RNF

FINAL REPORT
AIRCRAFT ACCIDENT

Law on Aircraft Accident Investigation, No. 35/2004

Ditching

M-02907/AIG-13

TF-SIF
Aerospatiale SA 365N
Icelandic Coast Guard
Atlantic Ocean near Reykjavik Airport (BIRK)
July 16, 2007

Contents

List of abbreviations

Abbreviation	Full description
UTC	Universal Time Co-ordinate
N/A	Not Applicable
Nr	Rotation Speed of Main rotor blades
IAS	Indicated Airspeed
GS	Ground Speed
PF	Pilot Flying
PNF	Pilot Not Flying
ELT	Emergency Locator Transmitter
CoA	Certificate of Airworthiness
VMC	Visual Meteorological Conditions
VFR	Visual Flight Rules
WO	Work Order
S/N	Serial Number
QRH	Quick Reference Handbook

Synopsis

The flight of TF-SIF was planned as a training flight where the mission was to hoist people from the lifeboat, B.S. Einar Sigurjónsson, a life raft and from the ocean. When the aircraft was hovering over the ship, the crew noticed that one of the engines lost power, followed by a drop of Nr (Rotor Speed). The flight crew headed the aircraft away from the ship, inflated the floats and ditched the aircraft in the ocean. After shutting down both engines, the crew evacuated the aircraft and swam to a boat supported by the rescue ship. About 18 minutes after ditching, the aircraft capsized.

The Icelandic Aircraft Accident Investigation Board (IAAIB) was informed of the accident at 19:25 on July 16th 2007, by the air traffic controller at Reykjavik Airport (BIRK). The investigators of IAAIB were transported to the wreckage by a boat and following the field investigation the wreckage was transported to a hangar at Reykjavik Airport for further investigation.

In accordance with established international agreements, the investigation authority in France, Le Bureau d'Enquêtes et d'Analyses (BEA), representing the State of Design and Manufacture of the aircraft, appointed an Accredited Representative to participate in the investigation. The BEA Accredited Representative, supported by a team of advisers, which included experts from Eurocopter (the manufacturer of the aircraft) and Turbomeca (the engine manufacturer), participated in the investigation. The operator, Icelandic Coast Guard, supported the investigation by providing expertise, information and material as required.

The cause of the accident was due to one of the engines losing power[1]. IAAIB considers that it was most probably the right hand engine that lost its power, but it was not possible to determine the cause of the power loss.

IAAIB made one safety recommendation to the operator, i.e. to operate all of its aircraft with both flight data recorders and cockpit voice recorders.

[1] The drop of the engine rotation speed was determined from the CVR spectral analysis

1 Factual information

Factual information	
Place:	64 04 N 022 04 W.
Date:	July 16th, 2007.
Time[2]:	18:48.
Aircraft:	
• **type:**	Aerospatiale SA 365N (Dauphin).
• **registration:**	TF-SIF.
• **year of manufacture:**	1985.
• **serial number:**	6136.
• **CoA:**	Valid.
• **Nationality:**	Icelandic.
Type of flight:	Training flight.
Persons on board:	Three crew members.
Injuries:	None.
Nature of damage:	The aircraft was damaged beyond economic repair.
Short description:	Ditching after engine failure.
Owner:	Icelandic Coast Guard.
Operator:	Icelandic Coast Guard.
Weather:	310°/10 KTS, VIS + 10K, FEW 3.400 QNH 1019, Temp. 14 °C.
Meteorological conditions:	VMC.
Flight rules:	VFR.

[2] All times in the report are UTC which coincides with local time.

1.1 History of the flight

The flight of TF-SIF was planned as a training flight where the mission was to hoist people from the lifeboat, B.S. Einar Sigurjónsson, a life raft and from the ocean. The location of this mission was over the Atlantic Ocean at Straumsvík near Hafnarfjörður.

The crew of TF-SIF started the engines of the aircraft in front of the Icelandic Coast Guard's hangar at 18:31. The aircraft was taxied to RWY 31 where the aircraft took off at 18:39. The aircraft was flown from Reykjavík at 1.000 feet directly towards the ship, B.S. Einar Sigurjónsson. The flight time from Reykjavík Airport to the training area was approximately 6 minutes. All applicable checklists were performed and all parameters were within limits according to the commander's statement.

When arriving at the training area, the aircraft was flown in a standard pattern at 200 feet and 60 knots IAS and then descended to 100 feet and 20 knots IAS. When the training session began, the aircraft was hovered at 45-50 feet and 0-5 knots GS. At this time a power check was made and the pre-hoist checklist was completed. According to the commander's statement, all parameters were normal and the torque was approximately 85%. The commander announced to the crew that the aircraft was in Class 3 performance[3] and the aircraft would be ditched in case of an engine- or tail rotor failure.

When hovering over the rescue ship at approximately 45 feet, the crew first lowered a guide line and then a rescue man from the aircraft to the ship and there after a rescue litter. The hoist operator reported to the commander that the litter had contacted the ship and 20[4] seconds later he reported that the line was free. About 3 seconds after the line was free from the litter the low Nr horn started to sound frequently. At this time the crew noticed a power loss followed by a reduction of main rotor speed (Nr). The PF directed the aircraft away from the ship and scanned the caution warning panel for warning lights but saw none lit. The PNF looked at the Nr indicator and determined it to show Nr between 300 and 330 (Normal Nr is 355) rpm and the aircraft was losing altitude.

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[3] Performance Class 3 operations are those operations such that, in the event of a power unit failure at any time during the flight, a forced landing may be required in a multi-engine helicopter but will be required in a single engine helicopter.

[4] time is calculated from the CVR

About ten seconds after the low Nr horn started to sound, the crew inflated the floats. Seven seconds later the commander ditched the aircraft in a level attitude. About four seconds after the ditching a vibration sound can be heard on the CVR and at that time the Commander asked for the status of the wire. The hoist operator reported that the wire was free (i.e. not attached or hooked to anything). About 30 seconds later the wire was cut from the winch.

After ditching the crew retarded the fuel flow control lever (FFCL) in order to shut off the engines. The pilot reported that when shutting off the right hand engine the engine seemed to be already on low rotation speed. The crew then stopped the main rotor by applying the rotor brake and then cut the hoist wire. After a short briefing the crew shut the battery off as well as the gyros. The crew then evacuated the aircraft through the right hand sliding door and swam to a boat from B.S. Einar Sigurjónsson.

After evacuating the aircraft, the crew noticed that the front floats were rubbing against the pitot antennas (pitot tubes). A few minutes later, the forward most chamber of the right front float deflated. The aircraft started to tilt and finally rolled to the right and capsized, approximately 18 minutes after ditching.

Figure 1: The aircraft capsized approximately 18 minutes after ditching

The Air Traffic Control Centre in Reykjavik received a distress signal from the aircraft's ADELT[5] and notified the Icelandic Aircraft Accident Investigation Board.

1.2 Injuries to persons

None.

1.3 Damage to aircraft

All fenestron (tail rotor) blades were found sheared off. The tail rotor blades were not retrieved from the ocean. Holes were found on the tail rotor fan case (see Figure 2) as well as small damage in one of the main rotor blades. This damage was evaluated to be caused by some of the tail rotor blades hitting the tail boom and the main rotor blade.

[5] Automatic Deployable Emergency Locator Transmitter

Figure 2: All fenestron (tail rotor) blades sheared off

The right hand engine fire bottle was found empty. The circuit breaker for the fire bottle was found tripped. The investigation concluded that a discharge of the fire bottle would not cause a power loss of the engine.

Following circuit breakers were also found tripped: Fuel G.1, Fuel G.2, DC Conv, CVR, AUX HYD, ATC, LAND LT.1 and BULB LT.2

The forward most compartment of the right front float was found damaged and deflated. According to witnesses, the float inflated correctly and kept the aircraft afloat in a level position, long enough for the crew to evacuate the aircraft. A few minutes after ditching, the forward most compartment of the right float deflated due to rubbing with the pitot antenna.

Figure 3: Aircraft with right front float deflated

During the investigation, scratches were found on forward part on both front floats, where the pitot antennas contacted the floats and the right float was torn (see Figure 4 and Figure 5).

The aircraft capsized after approximately 18 minutes in the water and was later evaluated damaged beyond economical repair.

Figure 4: Damaged (deflated) right front float

Figure 5: Scratches on left front float (not deflated)

1.4 Other damage

None.

1.5 Personnel information

<table>
<tr><th colspan="3">Commander</th></tr>
<tr><td>Age, sex:</td><td colspan="2">36 year old, male.</td></tr>
<tr><td>License:</td><td colspan="2">Holder of ATPL(H) license issued by Icelandic Civil Aviation Authorities. License was valid.</td></tr>
<tr><td>Medical certificate:</td><td colspan="2">First/Second class. Valid.</td></tr>
<tr><td>Ratings:</td><td colspan="2">AS 332/332 L2/ EC225 LP.
SA 365 / AS 365.
IR.</td></tr>
<tr><td>Experience:</td><td>Total all types:</td><td>3347 hrs</td></tr>
<tr><td></td><td>Total on type:</td><td>775 hrs</td></tr>
<tr><td></td><td>Last 90 days:</td><td>82 hrs</td></tr>
<tr><td></td><td>Last 24 hours:</td><td>1.5 hrs</td></tr>
<tr><td>Previous rest period:</td><td colspan="2">24 hours.</td></tr>
</table>

<table>
<tr><th colspan="3">Co-Pilot</th></tr>
<tr><td>Age, sex:</td><td colspan="2">28 year old, male.</td></tr>
<tr><td>License:</td><td colspan="2">Holder of CPL(H) license issued by Icelandic Civil Aviation Authorities. License was valid.</td></tr>
<tr><td>Medical certificate:</td><td colspan="2">First/Second class. Valid.</td></tr>
<tr><td>Ratings:</td><td colspan="2">AS 332/332 L2/ EC225 LP.
SA 365 N / AS 365 N2.
IR.</td></tr>
<tr><td>Experience:</td><td>Total all types:</td><td>408 hrs</td></tr>
<tr><td></td><td>Total on type:</td><td>62 hrs</td></tr>
<tr><td></td><td>Last 90 days:</td><td>48</td></tr>
<tr><td></td><td>Last 24 hours:</td><td>2</td></tr>
<tr><td>Previous rest period:</td><td colspan="2">48 hours.</td></tr>
</table>

1.6 Aircraft information

1.6.1 General

Manufacturer: Eurocopter

Type: Dauphin 365N

Aircraft serial number: 6136

Engine serial numbers: Engine 1 (left hand), S/N 2187;
Engine 2 (right hand), S/N 2193

Year of manufacture: 1985

Type of engines: Arriel 1C turbofan engines (Turbomeca)

Total airframe hours: 7057 hours

Remaining engine/FCU hours:

Left engine S/N 2187		Calendar next due	Remaining hours	Remaining cycles
	Module 1	July 2007	5945	N/A
	Module 2	August 2012	2769	9707
	Module 3	January 2021	2625	3892
	Module 4	July 2013	3867	6292
	Module 5	September 2012	671	N/A
FCU S/N B708B		June 2010	1273	N/A
Right engine S/N 2193				
	Module 1	July 2007	5945	N/A
	Module 2	October 2016	4639	11747
	Module 3	January 2022	2887	7201
	Module 4	August 2013	3889	6354
	Module 5	November 2015	1465	N/A
FCU S/N C105B		June 2016	2187	N/A

Table 1: Remaining engine/FCU hours

1.6.2 Maintenance

Aircraft

Last 500 hours inspection of the aircraft was recorded in the Aircraft Logbook on the 21st of February 2007. This inspection was performed per WO ICG-2007-2. According to the logbook, the aircraft's total hours at that time were recorded as 6943. Last 50 hours inspection of the aircraft was recorded on the 12th of July 2007.

Engines

Last 150 hours inspection of both engines was recorded on the 13th of July 2007, three days prior to the accident. This maintenance work was performed as per WO ICG-2007-143. Prior to this inspection there was a 100 hr. inspection of the engines made on the 25th of August 2006 (WO 4395).

Fuel control units (FCU's)

The fuel control unit with S/N B708B was installed on engine 1 (S/N 2187) on the 26th of September 2003 after a P2 chamber cleaning (in accordance with SB 0292 73 0236). The cleaning was performed by the manufacturer of the FCU. At that time the total hours of the FCU was 844 hours and the total hours of the aircraft was 6173. As listed above, the total airframe hours at the time of the accident were 7057. This means that the total hours of this FCU was 1728 hours.

The fuel control unit with S/N C105B was installed on engine 2 (S/N 2193) on the 7th of June 2006 after a repair. At that time the total hours of the FCU was 510 hours and the total hours of the aircraft was 6753. This means that the total hours of this FCU was 814 hours.

Time between overhaul (TBO) of the FCU units is 3000 hrs.

Airframe fuel system

In March 2006, the airframe fuel system was disassembled in order to replace the fuel hoses. This work is required every 10 years and was made according to WO 4117, 4123, and 4125.

1.6.3 Fuel

Prior to the accident the aircraft was refueled with 384 kg of Jet A-1. The aircraft's total fuel load was 610 kg, 305 kg in each main tank. The fuel uplift was made from the operator's private fuel tank at the airport, located next to the operator's hangar. Following the accident, a sample was taken from this tank and analyzed. The results from the analysis were normal.

1.6.4 Winch

The aircraft was equipped with a winch above the aft door on the right side.

1.6.5 Pitot static system

There are two possible locations for the pitot antennas on the SA 365 models (see Figure 6). One on each side (A), or both under the nose (B).

Usually the pitot antennas are fitted under the nose according to the location (B). Installation (A) is used for customization purpose only when a radar antenna is fitted under the nose of the aircraft or when the aircraft is fitted with some specific electronic components.

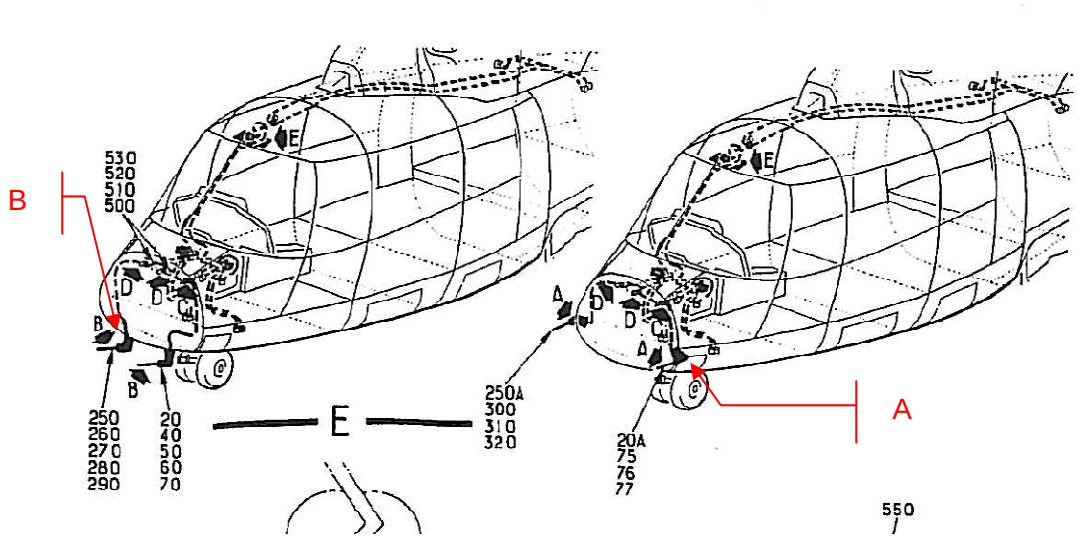

Figure 6: Two different location of Pitot antennas

On TF-SIF, the pitot antennas were originally fitted in location (A). At the time of the accident, the left pitot antenna was in accordance with its original delivery but the right antenna was replaced in 2004 due to a crack. The replaced antenna contained a metallic drain valve on the rear of the antenna that eventually ruptured the float.

1.7 Meteorological information

At the time of the accident, the wind was 310°/10Kts, temperature 14 °C, visibility +10Km, QNH 1019 and few clouds at 3.400 ft.

According to Sea State Code the wave height was ranked as code 2-3 (Smooth to Slight), see Table 2.

1.8 Aids to navigation

N/A.

1.9 Communications

N/A.

1.10 Aerodrome information

N/A.

1.11 Flight recorders

The aircraft was equipped with a Cockpit Voice Recorder (CVR) of 30 minutes duration. The recording medium was magnetic tape. The aircraft was not equipped with a Flight Data Recorder (FDR). The CVR was removed from the aircraft at the accident site, while still under water, and placed into a wet container. The CVR was kept in water until the data was downloaded. The process of downloading was made with the assistance of the UK Air Accident Investigation Board. The downloading of the data from the CVR was successful. The 35 minute CVR recording started when the crew was preparing for take-off and lasted until approximately 18 minutes after ditching. Initial analysis of the recorded sound revealed a drop in Nr (main rotor speed) a few seconds prior to the ditching. Further analysis of the data was performed by the investigation authorities in France (BEA). By analyzing the recorded sound, it was possible to estimate the speed of rotation of the main rotor. Figure 8 shows that about 17 seconds before ditching the main rotor speed became unstable and then dropped dramatically.

Figure 7: CVR in water before further processing

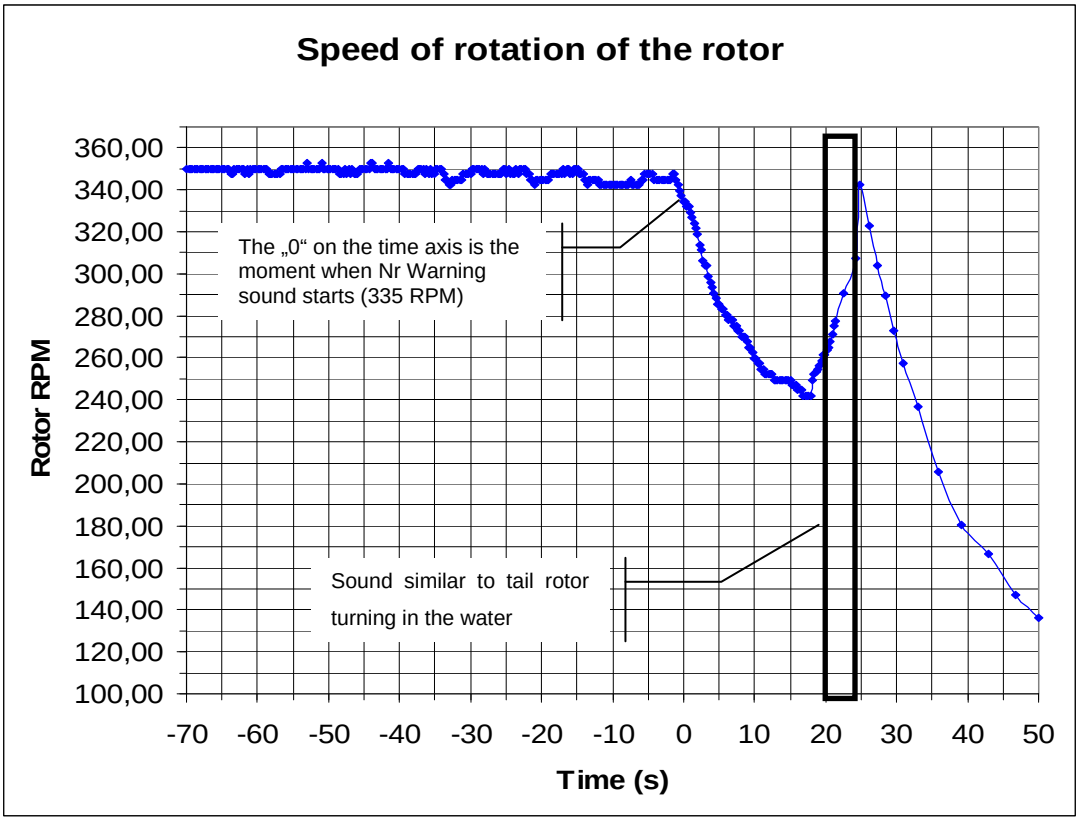

Figure 8: Rotation speed estimated from CVR readout.

Furthermore, it was possible to identify the sound of each engine where it shows that one of the engine's rotation speeds started to fluctuate about 45 seconds before the ditching. At the same time the other engine started to vary in power in order to maintain main rotor speed (see Figure 9). When the rotation speed for one engine suddenly decreased to or below idle, the rotation speed for the other engine increased to its maximum and remained there until the engines were shut down. It was not possible to determine which engine spooled down. However according to the crew's statement it seemed that the right hand engine was not responding normally when they were shutting down the engines. The crew did not notice any fluctuation or any engine failure prior to the drop of main rotor speed.

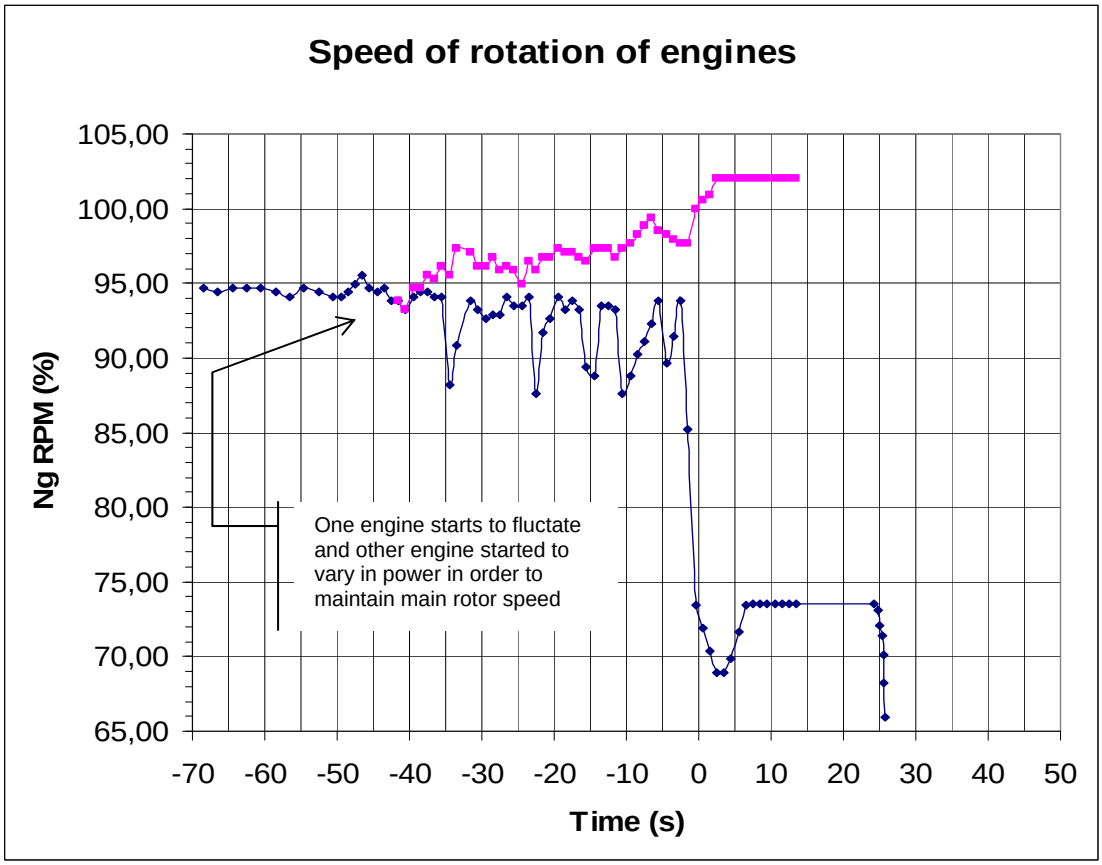

Figure 9: Estimated rotation speed of the two engines read out from the CVR.

In Figure 8, magenta color shows the “non failing” engine increasing its rotation speed following the “failing” engine losing its rotation speed.

1.12 Wreckage and impact information

According to the crew as well as witnesses, the ditching was smooth and in a level attitude. The tail rotor most likely hit the water right after the aircraft landed and before the crew shut down the engines. Due to the impact with water, the tail rotor blades sheared off and did some damage to one of the main rotor blades as well as the tail rotor fan case.

1.13 Medical and pathological information

N/A.

1.14 Fire

N/A.

1.15 Survival aspects

1.15.1 Search and rescue

This flight of TF-SIF was a training flight in co-operation with a maritime rescue team. The rescue team was at the accident site and was able to rescue the crew immediately. The aircraft's crew swam from the aircraft and directly to the boat supported by B.S. Einar Sigurjónsson.

1.15.2 Emergency flotation system

The emergency flotation system is designed to keep the aircraft afloat and stable after ditching to allow evacuation of the passengers and crew.
There are four sections within the aircraft's flotation system.

1. Forward cylindrical inflatable floats
2. Aft spherical inflatable floats
3. Tail boom
4. Fuel tanks compartment

According to the Aircraft Flight Manual, 20.13.1, the waterline runs above cabin floor at maximum gross weight.

According to the aircraft design and manufacture the floating of the aircraft was tested at Sea State Code 4, see Table 2, with all doors jettisoned and one compartment of the float deflated. During the test the aircraft remained upright.

Sea state code, World Meteorological Organization (WMO)

Sea State Code	Description of sea	Meters	Feet	Knots
0	Calm (Glassy)	0	0	0-3
1	Calm (Rippled)	0 to 0.1	0 to 1/3	4-6
2	Smooth (Wavelets)	0.1 to 0.5	1/3 to 1 2/3	7-10
3	Slight	0.5 to 1.25	1 2/3 to 4	11-16
4	Moderate	1.25 to 2.5	4 to 8	17-21
5	Rough	2.5 to 4	8 to 13	22-27
6	Very rough	4 to 6	13 to 20	28-47
7	High	6 to 9	20 to 30	48-55
8	Very high	9 to 14	30 to 45	56-63
9	Phenomenal	over 14	over 45	64-118

Table 2: Sea state code

During the investigation, the Sea State Code was estimated to be 2-3 at the accident site, at the time of the accident.

1.15.3 Evacuation

During the hoisting as well as the ditching, the right (aft) side door of the aircraft was open. The crew evacuated through this door approximately 4 minutes after ditching. The evacuation process was completed without difficulties.

When the aircraft had floated for a few minutes in the ocean, the most forward compartment of the right front float deflated due to a contact with the pitot antenna. Approximately 18 minutes after ditching, the aircraft capsized.

According to the aircraft Flight Manual the emergency evacuation procedure[6] for landing on water is as follows:

NOTE: With floats inflated, doors must be jettisoned only after landing on water.

Cockpit doors:
After landing on water, carry out the following operations:

- Pull the jettison handle
- Push the door
- Unlock the normal control
- Open the door through the normal control

Passenger doors:

- Jettison the doors after landing on water if necessary

The operator did not have a checklist within the QRH for ditching or emergency evacuation - SEA. The operator did however have this for its other type of aircraft, AS332L1 (Super Puma), which the crew was familiar with.

The emergency flotation system is designed[7] to keep the aircraft afloat and stable after ditching so as to permit evacuation of the passengers and crew.

[6] Eurocopter 365 N Flight Manual SUP.10.4 Page 4.
[7] Eurocopter 365 N Instruction manual 20.13.1, The principles of the emergency flotation system.

1.16 Tests and research

The aircraft was hoisted from the ocean and transported to a hangar near the accident site. The IAAIB carried out a visual inspection of the aircraft fuel system as well as the oil system. The visual inspection of the engines and airframe did not reveal any anomalies. Oil filters were found to be clean as well as the chip detectors. Fuel was found in fuel system next to the Fuel Control Units and the shafts for the main rotor were found to be in good condition.

During the investigation process, the engine fuel system was tested as well as the airframe fuel system. As the engines and the FCUs had been immersed in salt water for some time it was decided not to test them on a test bench. Both engines were disassembled for inspection as well as the FCU's.

The following components were disassembled for inspection or tested:

a) Fuel Control Units (as a part of the engine fuel system).
b) Over-speed and drain valves (as a part of the engine fuel system).
c) Starter injector electro-valves (as a part of the engine fuel system).
d) Tachometer Boxes.
e) Airframe fuel system.
f) P2 pipes (as a part of the air entering, in the engine fuel system).

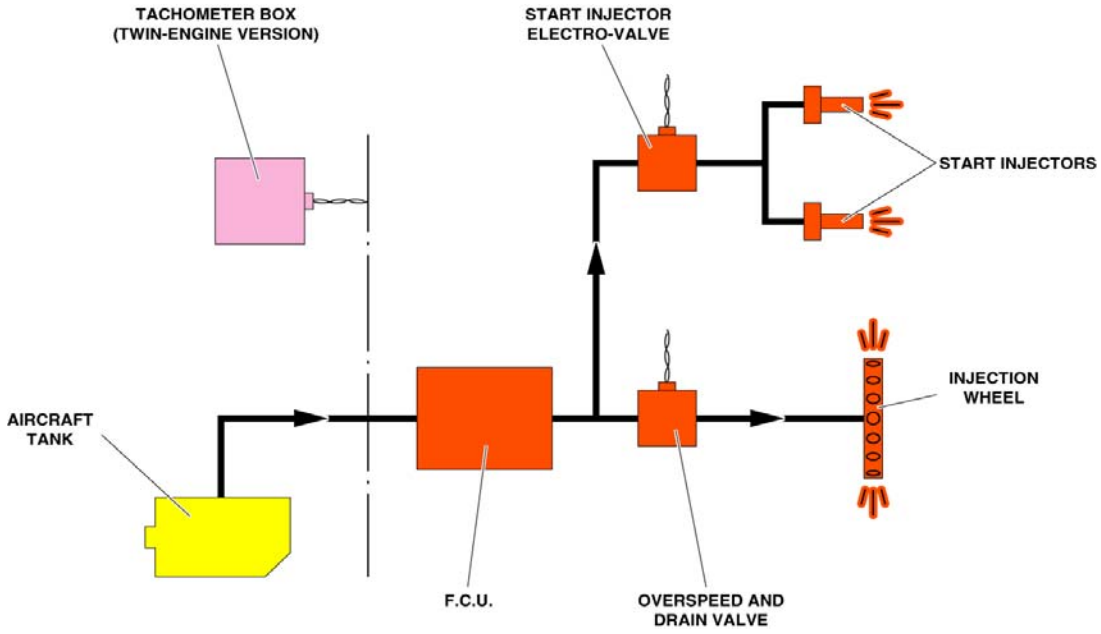

Figure 10: Schematic of the analyzed components

a) Fuel Control Units

Both fuel control units (FCU) were opened and inspected (see Figure 11).

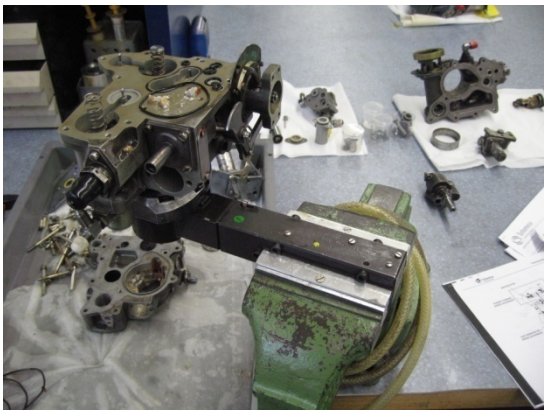

Figure 11: Disassembled FCU unit

The FCU unit (S/N B708B) on left hand engine contained some fuel in its P2 chambers, i.e. were fuel should normally not be found. This was a known finding within the FCU according to the engine manufacturer and could be traced to an O-ring that should be replaced with a different type. According to the engine manufacturer, it was concluded that this would not cause loss of engine power.

The FCU unit (S/N 105B) on right hand engine contained some substance in its P2 chamber. The substance was analyzed to be salt and grease. According to the manufacturer, the grease should normally be within the capsule but the technical examination could not determine the reason why the salt substance was found within the P2 chamber. Figure 12 and Figure 13 show the two different chambers.

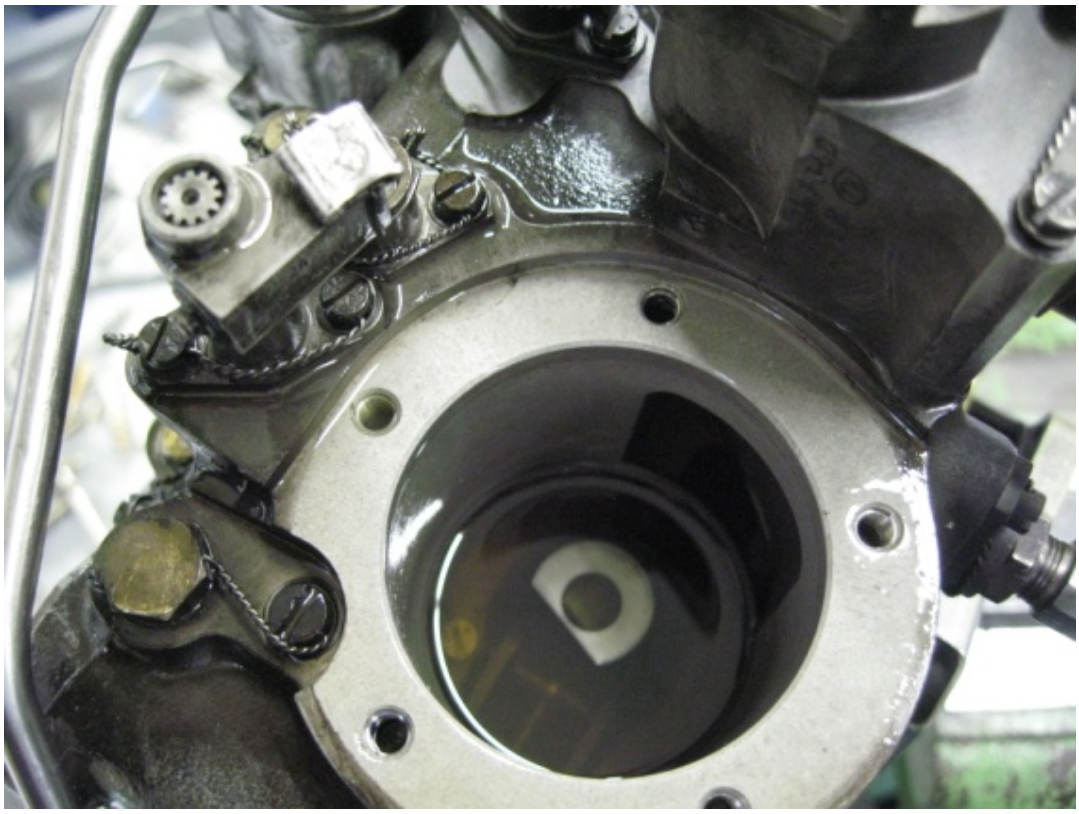

Figure 12: P2 Chamber with fuel

Figure 13: P2 Chamber with salt and grease

The FCU with S/N 105B had light scratches on its working piston, see Figure 14. The scratches were determined to be within manufacturer's limits.

Figure 14: Working piston of FCU unit S/N 105B

b) Overspeed and drain valves

Overspeed and drain valves were investigated with the following results:

Left (P/N 0174126090 - S/N A69B) tested and no significant fuel leakage found.
Right (P/N 0174126090 - S/N A46B) tested and no fuel leakage found.

c) Start electro-valves, bleed valves

Start electro-valves and bleed valves were tested with the following results:

Left

1. Start electro-valve (P/N 0174078030 - S/N C451B) was tested in a test bench and no fuel leakage found.
2. Bleed Valve (P/N 3151200-IND02 - S/N 20608) was tested and salt contamination found, the valve was found in open position which is considered to be normal and blocked due to the salt contamination.

Right

1. Start electro-valve (P/N 0174078010 - S/N A734B) was tested in a test bench and fuel leakage was found to be max 19 l/h. In order to verify the engine behavior with this start drain valve, it was tested by mounting it on an engine (ARRIEL 1C, S/N 2109), on the test bench. The maximum take-off power was available with a slightly too high fuel consumption (+15 l/h). The fuel leakage observed on the start drain valve cannot explain the engine rating dropping to idle.

2. Bleed Valve (P/N 3151200-IND03 S/N 20177) was tested and salt contamination found, the valve was found in open position which is considered to be normal and blocked due to the salt contamination.

d) Tachometer boxes

The tachometer boxes were investigated with following results:

Left tachometer box (P/N 0177555120 - S/N 85B) investigated and no overspeed activation found.
Right tachometer box (P/N 0177555120 S/N 90B) investigated and no overspeed activation found.

e) P2 pipes

The pipes that carry the air into the fuel system where tested in order to find possible air leaks. The pipes for both engines were found to be leak proof.

f) Engines

Both engines were disassembled and analyzed. Both engines were considered to be in good condition and no anomalies found.

g) Airframe fuel system

The airframe fuel system was tested and found to be working properly. The fuel tanks were opened and found to be free of dirt.

2 Analysis

The flight of TF-SIF was planned as a training flight where the mission was to hoist people from the lifeboat, B.S. Einar Sigurjónsson, a life raft and from the ocean. During the hovering over the lifeboat, the crew noticed a sudden drop of main rotor speed (Nr) and was forced to ditch the aircraft. After analyzing the recorded sound from the CVR it was found that one engine started to fluctuate until its speed decreased to approximately idle power. The loss of power[8] in one of the engines is determined to be the cause of the drop of main rotor speed.

After inspecting both engines, both fuel control units (FCU's), the airframe fuel system (as well as the fuel) and relevant components, no anomalies were found except within the FCU's as listed in chapter 1.16.

The investigation revealed that if the capsule of the P2 chamber is not waterproof, this could lead to a loss of power. The technical examination determined that both capsules of the P2 chambers were waterproof. The technical examination could however not determine the reason why the P2 chamber of the right hand engine FCU was found with grease and salt substance inside (Figure 13). IAAIB considers that the reason why the aircraft was forced to ditch was most likely due to that the right hand engine lost its power. This is based on the crew statement that the rotation speed was close to idle when shutting off the right engine as well as the findings within the right hand FCU.

According to the aircraft manufacturer the floating capability of the aircraft was tested with all doors jettisoned and one compartment deflated. The test results were that the aircraft remained upright at rougher sea than at the accident site, or up to Sea State Code 4. The manufacturer states that the flotation gear is designed to keep the aircraft floating long enough for the crew and passengers to evacuate. IAAIB considers the combined effects of the doors not being jettisoned[9], the moment/weight of the winch (lateral imbalance) as well as the right front compartment being deflated to be the reason for the aircraft capsizing.

[8] Engine rotation speed drop determined from the CVR spectral analysis
[9] Since the right hand sliding door was the only door that was opened, the AAIB believes that the water accumulated within the right front part of the aircraft.

According to the aircraft manufacturer's statement, this type of aircraft is not designed to maintain altitude (hovering) with one engine out. The manufacturer states that the only option in the event of engine failure during hovering at low altitude is to emergency land/ditch the aircraft.

The technical investigation did reveal that the rupture of the float was due to interference between the pitot antenna and the inflated float. In 1992 the manufacturer changed the design of the pitot antennas to correct this problem. After this improvement, the pitot antennas will not contact the floats while inflated.

During the investigation of TS-SIF, it was found that the left pitot antenna was in accordance with its original delivery but the right antenna had been replaced due to a crack within the antenna. The replaced antenna contained a metallic drain valve on the rear of the antenna that eventually ruptured the float. When purchasing this different antenna, the operator placed the order most likely by following the description for "All helicopters" in the illustrated part catalog (IPC) instead of the description for the specific S/N of the aircraft (see attachment A).

Conclusions

- One engine lost its power[10]
- FCU (S/N B708B) with fuel in P2 chamber
- FCU (S/N 105B) with salt and grease in P2 chamber
- FCU (S/N 105B) with scratches on working piston
- Fuel leak in starter valve
- Pitot antennas damaged the floats
- Right hand fire bottle was found empty

2.1 Findings as to causes and contributing factors

- One engine lost its power (Engine rotation speed drop determined from the CVR spectral analysis)
- FCU (S/N 105B) with salt and grease in P2 chamber

2.2 Findings as to risk

- Pitot antennas damaged the floats

2.3 Other findings

- Flight data recorder might have given useful information to the investigation

[10] (Engine rotation speed drop determined from the CVR spectral analysis)

3 Safety recommendations and action taken

3.1 Safety recommendations

1. IAAIB recommends to the operator to operate all its aircraft with both flight data recorders and cockpit voice recorders.

3.2 Safety action taken

1. After the accident the operator improved the emergency procedure by publishing EMERGENCY EVACUATION – SEA procedures for this type of aircraft.

Reykjavík, December 28, 2010

Aircraft Accident Investigation Board Iceland

Attachment A, Illustrated part catalog

FIG. ITEM	FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY	
01 - 1			PITOT STATIC SYSTEM 6001 6004-6005 6008-6010 6012-6013 6015 6017-6024 6026-6031 6033-6034 6036-6037 6039-6042 6046-6047 6051-6054 6058-6091 6093-6094 6096 6099-6103 6106 6108-6109 6111-6116 6118-6119 6126 6128 6130-6131 6133-6134 6136-6138 6140 6142-6147 6149 6151-6158 6161 6163 6205 6209-6215 6217-6220 6233 6236 6239 6245-6246 6248 6254-6255 6260-6261 6	REF	
- 1A			PITOT STATIC SYSTEM ALL HELICOPTERS	REF	
20	F0210	365A76-1036-1102	. PITOT HEAD SYSTEM LEFT APPLIC FOR NHA 1	1	
20A	F0210	365A76-1109-00	. PITOT HEAD LH APPLIC FOR NHA 1A	1	
			------ ATTACHING PARTS ------		
40	F0111	22208BC040012L	. SCREW APPLIC FOR NHA 1	3	
50	F0111	22208BC040016L	. SCREW APPLIC FOR NHA 1	3	R
60	F0111	23111AG040LE	. WASHER APPLIC FOR NHA 1	6	
70	F0210	DHS433-151.04	. NUT APPLIC FOR NHA 1	6	
75	F0111	22208BC040012L	. SCREW APPLIC FOR NHA 1A	2	
76	F0111	23111AG040LE	. WASHER APPLIC FOR NHA 1A	9	
77	F5442	ASN52320BH040N	. NUT APPLIC FOR NHA 1A	9	
			------ * ------		
80	F0210	365A76-1043-07	. . HOSE APPLIC FOR NHA 1	1	
80A	F0210	365A76-1101-13	. . HOSE APPLIC FOR NHA 1A	1	
90	F0331	DA130-170-60	. . GROMMET	1	
100	F0210	ASNA0198A06	. . UNION APPLIC FOR NHA 1	1	
100A	F0210	ASNA0198C06	. . UNION APPLIC FOR NHA 1A	1	
110	F5442	81810-051-31B5	. . O'RING APPLIC FOR NHA 1	1	
120	I9005	EN3628-0,8	. . WIRE,LOCKING	AR	
130	F0210	360A76-1037-20	. . BODY BLEED	1	
140	F1523	Z2CN18-10-D7,5	. . BALL	1	
150	F0210	360A76-1027-20	. . SPRING	1	
160	F5442	81810-051-31B5	. . O'RING	1	
170	F5442	2X10-31B5	. . O'RING	1	
180	F0210	360A76-1036-20	. . MANIFOLD	1	
190	F0111	22256BC030006L	. . SCREW	2	R
200	F5442	81810-050-31B5	. . O'RING	1	
210	F0212	46380-1	. . HEAD,PITOT TOTAL PRESSURE WITH VENDOR DOC	1	
220	F0210	ASNA4246-007X01	. . TUBE	1	
230	F0210	360A76-1038-20	. . TUBE	1	
240	F0210	341A76-1315-20	. . BUSHING,CRIMPING	2	
250	F0210	365A76-1036-1202	. PITOT HEAD ASSY RIGHT APPLIC FOR NHA 1	1	
250A	F0210	365A76-1109-01	. PITOT HEAD APPLIC FOR NHA 1A	1	
			------ ATTACHING PARTS ------		
260	F0111	22208BC040012L	. SCREW APPLIC FOR NHA 1	3	
270	F0111	22208BC040016L	. SCREW APPLIC FOR NHA 1	3	R
280	F0111	23111AG040LE	. WASHER APPLIC FOR NHA 1	6	
290	F0210	DHS433-151.04	. NUT APPLIC FOR NHA 1	6	
300	F0111	22208BC040012L	. SCREW APPLIC FOR NHA 1A	2	
310	F0111	23111AG040LE	. WASHER APPLIC FOR NHA 1A	9	
320	F5442	ASN52320BH040N	. NUT APPLIC FOR NHA 1A	9	
			------ * ------		
330	F0210	365A76-1043-07	. . HOSE APPLIC FOR NHA 1	1	
330A	F0210	365A76-1101-13	. . HOSE APPLIC FOR NHA 1A	1	
340	F0331	DA130-170-60	. . GROMMET	1	
350	F0210	ASNA0198A06	. . UNION APPLIC FOR NHA 1	1	
350A	F0210	ASNA0198C06	. . UNION APPLIC FOR NHA 1A	1	
360	F5442	81810-061-31B5	. . O'RING	1	
370	I9005	EN3628-0,8	. . WIRE,LOCKING	AR	

- ITEM NOT ILLUSTRATED

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