. CONCLUSIONS

In an attempt to reduce the aircraft's speed during increasing turbulence, the Commander inadvertently pulled both Power Levers past Flight Idle. This was not prevented by the built-in protection systems, and both propellers reached uncontrollably high rotation speeds. The right engine was severely damaged and control of the aircraft was partly lost. As the situation was brought under control, the crew managed to return and land safely in Tromsø with one engine in operation. Widerøe has modified its aircraft to prevent recurrences.

## 3.1 Findings

a) The aircraft was registered in accordance with the regulations and had a valid environmental and airworthiness certificate.

b) The aircraft's mass and balance were within the permitted limits at the time of the incident.

c) The investigations have not uncovered any technical malfunctions in the aircraft that affected the course of events.

d) It is extremely hazardous to pull the Power Levers behind Flight Idle and into the Beta-range when the aircraft is airborne.

e) To reduce the possibility of the Power Levers being inadvertently pulled behind Flight Idle when the aircraft is airborne, the system has been equipped with warning and blocking functions. However, these have several weaknesses.

f) The Accident Investigation Board is of the opinion that the incident occurred due to too weak safety barriers in the protection systems on the Power Levers.

g) The crew members had valid certificates and privileges for the aircraft type.

h) In an attempt to adapt the aircraft's speed during increasing turbulence, the Commander inadvertently pulled both Power Levers aft of the Flight Idle gate.

i) As the Power Levers entered the Beta-range, both propellers reached an uncontrolled high rotational speed, resulting in major mechanical damage to the right engine.

j) With both propellers in the Beta-range, the aircraft was briefly out of control and the noise from the propellers made it impossible for flight crew to communicate.

k) When the air speed fell and the aircraft came under control again, the crew was after a while able to feather the right propeller and stop the right engine.

l) The Accident Investigation Board consider that the left engine by mere chance avoided similar damages and regard the incident to be serious as the aircraft could have lost engine power on both engines.

m) The left engine was not seriously damaged, probably because it did not reach the same degree of propeller overspeed as the right engine.

n) The loss of altitude during the incident was not critical in relation to terrain height.

o) The aircraft returned to Tromsø with only one engine in operation.

p) Widerøe has decided to modify the relevant aircraft types, based on Bombardier Service Bulletin 8-76-28. In the opinion of the Accident Investigation Board, this will significantly reduce the probability of the incident recurring.

q) There have been earlier cases of incidents and accidents due to unintended airborne reversal of propellers.

# 4. SAFETY RECOMMENDATIONS

The Accident Investigation Board Norway (AIBN) makes the following safety recommendations[8]

**Safety recommendation No. 2012/04T**

This serious aircraft incident has shown that on the aircraft type DHC-8 it is possible to inadvertently pull the Power Levers back past Flight Idle while airborne. The consequences of this may include propeller overspeed, possible engine failure and loss of aircraft control.

The Accident Investigation Board Norway recommends that Transport Canada and EASA require the type certificate holder (Bombardier) to introduce measures to prevent propeller overspeed during unintended management of Power Levers.

The Accident Investigation Board Norway

Lillestrøm, 22 June 2012

[8] The Ministry of Transport and Communications ensures that safety recommendations are presented to the aviation authorities and/or other relevant ministries for assessment and follow-up, cf. Section 17 of the Regulations relating to public investigation of air traffic accidents and incidents in civil aviation.

# APPENDIX

Appendix A: Relevant abbreviations

# RELEVANT ABBREVIATIONS

| | |
|---|---|
| AD | Airworthiness Directive |
| AGL | Above Ground Level |
| AOC | Air Operator Certificate |
| ATPL(A) | Air Transport Pilot Licence, Airplane |
| BECMG | BECoMinG - weather code, forecasts change |
| BKN | BroKeN - weather code for broken clouds |
| CLD | CLouD - weather code for clouds |
| CPL(A) | Commercial Pilot Licence (Aeroplane) |
| CVR | Cockpit Voice Recorder |
| DME | Distance Measuring Equipment |
| EASA | European Aviation Safety Agency |
| FBL | FeeBLe - weather code for weak/little |
| FDR | Flight Data Recorder |
| FEW | Few - weather code for light clouds |
| FL | Flight Level |
| ft | Feet |
| g | 9,8 $m/s^2$ |
| JAR-OPS | Joint Aviation Requirements – Operations |
| KIAS | Knots Indicated Air Speed |
| KT/kt | Nautical Mile(s) (1 852 m) per hour |
| LLZ | Localiser |
| LOC | LOCal - weather code for local |
| MOD | MODerate - weather code for moderate |
| NW | NorthWest |
| OG | Overspeed Governor |
| PCU | Propeller Control Unit |

| | |
|---|---|
| PC | Proficiency Check |
| PROB | Weather code for probability |
| Q | QNH - weather code for altimeter setting related to the pressure at sea level |
| RADZ | RAinDriZzle - weather code for rain and drizzle |
| RISK | RISK- weather code for chance of undesirable phenomenon arising |
| RPM | Revolutions Per Minute |
| SFC | SurFaCe - weather code for ground level |
| AIBN | The Accident Investigation Board Norway |
| SIGMET | SIGnificant METeorological information |
| SNRA | SNowRAin - weather code for sleet |
| TEMPO | Weather code for temporary |
| TSB | Transportation Safety Board |
| UTC | Universal Time Coordinated |
| WX | Weather |