Sicherheitsuntersuchungsstelle
des Bundes

Final Report

Accident with the helicopter Sokol W-3A,
on 14.01.2019, at approx. 11:34 UTC at Bürglkopf,
Gemeinde Fieberbrunn, A-6391, Tyrol,
GZ.: 2021-0.905.481

Vienna, 2021

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Preface

The safety investigation is conducted in accordance with Regulation (EU) No. 996/2010 and the Accident Investigation Act, Federal Law Gazette I No. 123/2005 as amended.

The sole objective of the safety investigation is the prevention of future accidents or incidents, without apportioning blame or liability.

Unless otherwise stated, safety recommendations are addressed to those bodies that can translate the safety recommendations into appropriate measures. These bodies have competence to decide on the implementation of safety recommendations.

In order to preserve the anonymity of all natural or legal persons involved in the accident, serious incident or incident, the draft report is subject to restrictions on its content.

All times given in this report are in UTC (local time = UTC + 1 hour).

Note

The scope of the safety investigation and the procedure to be applied when conducting the safety investigation shall be determined by the national safety investigation authority in accordance with the findings it intends to draw from the investigation in order to improve flight safety. Article 5 of Regulation (EU) No 996/2010.

Investigating the causes does not imply establishing guilt or administrative, civil or criminal liability. Article 2 of Regulation (EU) No 996/2010.

Note on persons shown:

Uninvolved persons, accident investigators or members of the organising units may be seen and anonymised in pictures of the objects and locations (photos) included in this report. As the colours of the clothing of these persons (e.g. fluorescent colours of high-visibility waistcoats) may possibly distract from the message of the images, they have been digitally retouched (e.g. greyed out) if necessary.

Introduction

Aircraft owner:	Company
Operating mode:	Aerial Work
Aircraft manufacturer:	PZL-Swidnik
Type name:	Sokol W-3A
Aircraft type:	Helicopter
Nationality:	Austria
Accident site:	6391 Fieberbrunn**,** Bürglkopf, Trixlegg 12
Coordinates (WGS84):	N47°26´17´´ E 012°35´45´´
Altitude above sea level:	approx. 1260m
Date and time:	14.01.2019, approx. 11:34 a.m.

The on-call service of the safety investigation authority of the Federal Transport Authority Civil Aviation was informed about the incident by the Search and Rescue Centre of Austro Control GmbH (ACG) on 14 January 2019 at approx. 1 p.m. In accordance with Article 5(1) of Regulation (EU) No 996/2010, a safety investigation of the accident was initiated.

In accordance with Article 9(2) of Regulation (EU) No 996/2010, the States involved were informed of the accident:

State of manufacturer:	Poland
State of Design:	Poland
State of the operator:	Austria
State of Holder:	Austria
State of Registry:	Austria

Summary of events

Due to the enormous snowfall, a safety inspection of the high voltage supply line was carried out with the helicopter type Sokol W-3A.

Shortly before the end of the line, there was a sudden loss of power which could no longer be compensated. As a result, an emergency landing was carried out in the Bürglkopf area. At the touchdown point, the main rotor blades touched a birch tree standing to the left of the helicopter's longitudinal axis. This damaged the main rotor blades. Parts of the severed main rotor blades damaged the tail rotor. The helicopter was brought to a standstill.

1 Factual Information

1.1 History of flight

The flight progress and the circumstances of the accident were reconstructed as follows on the basis of the statements made by the pilot, the passenger, the flight assistant and the Federal Safety Investigation Authority

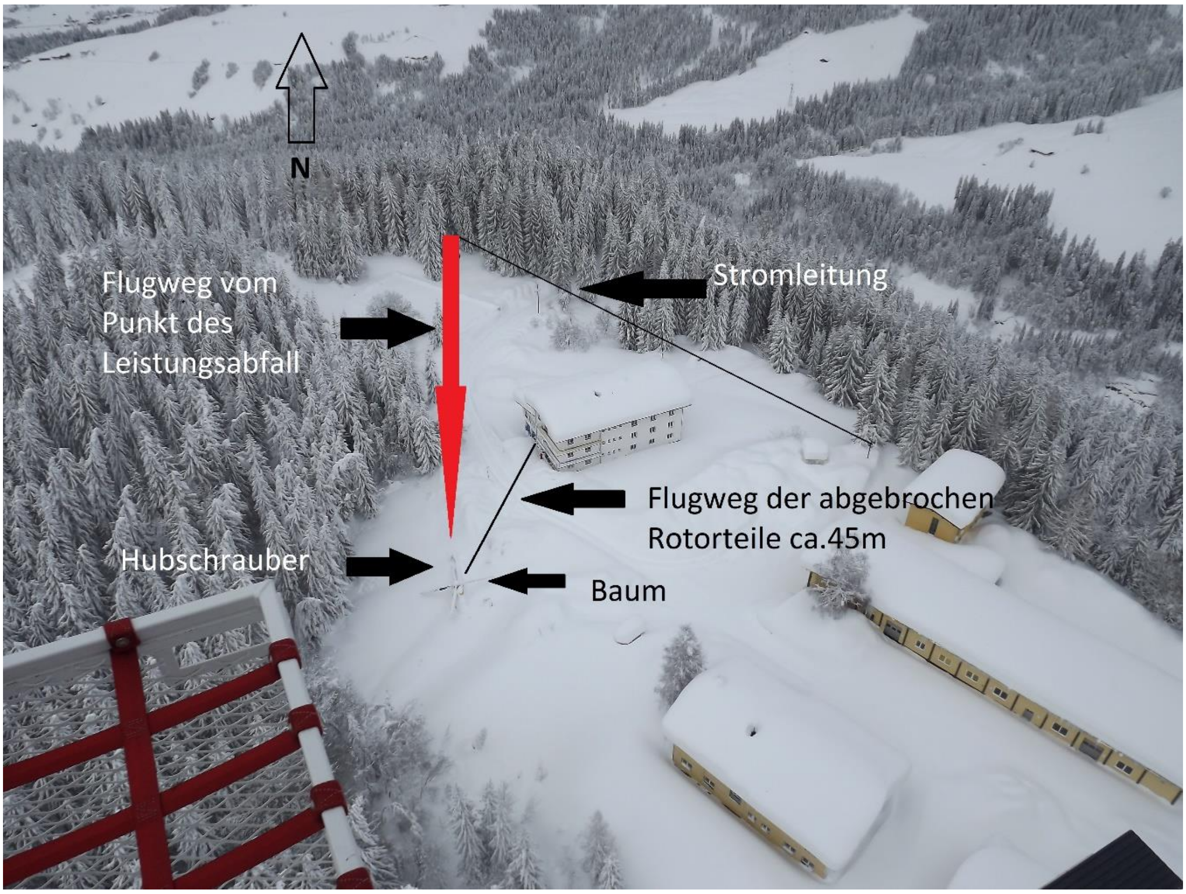
Due to the enormous snowfalls, an electricity network operator intended to carry out a safety inspection of the high-voltage supply lines from the air in the area of Fieberbrunn Eiserne Hand-Bürglkopf. The lateral trees were also to be cleared of snow. For this purpose, a contact was established with the helicopter company on 14 January 2019 at 07:30 hrs. A meeting point was arranged at the helicopter base on 14 January 2019 at around 09:20 hrs. In the meantime, the helicopter had been refuelled to a total quantity of approx. 1600 litres of Jet A-1. During the pre-flight inspection, the helicopter was "drained" and no foreign matter such as water or other contamination was detected. The last flight took place on 12 January 2019. The helicopter was in the heated tent hangar since the last flight. The pilot obtained the flight weather via his cell phone, an ATC flight plan was not filed. The helicopter took off from the helicopter base at 10:35 am. The pilot activated the "ENG & EAPS ANTI-ICE" system and activated the main and tail rotor blade de-icing in Manual Mode. The take-off went according to plan and without any complications. To the right of the pilot sat the responsible employee of the power supply company, who was "briefed" by the pilot before the flight. Behind the pilot sat the flight assistant.

The flight progressed via St. Johann in Tyrol to Fieberbrunn and from there to the “Eiserne Hand“. From there the path led further down the valley to the right of the power line road. The helicopter flew about 15 - 20 m above the treetops. The helicopter then flew towards Bürglkopf on the right along the power lines, turned off at the end and flew back to the junction. It then flew down the left side of the power lines to clear them of snow.

Shortly after reaching the Almgasthof, the pilot noticed an abrupt drop in the helicopter’s performance. He was no longer able to maintain altitude, so he aligned the nose of the helicopter to the right and started forward motion with the stick to reach the later emergency landing area. The helicopter had a high sink rate. The pilot decided to land on the western side of the Almgasthof. When the helicopter touched down at around 11:34 a.m., it touched a tree on the left with its rotor blades. This damaged the main rotor blades.

The pilot brought the helicopter to a standstill by immediately setting the power levers to "0", thus interrupting the fuel supply. He did not use a rotor brake. The rotor then stopped automatically. The ELT was not triggered during this emergency landing.

Figure 1: Overview of the emergency landing site



Source : Operator/SUB

1.1.1 Flight preparation

The flight preparation required according to Regulation (EU) No 923/2012 Annex SERA.2010/b as amended as well as the preparations required according to the Operation Handbook / Specialised Operations Handbook of the company in connection with Regulation (EU) No 965/2012 (Flight Order, Operational Flight Plan and Risk Analysis for control and surveillance flights) were carried out at the company's base before departure.

1.2 Injuries to persons

Table 1: Injuries to persons

Injuries	Crew	Passengers	Other
Fatal			
Serious			
None	2	1	

1.3 Damage to aircraft

The main rotor blades were severely damaged and severed by contact with the tree. The vertical fin and tail rotor blades were severely damaged.

1.4 Other damage

Damage to a house facade due to broken main rotor blades.

1.5 Personnel information

1.5.1 Pilot

Age:	55 years old
Type of civil aviation licence:	EASA FCL CPL(H) Commercial Pilot Licence (Helicopter); first date of issue 17.05.2013
Permits:	Helicopter
Type permits:	AS350/EC130, AS 355, Bell 204/ 205/ UH1-D, Sokol W3-A
Instrument rating:	none
Teaching authorisation:	none
Validity:	valid on the day oft he accident
Verifications (checks)	
Medical check:	Medical Class 1/2 valid until 20.10.2019

Crew Resource Management (CRM) Training:	valid until 20.07.2019
Dangerous Goods (DG) Training:	valid until 31.07.2020
Operator Proficiency Check (OPC):	issued on 17.11.2018
Licence Proficiency Check (LPC):	issued on 04.09.2018
Registered type rating Sokol W-3A :	valid until 31.08.2019

Total flight experience (including accident flight):	6700 hours
Of which within the last 90 days:	153 hours
Of which within the last 30 days:	52 hours
Of which within the last 24 hours:	2:37 hours
Flight experience on the type of accident:	84 hours

Duty/rest periods

Usage time last 24 hours:	07:50 hours
Rest period before last use:	> 12:00 hours
Duty period last 7 days:	48:09 hours
Duty period last 28 days:	68:19 hours
Duty period last year:	1263:22 hours

Sitting position:	Left seat

1.6 Aircraft information

The PZL W-3 Sokól (German Falcon) is a Polish multi-purpose helicopter manufactured by PZL Świdnik Except for the rotor blades of the main and tail rotor, the helicopter is conventionally made of metal. The landing gear is not retractable. The helicopter has two gas turbines to drive the four-bladed rotor, which is made of fibreglass composite material. The main and tail rotors and the two engines have a de-icing system.

Aircraft type:	Helicopter
Manufacturer:	PZL Swidnik, Poland
Manufacturer's designation:	PZL-W3A
Year of manufacture:	1996
Aircraft owner:	Company
Total operating hours:	3603:09
Landings:	7399
EASA Performance Class:	1

Engines

Manufacturer:	Pratt &Whitney Rzeszow S.A, Poland
Manufacturer's designation:	PZL- 10W

Engine 1

Operating hours:	2096:53 hours TSN
Cycles:	1276

Engine 2

Operating hours:	2387:34 hours TSN
Cycles:	1168

1.6.1 Aircraft certificates

Registration certificate:	issued on 13.09.2018 by Austro Control GmbH
Certificate of Airworthiness:	issued on 01.10.2018 by Austro Control GmbH
Certificate of Review (ARC):	issued on 01.06.2018 by Part M Organisation
Noise certificate:	issued on 01.10.2018 by Austro Control GmbH
Insurance:	valid on day of accident
Aircraft radio station licence:	issued on 24.09.2018 by the Telecommunications Office for Tyrol and Vorarlberg, valid until 30.09.2028

1.6.2 Aircraft maintenance

According to the decision of Austro Control GmbH dated 14.09.2018, the maintenance programme for the helicopter has been approved. An aircraft maintenance contract was concluded between the aircraft owner company and a company established in Spain, both for the helicopter itself and for the two gas turbine engines installed. The approval of a Continuing Airworthiness Management Organisation (CAMO) by the aircraft owner company covers the aircraft involved in the crash. According to the maintenance documents, maintenance records and technical log extracts submitted, no relevant defects were known. Correspondingly, sufficient remaining flight times until the next scheduled maintenance and repair measures for the planned flight project were available. Individual aircraft components were within the permissible periods of operation or within permissible extension periods.

Permits of the operator:

The owner company holds an Air Operator's Certificate (AOC) issued by Austro Control GmbH on 10.05.2017. Furthermore, it holds a licence for commercial specialised high-risk flight operations dated 29.10.2018, whereby the accident helicopter is specifically covered by this licence. Authorised specialised flight operations also include "examination/surveillance/survey flights including cartography". An SOP dated 21.04.2017 of the company regarding "Inspection and surveillance flights - visual" is available. In this SOP, "infrastructure facilities" and "high-voltage power lines" are explicitly listed under "possible objects". The minimum crew is 1 pilot, 1 observer and, depending on the dependency, additional observers for coordination and security. According to the SOP, observers may also be NON-Company employees, provided that they have been given appropriate instruction ("training or briefing"). Furthermore, a basic SOP "Working from the cabin", dated 30.06.2018, is available. There is also a notice issued by the Office of the Tyrolean Provincial Government on 29 May 2018 (valid until 31 May 2019) regarding the execution of off-field landings and off-field departures.

1.6.3 Mass and center of gravity

The Technical Journey Log Book from 14.01.2019 shows that 1,600 l (full tank) of fuel was available on take-off.

The reconstructed calculation of mass and centre of gravity position (longitudinal) at the take-off site at ERPFENDORF (with the values of the flight execution plan):

Table 2: Mass and centre of gravity calculation Erpfendorf

Position	Mass (kg)	Lever arm (m)	Moment (kgm)	Comment
Empty weight	4044	-0,1005	-406,422	
Pilot (FrontSeat)	175	2,548	445,9	Pilot ;1 PAX
Hoist operation	75	1,302	97,65	
Fuel	1248	0,369	460,512	Full tank
Total mass	**5542**	**0,1078**	**597,64**	

The take-off mass at take-off in ERPFENDORF was thus 858 kg below the maximum take-off weight of 6,400 kg. The centre of gravity was within the permitted range.

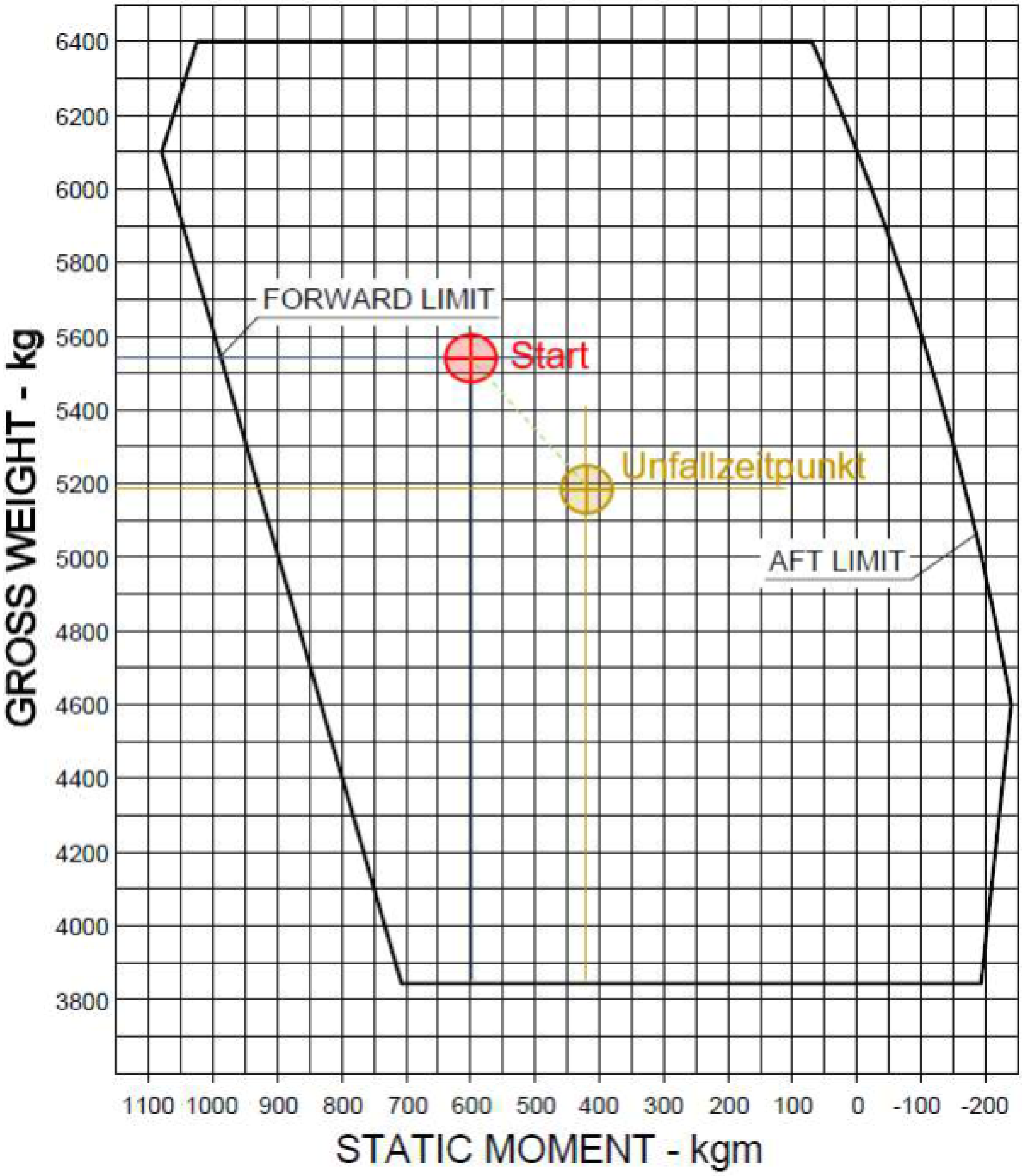
The reconstructed calculation of mass and centre of gravity position (longitudinal) at the BÜRGLKOPF site (with the fuel value according to the Technical Journey Log Book)

Table 3: Mass and centre of gravity calculation Bürglkopf

Position	Mass (kg)	Lever arm (m)	Moment (kgm)	Comment
Empty weight	4044	-0,1005	-406,422	
Pilot (FrontSeat)	175	2,548	445,9	Pilot ;1 PAX
Hoist operation	75	1,302	97,65	
Fuel	897	0,369	296,200	1150 Litre Jet A1
Total mass	**5191**	**0,0835**	**433,33**	

Mass and centre of gravity at the BÜRGLKOPF site were within the permissible range.

Figure 2: Centre of gravity limits



Source: RFM

1.6.4 Determining the flight performance class and calculating flight performance

Calculation of the pressure altitude (PA):

Elevation location BÜRGLKOPF: 4,133 ft AMSL

For the current mission, a rather low flight altitude of 40-50 m above ground was required. At the time of the accident, therefore, a flight altitude of 4,300 ft AMSL can be assumed.

Current QNH: 1009 hPa (= 4 hPa beolw the ISA-QNH of 1013 hPa)

PA: 4,300 + (4 x 30) = ~4,420 ft AMSL

Calculation of the density altitude (Density Altitude DA):

Pressure altitude: 4,420 ft AMSL

ISA temperature: 15°C - (4.3 x 2) = 6.4°C

Current temperature: - 4°C (= 10.4°C below the ISA temperature of 6.4°C)

DA: 4,420 - (10.4 x 120) = 3,172 ft AMSL

According to regulation (EU) No. 965/2012, CAT.POL.H. 100, the helicopter is to be operated in flight performance class 1 or 2.

According to RFM, Supplement AE 30.04.20.0 ERFMS-13.00 for Operations with Maximum Gross Weight not greater than 12,500 lb (or 5,670 kg), the Maximum Density Altitude (or Pressure Altitude, if lower) for Category A procedures (Flight Performance Class 1) is 9,000 ft (2,744 m) AMSL.

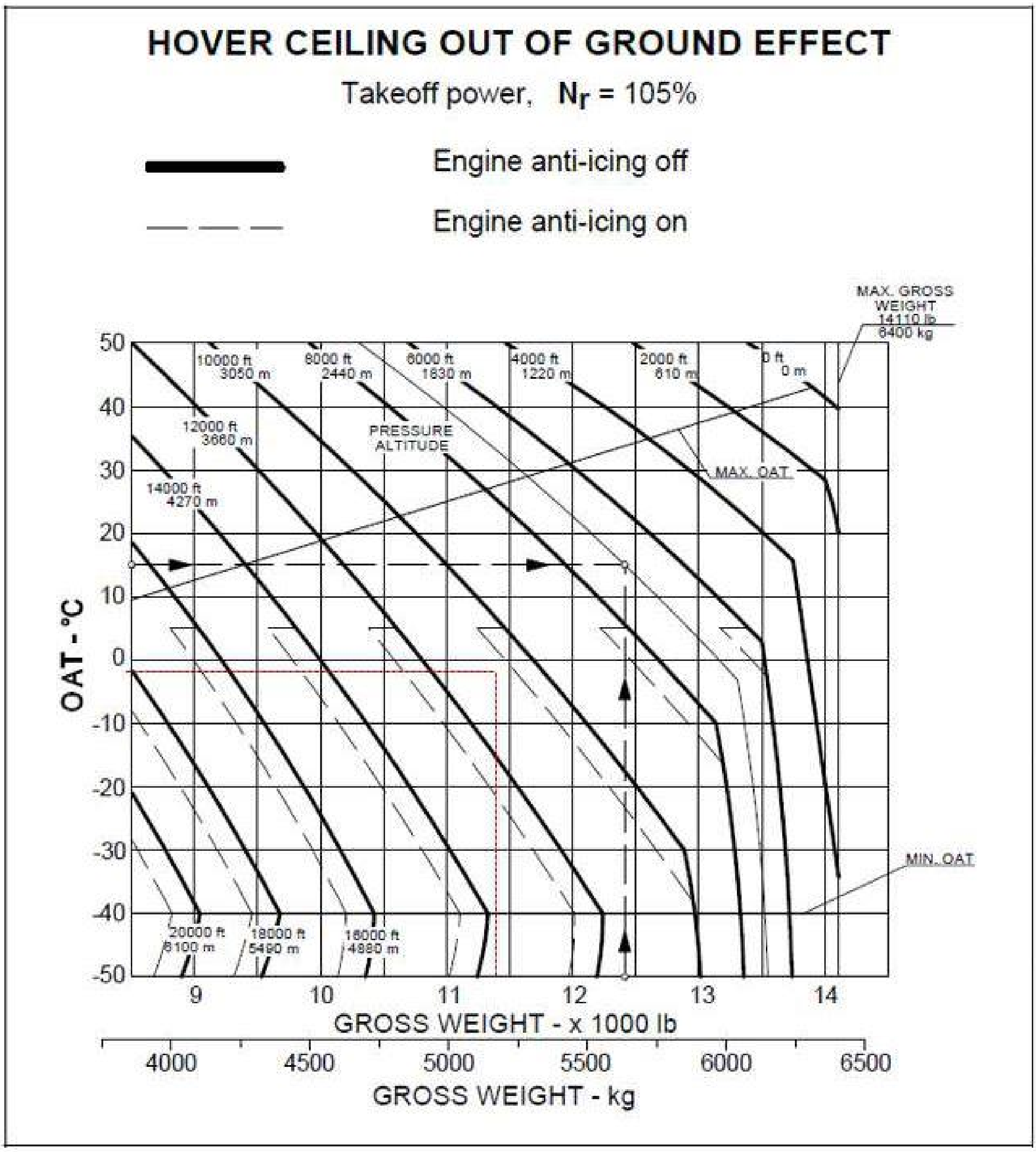
The reduction in engine power when using the engine anti-icing system is shown in the tables for hovering flight outside the ground effect but again only when both engines are in operation.

With both engines and the engine anti-icing system switched on, hovering outside the ground effect (HOGE) at the BÜRGLKOPF site would have been possible without any problems even at maximum continuous power. However, the RFM does not include a table for single-engine operation (OEI).

It is therefore not possible to determine whether hovering with one engine in the ground effect (HIGE) or outside the ground effect (HOGE) would have been possible by calling up the maximum available power (OEI 2.5 min).

The pilot had a power of OEI 30 min at his disposal.

Figure 3: Hover ceiling out of ground effect



Source: RFM

Statement PZL-Swidnik to the flight performance

„…If only OEI 30min. power from one engine is available (no disposable power provided by the other engine), it is not possible to perform the hover in windless conditions for the undisturbed rotor characteristics (without icing). For the disposable power value presented in Figure 4 and the WN RPM, the hover IGE in windless conditions would have been possible with undisturbed main rotor characteristics (no icing) until the moment of the detected ground contact. This suggests that at the time of the incident, the power demand of the engines for flight and hover was greater than that corresponding to the undisturbed rotor characteristics. In addition, the amount of disposable power of the engines prior to the onset of the event, shown in Figure 4, suggests a significantly higher demand for power needed for flight (the use of take-off power to perform a level flight shown in Figure 4 suggests an excess power demand of 400-600[hp] over the baseline level of the power needed). The accurate determination of the power required for flight is very difficult due to the lack of helicopter airspeed data at the time of the incident…"

Figure 4: Extract from the report RB/P/401,64/4/2019

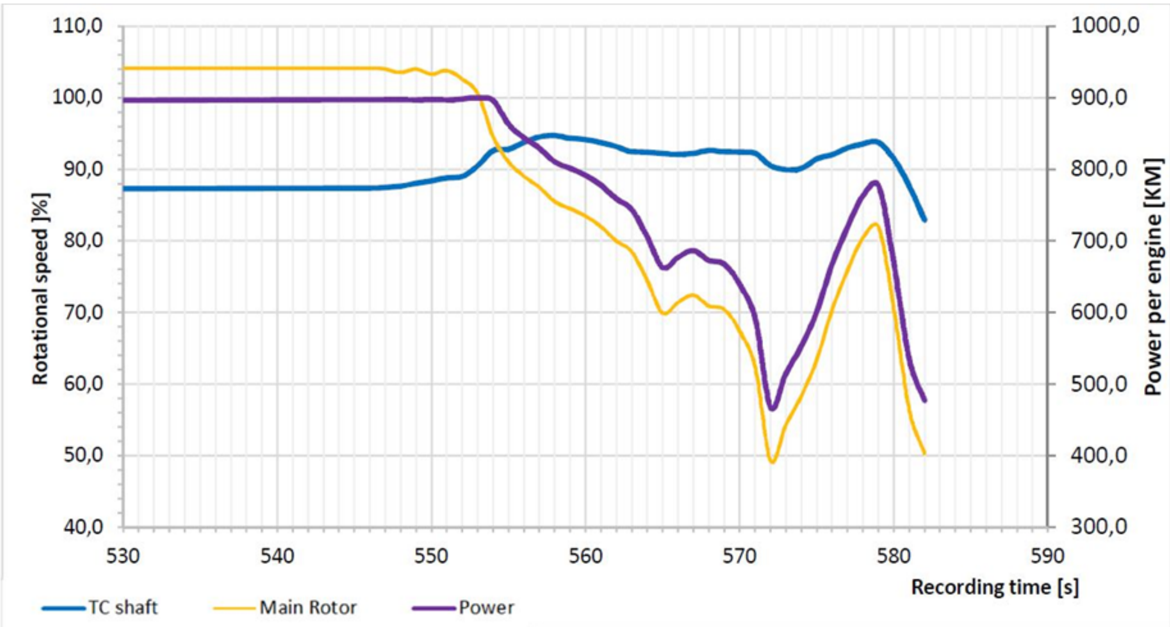


Fig. 6 Compressor turbine and main rotor rotational speed, power (one engine), recording time 530-590s

Source: Bericht Pratt & Withney Rzeszów

1.6.5 Limitation according Rotor flight manual AE 30.04.20.0

Figure 5: ERFM Section 1 Limitation

TYPE OF OPERATION

The helicopter is approved for operation under Day and Night VFR and, if fitted out with additional equipment, under IFR.
Operations in known icing conditions are prohibited.

BASIS OF CERTIFICATION

This helicopter is certified as Category A and B rotorcraft under FAR Part 29.

Source: ERFM AE 30.40.20.0

1.7 Meteorological information

1.7.1 Aeronautical weather overview, Aeronautical Meteorological Service Austro Control GmbH

Figure 6: Aeronautical weather overview

Flugwetterübersicht für die Alpennordseite

FXOS42 LOWW 132300
FLUGWETTERUEBERSICHT OESTERREICH,
gueltig fuer den Alpenhauptkamm Nordseite, die Nordalpen
vom Bodenseeraum bis zum Hochschwab, sowie die nordalpinen Taeler,
Herausgegeben am Montag, 14.01.2019 um 00:00 Uhr lct.
Vorhersage bis morgen Frueh.
.
WETTERLAGE:
Stuermische Nordweststroemung mit markantem Stau, der durch
eingelagerte Seitentroege verstaerkt wird. Die Alpensuedseite ist
nach wie vor leebeguenstigt.

WETTERABLAUF:
Es bleibt heute dicht bewoelkt und es gibt auch weitere
Niederschlaege. In den Nordstaulagen vom Bregenzerwald bis zum
Hochschwab sind anhaltende und ergiebige Niederschlaege zu erwarten.
Vormittags liegt die Schneefallgrenze noch bei 2500ft amsl,
nachmittags sinkt sie weiter ab.

WIND UND TEMPERATUR IN DER FREIEN ATMOSPHAERE
fuer heute 13:00 Uhr lct:
5000ft amsl 290-320/35kt -5 Grad C.
10000ft amsl 310/40-50kt -16 Grad C.
Nullgradgrenze: 2500ft amsl.

ZUSATZHINWEISE IFR:
Im Nordstau weiterhin hohe Vereisungsgefahr unterhalb von FL140.
Maessige bis starke Turbulenz in allen Hoehen.

ZUSATZHINWEISE VFR:
Die Wolkenbasis liegt im tiefen Stratocumulusniveau, dazu rasche
Sichtwechsel bis auf 2000m und darunter. Im Laufe des Nachmittags
klingen die Niederschlaege im noerdlichen Alpenvorland ab, die
Sichtflugmoeglichkeiten bleiben auch dort bescheiden.

ZUSATZHINWEISE THERMIK/WELLEN:
Keine.

ZUSATZHINWEISE BALLONFAHRTEN:
Lebhafte bis stuermische Winde bis in tiefe Lagen.

Detaillierte Vorhersagen ueber Hoehenwind, Hoehentemperaturen und QNH
entnehmen Sie bitte unseren grafischen Vorhersagekarten.
Diese Vorhersage wird bei abweichender aktueller Entwicklung
nicht berichtigt.
Die naechste planmaessige Aktualisierung erfolgt am
Montag, 14.01.2019 um 14:00 Uhr lct.

Source: Austro Control GmbH

1.7.2 TAF, METAR Aeronautical Meteorological Service Austro Control GmbH

Figure 7: TAF, METAR Aeronautical weather data

TAF Flughafen Innsbruck LOWI

```
TAF LOWI 140515Z 1406/1506 08006KT 8000 -RASN SCT020 BKN040
    TX02/1406Z TNM02/1506Z
    TEMPO 1406/1408 30015G25KT 3000 RASN BKN010
    PROB30 TEMPO 1406/1408 36025G50KT
    TEMPO 1408/1417 30015G30KT 1200 SHSN VV006
    TEMPO 1417/1506 30010G20KT 1500 SHSN VV008=
```

METAR Flughafen Innsbruck LOWI

```
METAR LOWI 140850Z 23008KT 140V260 6000 -RASN FEW005 SCT010 BKN015 02/00
Q1007 R08/29//95 TEMPO 3000 SNRA OVC013=
METAR LOWI 140920Z 25014KT 6000 RASN SCT007 BKN015 02/00 Q1008 R08/29//95
TEMPO 2000 SNRA VV010=
METAR LOWI 140950Z 24011KT 6000 -RASN FEW005 SCT007 BKN015 02/01 Q1008
R08/29//95 TEMPO 2000 SNRA VV010=
METAR LOWI 141020Z 25012KT 8000 -RASN FEW005 SCT007 BKN017 03/01 Q1008
R08/29//95 TEMPO 4000 SNRA VV013=
METAR LOWI 141050Z 26010KT 9000 -RASN FEW005 SCT010 BKN025 02/00 Q1008
R08/29//95 TEMPO 4000 SNRA VV013=
METAR LOWI 141120Z 28007KT 260V330 9999 -RASN FEW005 SCT015 BKN035 02/00
Q1008 R08/29//95 TEMPO 4000 SNRA VV013=
METAR LOWI 141150Z 25011KT 9999 -SHRA FEW005 SCT016 BKN025 03/00 Q1008
R08/29//95 TEMPO 4000 SNRA BKN012=
```

TAF Flughafen Salzburg LOWS

```
TAF COR LOWS 140545Z 1406/1506 28010KT 9999 SCT025 BKN035
    TX04/1409Z TN02/1506Z
    TEMPO 1406/1415 30015G30KT 5000 -SHRASN SCT012 BKN025
    TEMPO 1415/1506 30015G25KT 4000 -SHSN BKN014=
```

METAR Flughafen Salzburg LOWS

```
METAR LOWS 140850Z 29010KT 250V320 9999 -SHRA FEW011 SCT022 BKN060 04/01
Q1006 R15/29//95 NOSIG=
METAR LOWS 140920Z 29011G23KT 9999 -SHRA FEW008 SCT015 BKN026 03/01 Q1007
R15/29//95 NOSIG=
METAR LOWS 140950Z 28013KT 9999 -SHRA FEW010 SCT013 BKN022 04/01
Q1007 R15/29//95 NOSIG=
METAR LOWS 141020Z 30011KT 9999 -RA FEW009 SCT014 BKN020 03/01 Q1007
R15/29//95 NOSIG=
METAR LOWS 141050Z 35013KT 310V010 8000 -RA FEW004 SCT008 BKN019
03/01 Q1007 R15/29//95 NOSIG=
METAR LOWS 141120Z 35009KT 2700 -RASN FEW003 SCT006 BKN012 01/M00
Q1007 R15/29//95 TEMPO 4000 FEW005 BKN015=
METAR LOWS 141150Z 34003KT 310V020 6000 -SHSN FEW003 SCT005 OVC009
01/00 Q1007 R15/29//95 TEMPO 1400 SHSN VV006=
```

Source: Austro Control GmbH

1.7.3 Autometar

Figure 8: Autometar flight weather data

AUTOMETAR Kössen 11131 (588m)

```
METAR 11131 140900Z AUTO 28002KT 2900 -SN OVC022 02/01=
METAR 11131 140930Z AUTO 28004KT 4500 -SN OVC022 02/01=
METAR 11131 141000Z AUTO 26005KT 5000 -RASN OVC027 02/00=
METAR 11131 141030Z AUTO 27004KT 4300 -RASN OVC026 02/01=
METAR 11131 141100Z AUTO 25005KT 7000 -RASN OVC030 02/01=
METAR 11131 141130Z AUTO 25005KT 6000 -RASN OVC022 02/01=
METAR 11131 141200Z AUTO 25006KT 4200 -RASN OVC020 02/01=
```

AUTOMETAR Lofer 11140 (622m)

```
METAR 11140 140900Z AUTO 05003KT 3400 -RASN OVC011 01/00=
METAR 11140 140930Z AUTO 30001KT 4600 -RASN OVC013 01/00=
METAR 11140 141000Z AUTO 35002KT 3000 -SN OVC014 01/00=
METAR 11140 141030Z AUTO 03002KT 5000 -RASN OVC016 01/00=
METAR 11140 141100Z AUTO 02003KT 6000 -RASN OVC017 01/01=
METAR 11140 141130Z AUTO 33003KT 3500 -RASN OVC014 01/00=
METAR 11140 141200Z AUTO 30003KT 6000 -RASN OVC013 01/00=
```

AUTOMETAR Zell am See 11144 (769m)

```
METAR 11144 140900Z AUTO 14004KT 3800 -SN BKN005 OVC016 01/01=
METAR 11144 140930Z AUTO 13004KT 5000 -RASN OVC009 01/00=
METAR 11144 141000Z AUTO 17003KT 1000 -SN OVC005 01/01=
METAR 11144 141030Z AUTO 19003KT 2900 -SN OVC004 01/01=
METAR 11144 141100Z AUTO 17003KT 6000 -SN OVC010 01/01=
METAR 11144 141130Z AUTO 13006KT 9999 -RA OVC012 02/M00=
METAR 11144 141200Z AUTO 29002KT 4400 -RASN OVC019 01/01=
```

AUTOMETAR Schmittenhöhe 11340 (1955m)

```
METAR 11340 140900Z AUTO 33018G35KT M06/M08=
METAR 11340 140930Z AUTO 34015G26KT M06/M07=
METAR 11340 141000Z AUTO 33012G24KT M06/M07=
METAR 11340 141030Z AUTO 33017G34KT M06/M07=
METAR 11340 141100Z AUTO 33017G36KT M06/M07=
METAR 11340 141130Z AUTO 33012G22KT M06/M07=
METAR 11340 141200Z AUTO 30016G24KT M06/M07=
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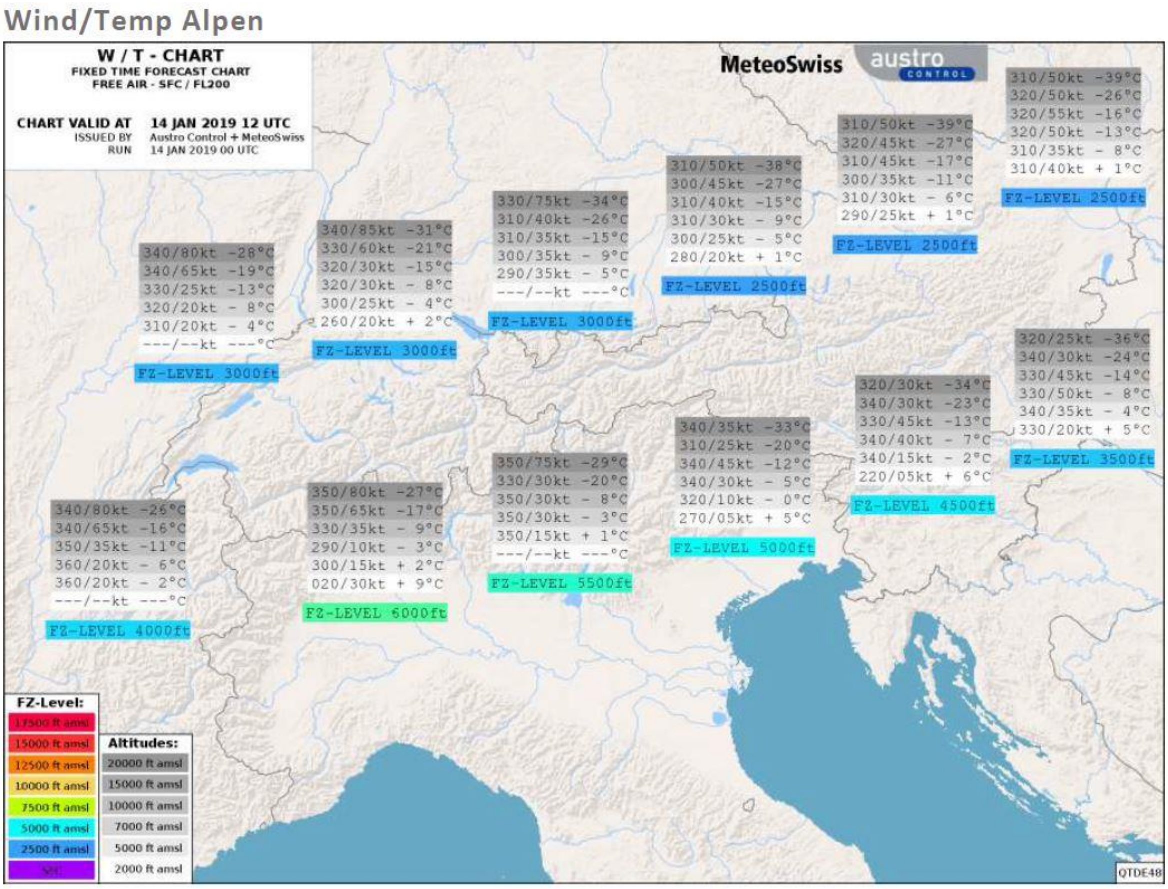
Source: Austro Control GmbH

1.7.4 Wind Temperature Chart (W/T Chart)

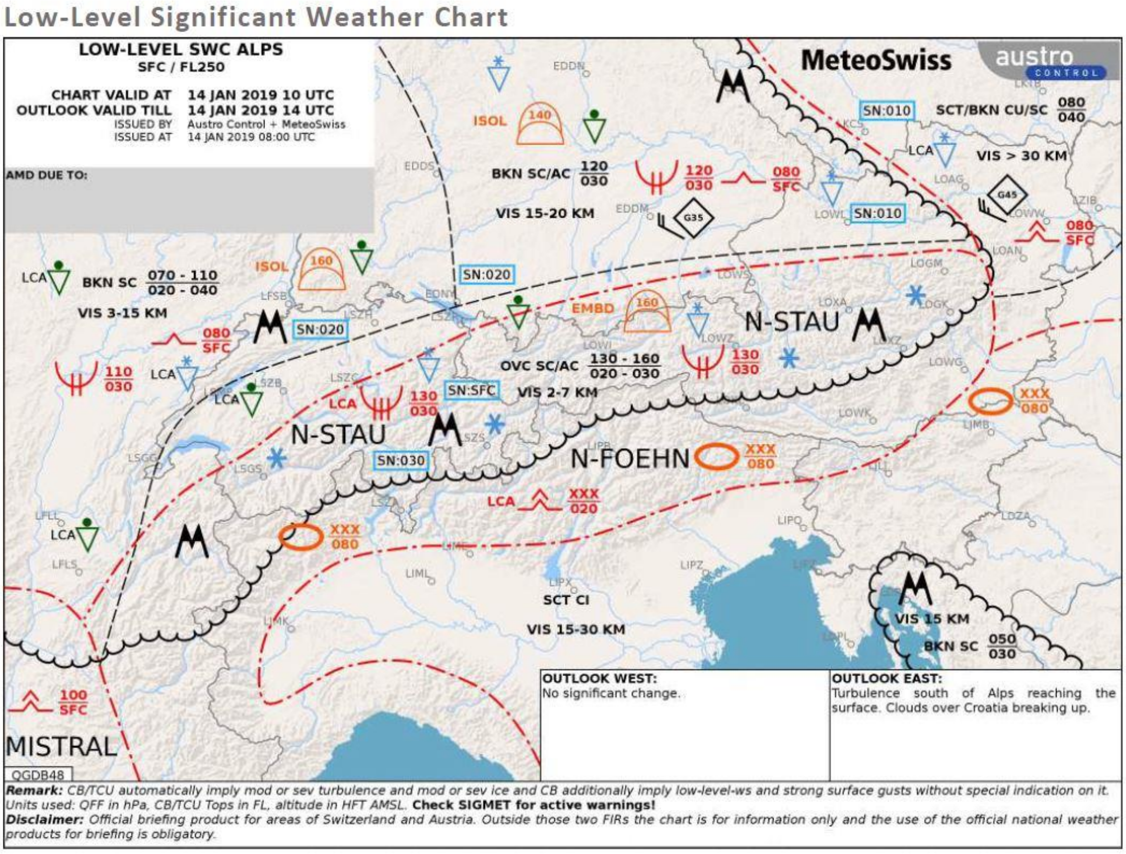
Figure 9: Wind/Temp Alps



Source: Austro Control GmbH

1.7.5 Low-Level Significant Chart

Figure 10: Low-Level Significant weather chart



Source: Austro Control GmbH

The contents of the Low-Level Significant and the W/T Chart applicable at the time of the accident predicted snow showers, moderate icing conditions between 3,000 feet (915 metres above MSL) and 13,000 feet, and main cloud bases of approximately 2,000 feet to 3,000 feet for the incident site and its wider surroundings.

1.8 Flight recorders and other recording devices

1.8.1 ELT

The mandatory emergency transmitter ELT was on board, was operational and did not trigger.

1.8.2 Flight data recorder

The helicopter was equipped with a flight data recorder. Due to a defect, the flight data recorder did not record any data. A flight data recorder and CVR was not required under aviation law.

1.8.3 CVR

A CVR was on board, the system is automatically activated when the helicopter is started. The evaluation of the data was carried out with the support of the aircraft manufacturer.

The following relevant sequences/times were highlighted:

"...

34:50 min: The pilot asks the client whether the transformer station, which can obviously be seen from the cockpit, is the last point to be flown over.

35:03 min: Noticeable drop in rotor speed

35:04 min: Audible low RPM warning signals (low RPM warning), which occurs when 95 % of the nominal speed is reached

35:05 min: Acoustic low speed warning stops

35:05 - 35:20 min: Decreasing or slightly changing rotor speed

35:20 - 35:22 min: Touch noises, sounds of a collision and further drop in rotor speed

35:23 - 35:29 min: Increase in rotor speed (probably due to severed rotor blades and the resulting reduced drag and lower mass on the main rotor system)

from 35:29 min: Noises from systems slowing down..."

From 34:50 min. on, according to the recording, no more calls were made in the aircraft which were recorded by the recording system.

1.8.4 Video recording

A video camera was installed in the aircraft by the pilot and could be evaluated.

1.9 Wreckage and impact information

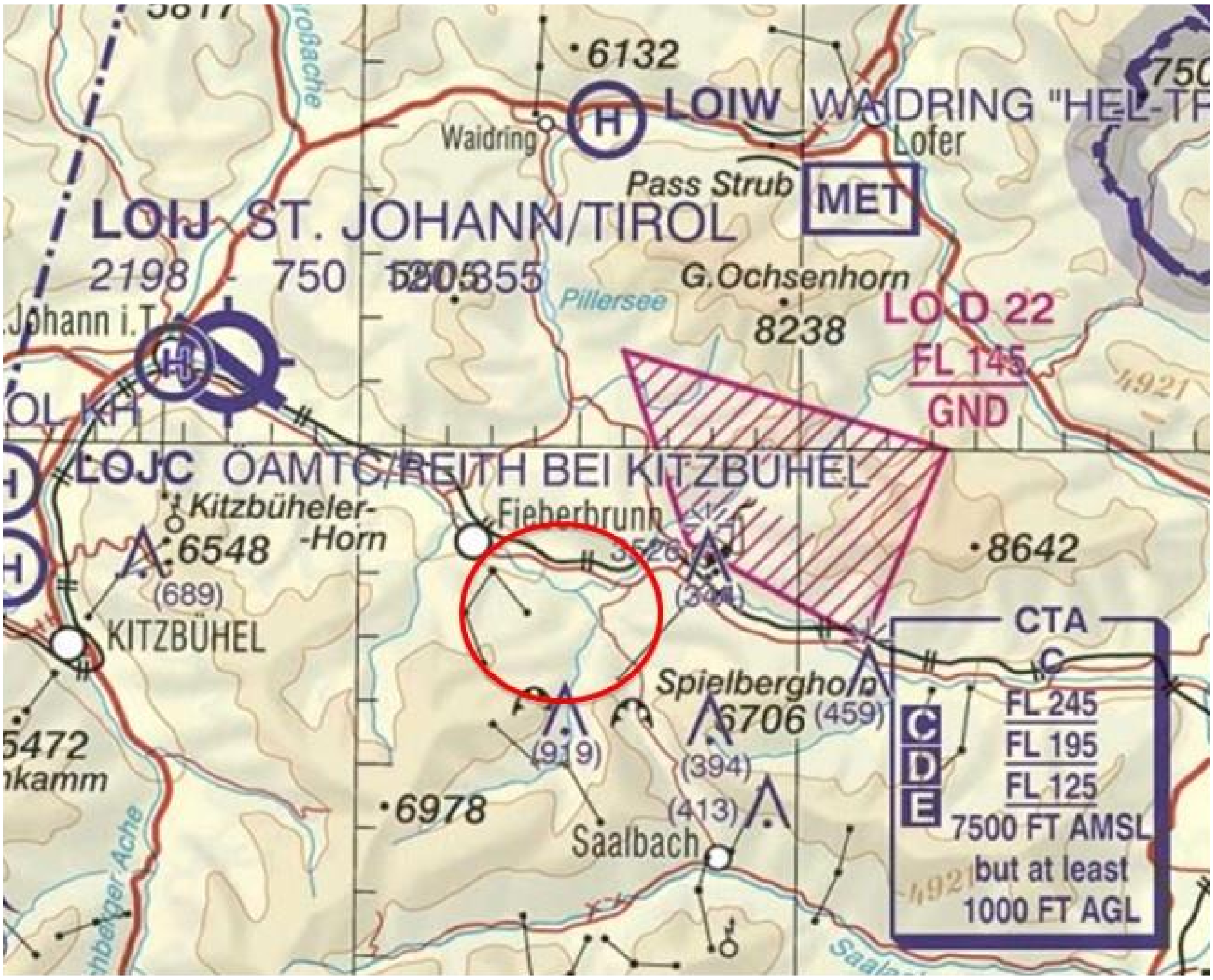
1.9.1 Accident site

The airspace in the entire operational area is uncontrolled airspace qualifying as airspace class G up to an altitude of 7,500 ft AMSL or 1,000 ft AGL.

The BÜRGLKOPF area is located in alpine terrain at an altitude of 890 m to 1,260 m AMSL.

The emergency landing site (accident site) with the coordinates N 47°26'17" E 012°35'45" is located at an altitude (elevation) of 1,260 m (4,133 ft) AMSL in the area of the BÜRGLKOPF. An approximately flat area of approx. 50 x 70 m between the buildings in the east and the edge of the forest in the west was available for the helicopter to conduct an emergency landing.

Figure 11: Map overview airspace structure



Source: ICAO

1.9.2 Dispersion and condition of the wreckage

In the final position the helicopter was resting on its landing gear with alignment of the helicopter longitudinal axis of approx. 180 degrees.

The average distance between the rotor mast and the touched tree was about 6.4 m (see Figure 12). This distance corresponds approximately to the average length of the severed main rotor blades. Furthermore, the damage to the tail rotor and the vertical fin could be attributed to the severed main rotor blades. A part of a severed rotor blade damaged the front of a local house at a distance of about 45 m (see figure 1).

The picture of the emergency landing site (see Figure 12) was taken the day after the emergency landing. The pictures in Figure 13, Figure 14 and Figure 15 were taken by the flight helper immediately after the emergency landing. The snow on the rotor blades

(Figure 14) was fresh snow that was left on the aircraft after the helicopter was parked at the emergency landing site. No ice accumulations were visible on the main rotor blades. Slight ice accumulations were visible in the area of the forward landing gear fairing. Wet snow accumulations were visible above the engine cowling. (Figure 15).

Figure 12: Distance to obstacle the picture was taken the day after

Source: Operator

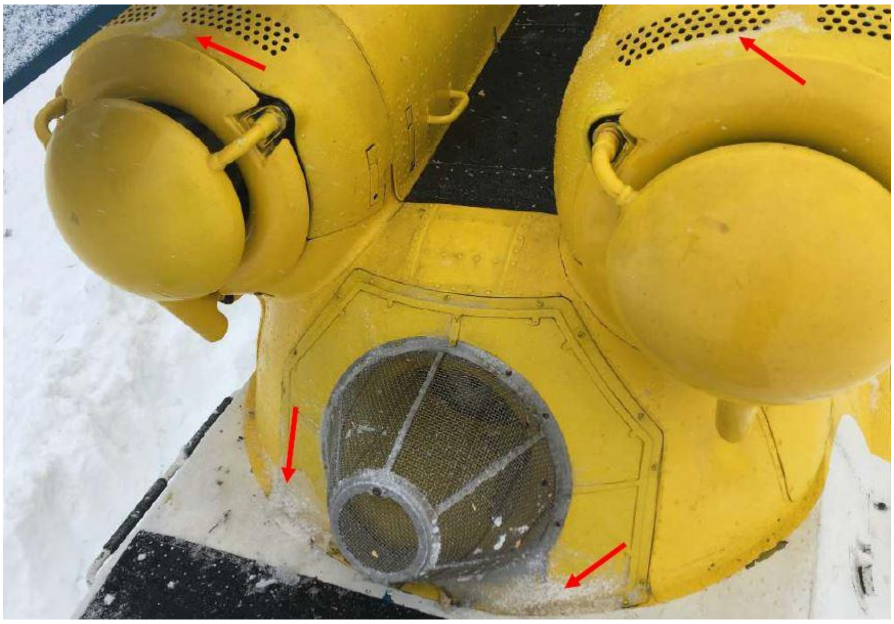
Figure 13: Position of the helicopter direct after the emergency landing

Source: Operator

Figure 14: Picture was taken direct after emergency landing

Source: Operator

Figure 15: Picture was taken direct after emergency landing



Source: Operator

1.9.3 Cockpit and avionik

The pilot deactivated all systems and switches after the emergency landing.

1.10 Medical information

There are no indications of any pre-existing psychological or physical impairment of the pilot.

1.11 Survival aspects

1.11.1 Evacuation

The pilot, the employee of the electricity grid operator and the flight assistant were able to leave the aircraft on their own and did not suffer any injuries

1.12 Continue technical investigation

1.12.1 Technical investigation

SUB/ZLF initiated the following investigations:

Fuel analysis

This study involved a qualitative comparison of two samples taken, one sample was taken from the helicopter's tank and the other from the tanker through which the helicopter was refuelled.

Audio spectrum analysis

An audio spectrum analysis of the existing cockpit voice recorder data was carried out jointly with the engine manufacturer.

Engine inspection

The engines were inspected at the manufacturer Pratt & Witney in Rzeszow S.A., in coordination with SUB/ZLF. Prior to this, the engines were dismantled by the airframe manufacturer Swidnik and submitted to detailed examination.

Main and tail rotor blade de-icing system

The main and tail rotor blade de-icing system was checked for function at the helicopter manufacturer Leonardo Swidnik.

1.12.2 Fuel analysis

The result of the fuel analysis was as follows:

"The two samples differ neither in colour nor in olfactory characteristics.

Visually noticeable are the contaminations in the sample from the tank of the helicopter of 16.01.2019 which can be seen with the naked eye.

Possible causes for this contamination are production-related contamination, contamination of pipelines and/or storage, transport or aircraft tanks or contamination of the sampling containers before, during or after sampling. To what extent the observed contaminations influence the quality of the fuel samples could not be determined on the basis of the investigations performed.

With regard to the parameters of density, sulphur content, water content, viscosity, flash point, boiling curve, elementary conformity, the two samples show largely high conformity.

The differences observed between the samples are within the normal ranges of variation for fuels of the same type".

1.12.3 Audio spectrum analysis

Using the available CVR data, Pratt& Withney performed an audio spectrum analysis.
As part of this audio spectrum analysis, frequency extraction methodes were used to evaluate rotor speed history and other rotating component values.
The figures 16, 17 show the analysis of the acoustic recording. The figures show the signal spectrum for the recording fragment when the main rotor speed decreased and the engine was shut down.

Figure 16: Extract from the report RB/P/401,64/4/2019

On charts below (Figures 4÷5) characteristic turn of events points were marked.

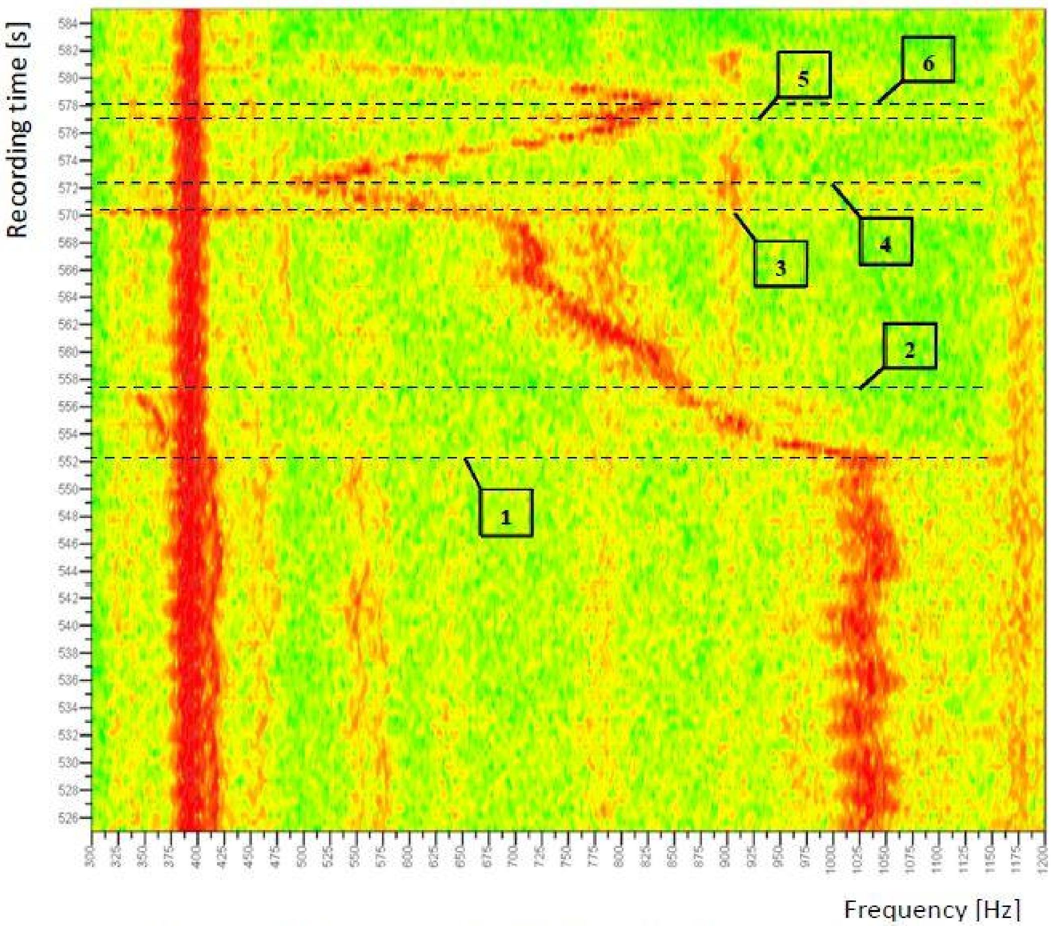


Fig. 4 Contour chart, frequency band 300-1200Hz, resolution 2Hz, recording time 525-585s

Source: Pratt & Withney Rzeszów report

Figure 17: Extract from the report RB/P/401,64/4/2019

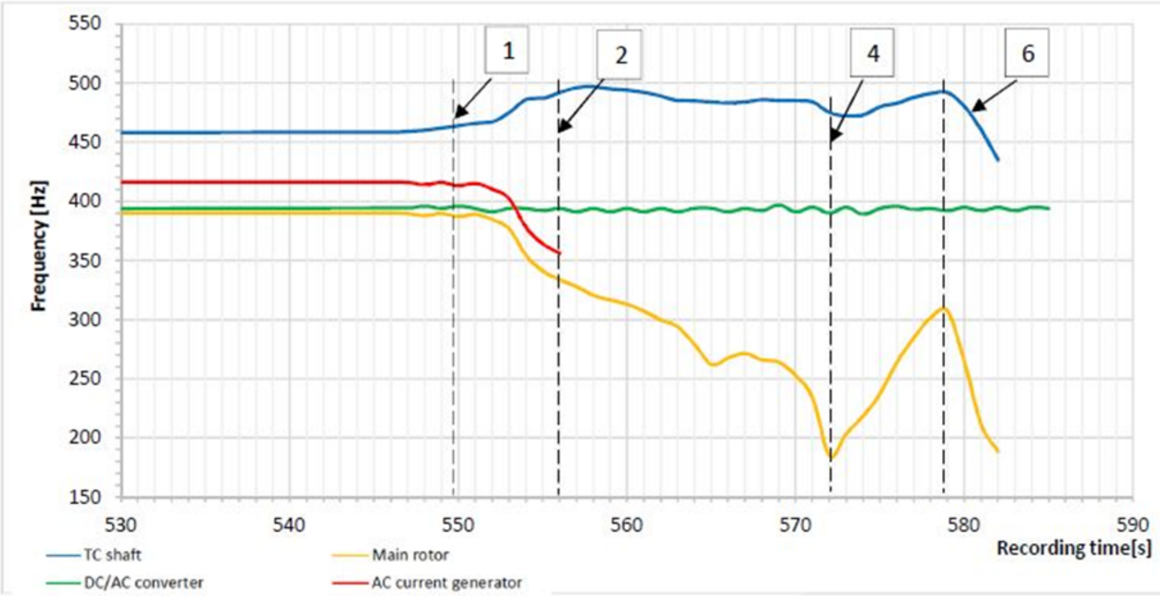


Fig. 5 Power plant work parameters (frequencies), recording time 530 ÷ 590 s.

On charts (Figures 4÷5) were marked:

1. Main rotor rotational speed decrease, compressor turbine rotational speed increase
2. AC current generator turn off at 87% main rotor speed
3. Acoustic noise on audio recording – possibility of collision with terrain obstacles
4. Main rotor and compressor turbine rotational speed increase
5. Acoustic noise on audio recording – possibility of hard landing
6. Main rotor rotational speed decrease, power plant shut down

Source: Bericht Pratt & Withney Rzeszów

1.12.4 Results of the engine test

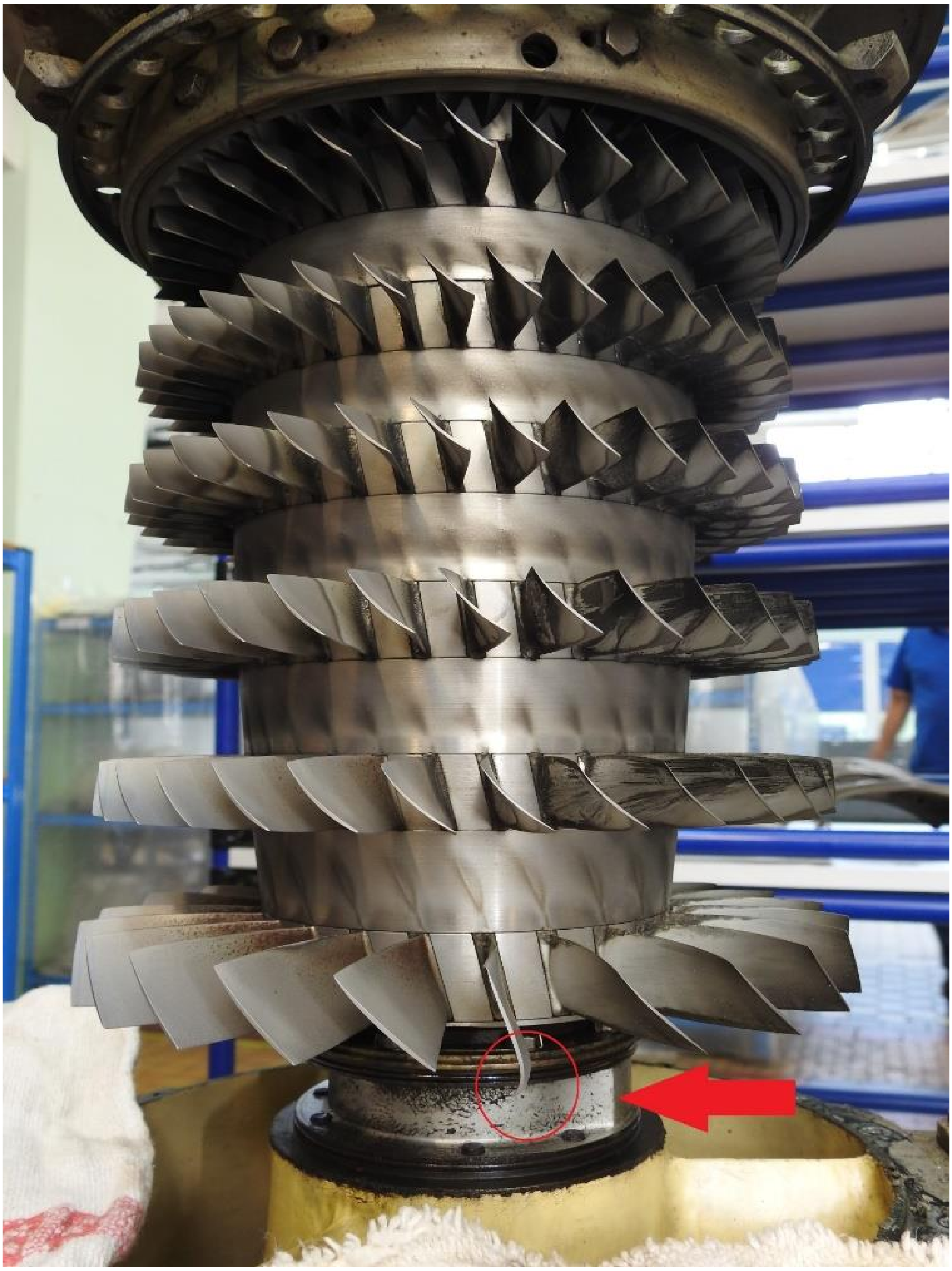
In the course of these investigations, it was found with regard to the right-hand gas turbine engine (Engine 2) that

"...

- *In the front axial compressor stage there was damage in the form of deformed compressor blades (2 pieces), and stator blades (11 pieces)*
- *Two Inlet Case Front Struts were painted with an atypical yellow paint; it was also found that this paint was subject to severe corrosion*
- *Openings in the two Inlet Case Front Struts referred to in the previous point, through which hot air was supposed to flow out to prevent ice build-up, were closed due to the corrosion referred to above*
- *All components (N1-stage and N2-stage) were free to rotate, so that the engine should not have failed due to a mechanical blockage or existing damage causing a mechanical blockage*
- *No foreign bodies or damage patterns were detectable on the front gas compressor stage, irrespective of or in accordance with the above described damage*
- *No other defects, damages, etc. were found*
- *Metal detectors, filters etc. were inconspicuous*

..."

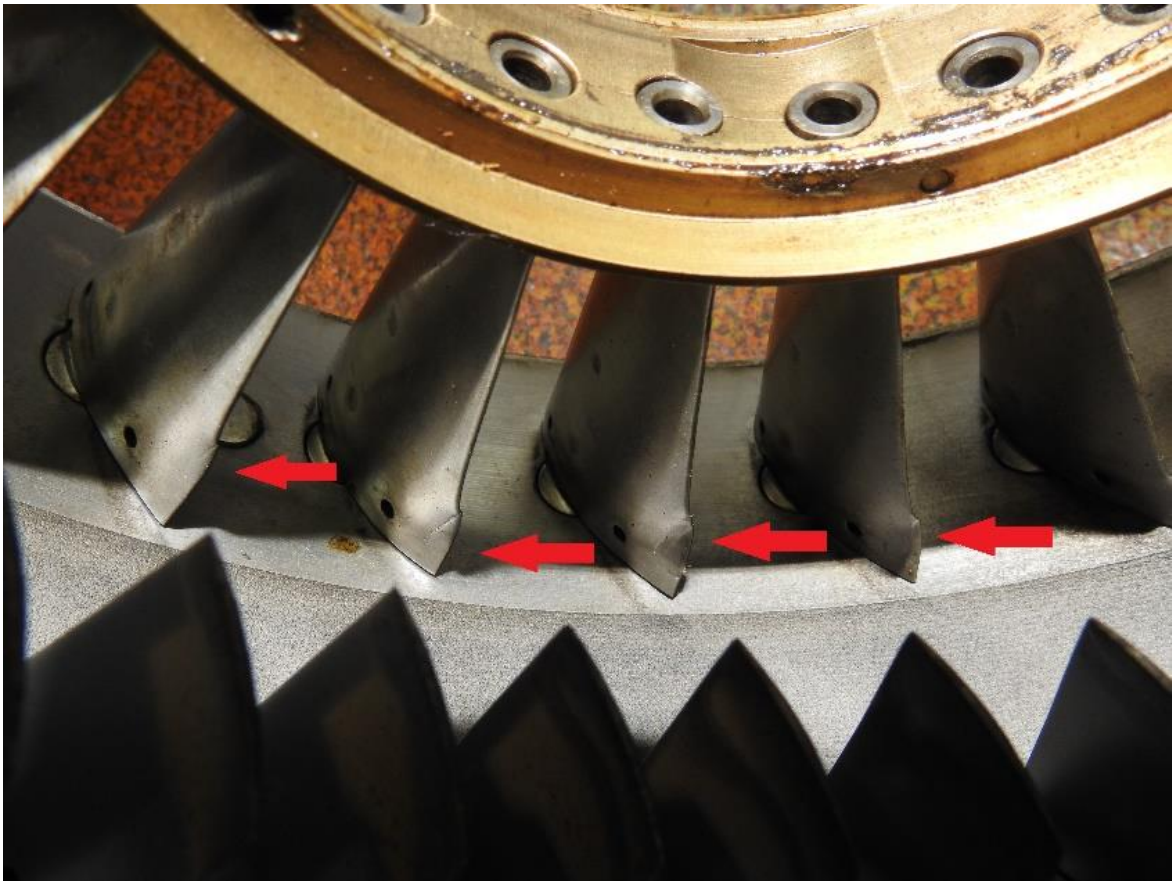
Figure 18: Compressor stage axial compressor



Source: SUB

In the front axial compressor stage of the right engine (Engine 2), two compressor blades showed considerable deformation. (Position of the second compressor blade opposite).

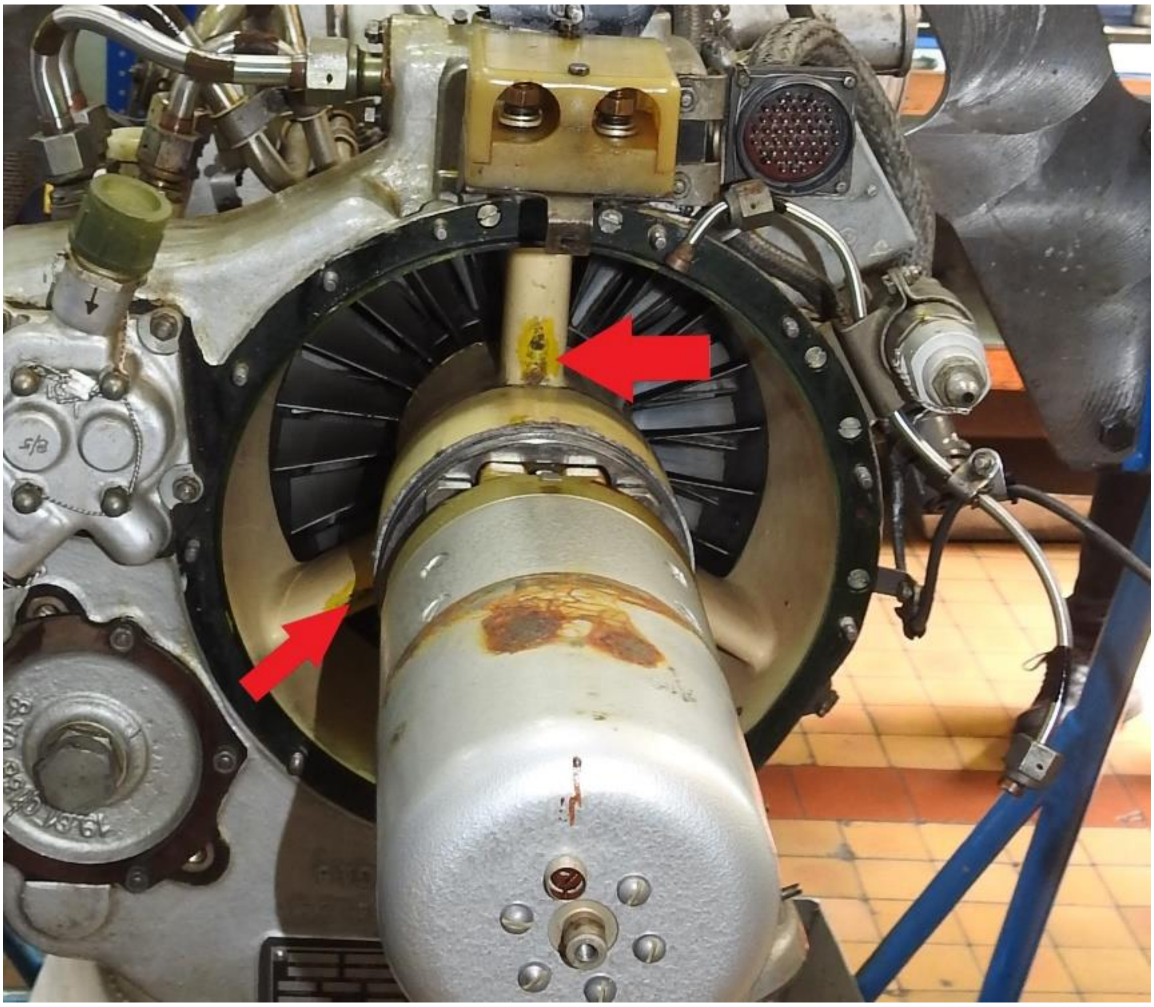
Figure 19: Stator blades of the first axial compressor stage



Source: SUB

Eleven stator blades of the first axial compressor stage of the right engine (Engine 2) exhibited deformation.

Figure 20: Anti-icing airflow ducts in intake casing



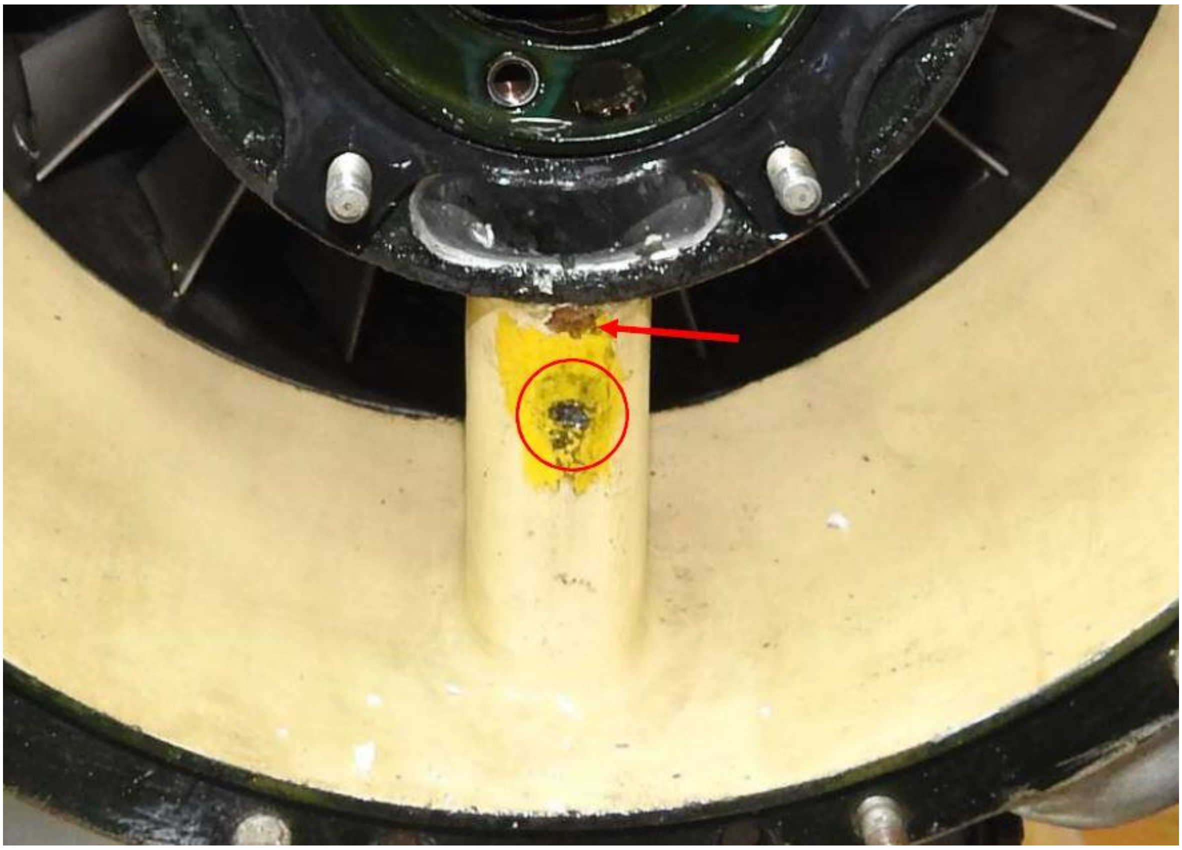
Source: SUB

At two inlet case front struts in the engine air intake cowling (Figure 15 + Figure 16), through which combustion air (hot air from the engine combustion chamber) is passed to prevent ice build-up in the engine inlet, corrosion was detected to such an extent that those openings through which the hot air was to flow out were closed. Further visible in the form of yellow paint on two inlet case front struts of the inlet case assy indications that the repair in this area was carried out improperly. According to the engine manufacturer's instructions, such repairs in this area are inadmissible and not intended, irrespective of any measures taken by the manufacturer.

Tests on the engine manufacturer's test bench confirmed that hot air was not able to flow through the two opening holes of the inlet case front struts.

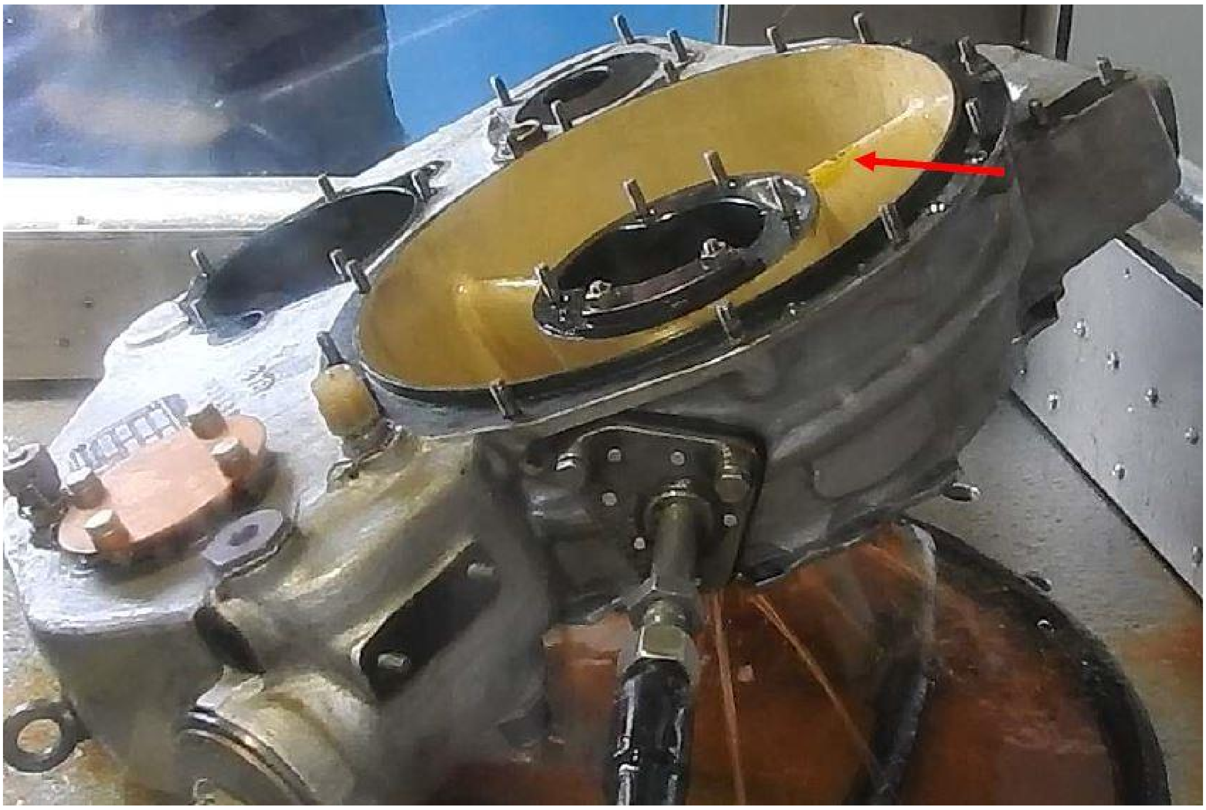
(Test execution at the test bench with a nominal pressure of ~ 2 bar with oil as test substance).

Figure 21: Corroded airflow ducts



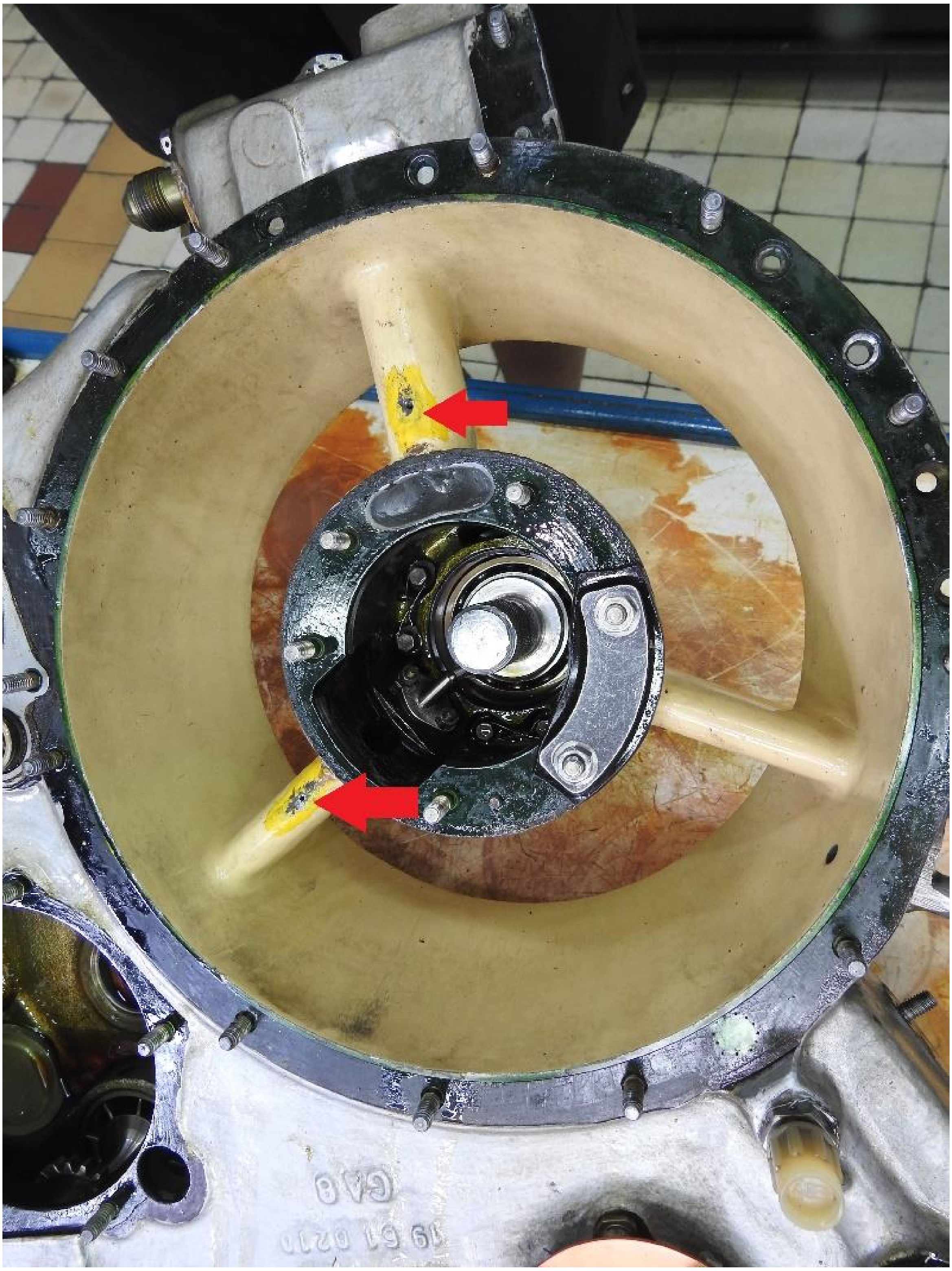
Source: SUB

Figure 22: Test on test bench with corroded opening holes



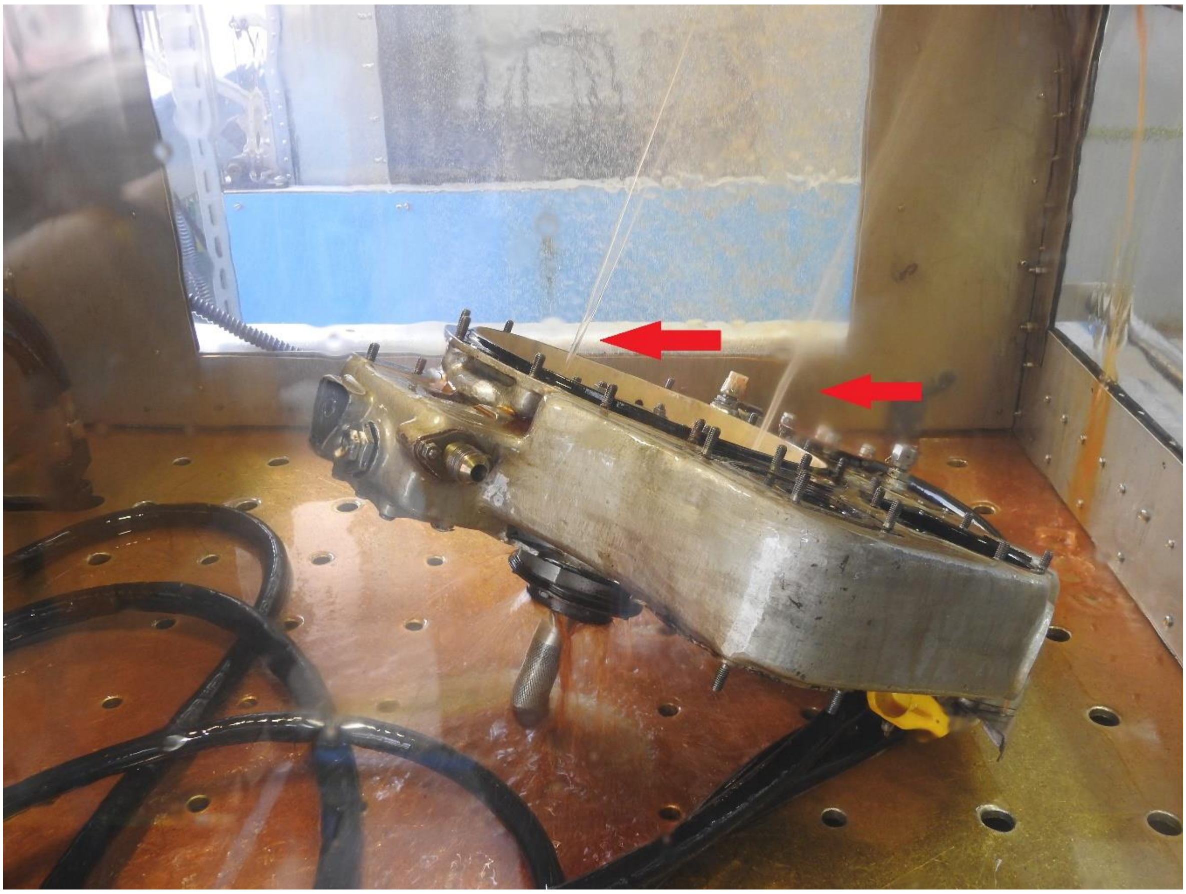
Source: SUB

Figure 23: Removing corrosion from the opening holes



Source: SUB

Figure 24: Test on the test bench after removing the corrosion from the opening holes



Source: SUB

After removal of the corrosion detected at the opening boreholes, a new similar test on the test stand showed that oil could flow through as a test substance. Thus it was proved that corrosion was the reason for the partial failure of the ice prevention system.

All other components of the engine anti-icing system (valves etc.) including indicators were found to be functional and inconspicuous.

1.12.5 Description of the anti-ice system at the engine

The helicopter is equipped with various ice prevention systems to prevent ice build-up (anti-icing) and systems to remove ice that has already built up or is about to build up (de-icing).

Firstly, the engine is equipped with an Engine Air Particle Separator (EAPS) Anti-Icing Hot Air / Oil System. This system prevents ice build-up in the front area where air is introduced into the intake tract. Secondly, from the Engine Inlet Anti-Icing System, where the inlet struts, guide vanes and the starter generator are supplied with hot air from the final compressor stage.

In this case, particular attention is to be paid to the Engine Inlet Anti-Icing System due to the corrosion detected in the area of the two opening bores of the Inlet Case front Struts.

The basic function of the Engine Inlet Anti-Icing System is that hot air from the area immediately after the final compressor stage is branched off and directed to the points to be heated by means of pipes, hoses etc. The hot, outflowing air serves to prevent ice build-up or to melt any ice that may have settled.

At temperatures of less than 5°Celsius prevailing outside temperature, the Engine Inlet Anti-Icing System must be activated to prevent ice build-up in the engine inlet area.

Activation of the engine anti icing system in the cockpit

The Engine Inlet Anti-Icing System is actively activated by the pilot by means of toggle switches in the cockpit, whereby both engines have separate switches and technically speaking, fully separate systems. The two toggle switches in the cockpit (one per engine) on the "ICING PROTECTION" panel (positioned on the overhead panel) have three positions each. In the middle position the entire EAPS and Engine Inlet Anti-Icing system is switched off, in the forward position only EAPS Anti-Icing is activated, in the aft position both Engine Inlet Anti-Icing and EAPS Anti-Icing system are active. The Engine Inlet Anti-Icing System must be activated when the outside temperature is less than 5° Celsius.

Figure 25: Icing protection

Source: SUB

Engine anti icing display in the cockpit

The electromagnetically actuated valve, from the Engine Anti-Icing System, controls the hot air, which is branched off from the area immediately after the last compressor stage, via pipes and hoses to the opening holes in the Inlet Case front Struts. When the Engine-Anti-Icing-System is activated and functioning, the position of the electromagnetically controlled valve controls the cockpit display, the Operation Light. It has been found that these lights of both engines were functional.

Figure 26: Operation light ENG 1 Anti-Icing ON

Source: SUB

Figure 27: Operation light ENG 2 Anti-Icing ON

Source: SUB

Partial constraints on the engine-anti-icing system, as in this case caused by corrosion, has no effect on the displays in the cockpit. The electromagnetically actuated valve opened and let the hot air (Combustion Air) pass up to the opening holes in the Inlet Case front Struts. Since these openings were closed by corrosion, no Combustion Air could escape to prevent ice build-up.

Description of the available engine power in the event of an engine failure:

The two gas turbine engines have three power stages, which are available and can be called up depending on the power configuration.

Primary Level - maximum power which can be called up with two engines running.

Contingency Level (30 min OEI) - power that can be retrieved by the remaining engine in case of failure of the other engine, unless further action is taken by the pilot (available as soon as the N1 of the failed engine falls below 58%). This power can be called up for 30 minutes.

Safety Level (2.5 min OEI) - power which can be called up by the remaining engine in case of failure of the other engine, provided that the corresponding button on the collective pitch control lever is pressed by the pilot. This power can be called up for 2.5 minutes.

1.12.6 Main rotor and tail rotor blade deicing system

Functional description

The main and tail rotor blade defroster has three switch positions: Manual/Auto/OFF.
If the switch is in position Manual the deicing system is switched on, independently of the detection of the RIO-3A sensor and the main and tail rotor blades are alternately heated (depending on the EN-02/EN-03 De-icing Control Unit). The indicator lights "Main Rotor Deicing On" and "Tail Rotor Deicing On" appear in the cockpit. If the switch is in position Auto the RIO-3A ice detector automatically activates the main and tail rotor blade deicing system. As soon as the RIO-3A sensor detects an ice build-up, the warning light "ICE" is activated and at the same time the indicator lights "Main Rotor Deicing On" and "Tail Rotor Deicing On" are activated. As soon as the system is controlled via the EN-02/EN-03 Deicing Control Unit. In the OFF position, the blade deicing system is switched off and cannot be activated even if the RIO-3A sensor is detected.

Functional check of the de-icing system Technical Note 26/06/2019

- helicopter de-icing system in Manual Mode verification – proper operation
- helicopter de-icing system in Auto Mode verification
  -no illumination of the "ICE" warning light, no activation of the installed de-icing system.
  -system electric circuit verification in order to failure localization. It was found that two connectors were not connected to the control unit of the RIO 3A sensor, see Figure 28.
  -When the connection with the RIO 3A control unit was established, it could be determined that the "ICE" warning lamp was permanently activated (regardless of which signal the RIO 3A sensor had transmitted). Afterwards the RIO 3A sensor including the cabling up to the RIO 3A control unit was checked, this was done without any abnormalities.

Figure 28: Controll unit RIO 3A

Source: Technical note

2 Analysis

2.1 Flight operation

2.1.1 History of Flight

The operator’s permit was an Air Operator Certificate (AOC) by the Republic of Austria, issued by Austro Control GmbH, including authorisation for commercial specialised high-risk flight operations to carry out the work flight in question with the helicopter involved. The pilot obtained the flight weather for this flight via his cell phone. An ATC flight plan was not posted. The pilot activated the Engine Inlet Anti-Icing System according to RFM for the flight, as the prevailing outside temperature was less than 5° Celsius. The main- and tail rotor blade deicing system was switched to manual by the pilot. By the selected mode "Manual", the main- and tail rotor blade de-icing system was switched on and in function. The function check also showed that the system was functioning in this mode. If the pilot had selected the mode "Auto", the system would not have been activated because there was no connection between the RIO 3A „Ice Detector Sensor“ to the control unit RIO 3A. Based on the video recordings, it can be determined that the helicopter was outside of clouds and fog during the malfunction and always had ground visibility. The pictures which were taken by the flight assistant directly after the emergency landing, do not show any ice buildup on the main rotor blades. There are slight ice deposits in the area of the transmission cowling and damp snow deposits above the engine air intakes. Based on the evaluation of the audio spectrum analysis, the CVR and the video recordings, the following sequence of events could be reconstructed.

After approximately 35 minutes of flight time, the power loss of engine 2 occurred. Two seconds later, the acoustic low RPM warning came on. At this time, the helicopter was abeam of the Almgasthof. Initially, he steered the helicopter uphill with the nose parallel to the power line. In doing so, he aligned the helicopter nose slightly to the right and picked up forward speed (airspeed) to reach the emergency landing area about 150m away. The pilot could not give any information about the IAS, vertical speed, because he was preparing for the emergency landing. Approximately 20 seconds after the occurrence of the power loss, the collision of the main rotor blades with the tree can be heard. The main rotor blades were separated and parts of them damaged the tail rotor. As a result, the main rotor and turbine compressor speeds increased. Approximately 30 seconds after the power loss occurred, the main rotor speed dropped and the pilot shut down the engine. The pilot operated the "Fuel Valve Switches" and brought them into the "CLOSED" position. No rotor brake was used. The pilot deactivated all electrical switches and left the helicopter with the crew. There were still about 1150 liters of fuel in the tank. To fulfil the mission and the purpose of the working flight it was necessary to fly below the minimum flight altitude of 150 metres above ground, which generally applies at the site of the accident, a step that was admissible due to the flight operation permits and documents available. The use of a twin-engine helicopter would not have been absolutely necessary for this specific flight due, among other factors, to the low population and building density of the route flown and due to the type of activity performed, and theoretically one single-engine helicopter could have managed the task. It was therefore not necessary to operate in power class 1, which, by definition, requires that a safe continuation of the flight be ensured at all times following an engine failure. It would also have been permissible to perform the working flight or sections thereof in performance classes 2 or 3. The flight therefore also met the technical and operational requirements.

2.1.2 Crew

The pilot is and at the time of the accident was the holder of the commercial pilot licence (CPL(H)) issued by the Federal Office of Civil Aeronautics (Germany) including registered type rating for the accident type "W-3SOKOL", in operation with one pilot valid until 31.08.2019. He has language certificates in German and English (English limited until 21.11.2010). He has a Class 1 Medical Certificate of Airworthiness without restrictions and conditions valid until 20.10.2019. The latest OPC (Operators Proficiency Check) required for commercial flight operations on the type had been taken on 17.11.2018. The flight examiner endorsed it as "excellent skills and knowledge on the Sokol W3A type ". The pilot holds a general radiotelephony certificate for aeronautical mobile radiotelephony, issued by the Telecommunications Authority of Tyrol and Vorarlberg on 23.01.2006. According to his own records, he had a total flying time experience of approximately 6,700 flying hours at that time, 4,656 hours of which as a pilot on helicopters, 153 hours within the preceding 90 days, 52 hours within the preceding 30 days. The number of flying hours on the PZL W-3A accident type totalled 84 hours during the preceding 90 days. The start of duty on the day of the accident was preceded by a rest period of 16 hours and 10 minutes, according to own records. On the day of the incident, the pilot had started work at 10:00 a.m. On the day before, he had been on duty for 10:05 hours, with a flight time of 03:39 hours.

The persons on board carried out activities which were necessary for the performance of the work flight, passengers on the flight were hence also factually justified in accordance with the applicable standard procedures and general provisions.

2.2 Aircraft

2.2.1 Mass and centre of gravity

Mass and centre of gravity were within permitted limits at the time of take-off, during the entire flight and at the time of the accident. There is no indication of possible accident causality. No calculation of the lateral C.G. position occurred, especially since there is no indication of a causal relationship.

2.2.2 Calculation of Flight Performance HOGE and HIGE with one Engine (OEI)

No graphs or other information are available from the aircraft manufacturer for this type of helicopter in the Airplane Flight Manual or its supplements, which would allow performance calculations to be made with respect to performance with a failed engine in hover, neither in (HIGE) nor out of (HOGE). Therefore, it is not possible to conclusively determine whether, theoretically, a hovering manouevre would have been possible to continue the flight without landing at the corresponding location and calling up the maximum available power (OEI Safety Level 2.5 min). According to the information provided by the pilot, he had not taken any active steps as a result of the occurrence of the event which for him was not causally classifiable at this point in time, i.e. he had not taken any active steps to call up the OEI 2.5 min. power. The pilot thus had the OEI 30 min power available. Based on available data, it is only possible to determine the hovering power with existing take-off power using both engine

<u>Statement engine manufacturer Pratt & Whitney</u>

„…

According to the evidence tests of the W-3A helicopter, the operation of one engine in the OEI 2.5 min range should ensure not only maintaining the horizontal flight of the helicopter but also its climb. Meanwhile, according to the pilot, the helicopter loosed altitude quickly. This may be evidence of:

- flight at too high angle of main rotor loading, resulting in a drop in rotor speed, or

- not turning on the power button 2.5 OEI by pilot, or

- icing of the rotor blades, which caused a significant decrease of lift

….."

2.2.3 Aircraft maintenance

At the time of the accident, the helicopter was fully airworthy and had the necessary registrations and approvals, documents and permits required for the flight operations that took place and was insured accordingly. The aircraft was under the supervision of a Continuing Airworthiness Organisation (CAMO). The 300/ 600 hour inspection and the Special Inspection "Winter Inspection" was performed by an EASA Part145 on 24.04.2018 with a total aircraft operating time of 3521 hours. During the execution of the Special Inspection "Winter Inspection" according to Maintenance Manual 5.40.03, there was no indication of a non-functional main rotor and tail rotor blade de-icing system in Mode Auto.

2.2.4 Service life file right engine Engine 2

The PZL W-3A helicopter is powered by two gas turbine engines manufactured by Pratt & Witney Rzeszow S.A. (PW for short), type PZL-10W. Each engine has a continuous shaft power of 574 kW and a maximum shaft power of 846 kW (2.5 min OEI). According to the submitted service life file (L file) concerning the engines, the engine with the serial number 219954019A is installed on the right-hand side. According to the Lifetime file, the engine has been overhauled once, the last time on 28.02.2008. The life cycle files do not contain any information which would allow the conclusion to be drawn that the repair was improperly carried out by applying paint to the two web struts in the engine air intake fairing (Inlet Case Front Struts) in the area of the air intake. According to the findings of the engine manufacturer, however, there is a causal relationship between this application of paint and the formation of corrosion. The repair carried out was not approved by the engine manufacturer. Also, it is unclear what has led to the repair.

2.2.5 Audio spectrum analysis, cockpit voice recorder and video recording

The evaluation of the audio spectrum analysis, CVR and video recordings show similarities in the time sequences from the occurrence of the incident to the emergency landing, the contact with the tree and the shutdown of the engines.

2.2.6 Fuel analysis

The two fuel samples tested met the required specifications. None of the examined fuel filters and oil filters nor the mechanical chip indicators gave indications of any other defects.

2.3 Meteorological information

All of the above data from the aeronautical weather reports of the two airports and the Autometar measuring stations indicate a temperature of approximately -1 to -3 degrees Celsius (interpolation using ISA standards) and a very high relative humidity (spread). It must therefore be assumed that these conditions favoured ice formation.

However, as far as can be ascertained the moderate icing conditions indicated on the aeronautical weather overviews only apply to a limited extent, especially as the helicopter was constantly outside the clouds or fog while maintaining visual sight of the ground. The minimum conditions applicable for the respective aeronautical weather were complied with during the accident flight for airspace class G. The flight was performed under visual flight rules (VFR).

2.4 Summary

Due to the corrosion in the area of two airflow ducts in the inlet case front struts in the right engine, two holes were closed, through which hot air flows when the engine anti-icing is activated to prevent ice formation. The fact that considerable damage was found in the form of deformations in the engine, specifically in the first compressor stage on 11 stator blades (gas compressor stator vanes) and 2 rotor blades (gas compressor rotor blades), but at the same time no recognizable foreign bodies or residues of such in the engine, in conjunction with the prevailing weather conditions and signs of ice build-up in the area of the fairings in the vicinity of the engine air intakes, indicates that the engine was damaged. When the ice build-up in this area had reached an appropriate level, the ice came loose and was sucked into the compressor. This resulted in the failure of the right engine and subsequently the loss of helicopter performance. The formation of ice was not visible to the pilot, as the corresponding indicator in the cockpit (Engine Anti Ice on) for both engines was lit up when the Engine Anti Ice System was activated. The fact that the left engine was running perfectly can be attributed to a functioning engine anti-icing system. The engine failure and the associated loss of power (decreasing rotor speed) forced the pilot to make a technical emergency landing. The pilot only had limited time to approach a landing area with as few obstructions as possible. This limited time factor was the result of several factors, the low flight altitude, weather conditions and the various obstacles.

3 Conclusions

3.1 Findings

- The pilot had all the necessary authorisations for the flight.
- The company had all the necessary authorisations to operate this flight.
- The applicable meteorological minima for airspace class G were met for this flight.
- The flight was conducted as a VFR flight.
- Weather conditions can be expected where ice formation may occur.
- According to RFM the helicopter is certified for day and night VFR. With additional equipment also for IFR.
- Operations in knowing icing conditions are prohibited under the RFM.
- The flight preparation required according to Regulation (EU) No 923/2012 Annex SERA.2010/b as amended as well as the preparations required according to the Operation Handbook / Specialised Operations Handbook of the company in connection with Regulation (EU) No 965/2012 (Flight Order, Operational Flight Plan and Risk Analysis for control and surveillance flights) were carried out at the company's base before departure.
- The mass of the aircraft and the longitudinal centre of gravity were within the permissible range during the entire flight until the time of the accident.
- The 300/ 600 hour inspection and the Special Inspection "Winter Inspection" was signed off and released by an EASA Part145 performed on 04/24/2018 for a total aircraft operating time of 3521 hours.
- The performed winter inspection did not receive a note about a non-functioning in mode “Auto” main and tail rotor blade de-icing system.
- The control unit RIO 3A was not connected, thus the function of the main and tail rotor blade deicing system was not given in the mode car.
- The pilot activated the mode”Manuel” on the main and tail rotor blade de-icing.
- The investigation revealed evidence of technical defects in the engine ice prevention system of the right engine.
- Corrosion formation at the outlet ducts in the inlet case front struts of the right engine was the reason for the partial failure of the ice prevention system.
- The formation of corrosion was not visible to the pilot either during the pre-flight check or during the flight.
- According to the findings of the engine manufacturer, however, there is a causal relationship between this application of paint and the formation of corrosion.
- The repair performed was not approved by the engine manufacturer.

- Due to the partial disruption of the ice prevention system, ice formed in this area due to the high humidity.
- The ice came loose and was sucked in by the right compressor, which led to the engine failure.
- The pilot activated the Engine Inlet Anti-Icing System for the flight according to RFM, as the prevailing outside temperature was less than 5° Celsius.
- The tested fuel met the specifications.
- The aircraft was airworthy at the time of the flight.
- The pilot did not turning on the power button 2.5 OEI.
- The emergency landing performed by the pilot was technically forced.
- The tree contact with the main rotor blades was not a factor that could have been influenced by the pilot.
- The helicopter was equipped with a flight data recorder. Due to a defect, the flight data recorder did not record any data. A flight data recorder and CVR was not required under aviation law.
- A CVR was on board, the system is automatically activated when the helicopter is started.

3.2 Probable causes

- Failure of the right engine and loss of power at low altitude above GND.
- Technically forced emergency landing with tree contact at the emergency landing field.

3.2.1 Probable factors

- Pre-existing technical defects in the engine anti-icing system of the right engine.
- Ice build-up in the area of the fairings near the engine air intakes.
- Ice was sucked in by the compressor, which subsequently led to the failure of the power unit.

4 Safety recommendations

No safety recommendations

5 Consultation procedures/ Comments procedures

In accordance with Article 16(4) of Regulation (EU) No 996/2010, the Federal Safety Investigation Authority sought comments from the authorities concerned, including EASA and the type certificate holder concerned, the manufacturer and the operator (holder) concerned, before publishing the final report.

In obtaining such observations, the Federal Safety Investigation Authority has complied with the International Guidelines and Recommended Practices for the Investigation of Aircraft Accidents and Incidents adopted pursuant to Article 37 of the Chicago Convention on International Civil Aviation.

Pursuant to § 14 para. 1 UUG 2005 as amended, the federal safety investigation authority has given the owner of the aircraft, the surviving dependents or victims the opportunity to comment in writing on the facts and conclusions relevant to the incident under investigation (comment procedure) before concluding the investigation report.

The comments received were taken into account or incorporated into the final report where applicable.

Tables

Table of Figures

List of regulation

Federal law of 2 December 1957 on aviation (**Aviation Act 1957 - LFG**), BGBI. No. 253/1957, last amended by BGBI. I No. 92/2017.

Federal Act on the Independent Safety Investigation of Accidents and Incidents (**Accident Investigation Act - UUG 2005**), Federal Law Gazette I No. 123/2005 as last amended by Federal Law Gazette I No. 102/2015.

Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, as amended

Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on occurrence reporting, analysis and follow-up in civil aviation, amending Regulation (EU) No 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007, as amended.

Implementing Regulation (EU) No. 923/2012 of the Commission of 26 September 2012 laying down common rules for the operation of air traffic control services and procedures, amending Regulation (EC) No. 1035/2011 and Regulations (EC) No. 1265/2007, (EC) No. 1794/2006, (EC) No. 730/2006, (EC) No. 1033/2006 and (EU) No. 255/2010 (**SERA**)

Abbreviations

AGL	Above Ground Level
AIP	Aeronautical Information Publication
ALT	Altitude
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
AUTOMETAR	Automatic weather station
BCMT	Beginning of Civil Morning Twilight
BKN	Broken (5/8 - 7/8)
CBO	Cycles Between Overhaul
COM	Communications
CPL	Commercial Pilot Licence
CRI	Class Rating Instructor
CSN	Cycles Since New (manufacture)
CSO	Cycles Since Overhaul
CU	Cumulus
CVR	Cockpit voice recorder
DA	Density Altitude
EASA	European Aviation Safety Agency
ECET	End of Civil Evening Twilight
EFB	Electronic Flight Bag
ELEV	Elevation
ELT	Emergency Locator Transmitter
FDR	Flight Data Recorder
FEW	Few (1/8-2/8)
FI	Flight Instructor
FMDS	Flight Management Data System
GND	Ground
GS	Ground Speed
HIGE	Hovering in Ground effect
HOGE	Hovering out of ground effect
HPA	Hectopascal
KT	Knots

LAT	Latitude
LONG	Longitude
METAR	Aviation Routine Weather Report (Code Form)
MSL	Mean Sea Level
NCD	No Clouds Detected
NIT	Night Qualification
NOSIG	No Significant change
OEI	One engine inoperative
OFP	Operational Flight Plan
OMA	Operational Manual Part A
OMB	Operational Manual Part B
OVC	Overcast (8/8)
OPS	Operational- Flightplan
PA	Pressure Altitude
PCA	Post Holder Continuing Airworthiness
PFO	Post Holder Flight Operations Manager
PIC	Pilot in Command
P/N	Part Number
PPL	Private Pilot Licence
Q	Indicator for QNH in Hectopascal
QFE	Air pressure at airport altitude (or at the threshold of the runway)
QNH	Altimeter scale adjustment to maintain the airfield altitude during landing
RA	Rain
RCC	Rescue-Coordination-Centre
RFM	Rotor Flight Manual
RMK	Remark
RPM	Revolutions Per Minute
SC	Stratocumulus
SCT	Scattered (3/8 - 4/8)
SERA	Standardised European Rules of the Air
S/N	Serial Number
SSR	Secondary Surveillance Radar
TAF	Aerodrome Forecast
TBO	Time Between Overhaul

THCM	Technical Crew Member
TR	Track
TSN	Time Since New (manufacture)
TSO	Time Since Overhaul
UMS	Utility Monitoring System
UTC	Coordinated Universal Time
ü.d.M.	Above the Sea
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VRB	variable
WGS84	World Geodetic System 1984
Z	zulu – see UTC

Imprint

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The sole objective of the safety investigation is the prevention of future accidents and incidents, without apportioning blame or liability. This draft report is based on the information provided. If the information basis is expanded, the Federal Safety Investigation Authority reserves the right to supplement the present draft report.

All information on data protection can be found at the following link:
https://wwww.bmk.gv.at/datenschutz

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