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Report RL 2001:49e

***Accident involving helicopter SE-HVM
at Fjäderholmarna, AB county, Sweden,
on 7 September 2001***

Case L-073/01

SHK investigates accidents and incidents with regard to safety. The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

Translated by Dennis Lynn Anderson
From the original Swedish at the request of the Board of Accident Investigation.

In the event of discrepancies between the English and the Swedish texts, the Swedish text is considered to be the authoritative version.

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Swedish Civil Aviation Administration

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Report RL 2001: 49e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an accident that occurred on 7 September 2001 at Fjäderholmarna¹, AB county, Sweden, involving a helicopter with registration SE-HVM.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Board herewith submits a final report on the investigation.

Ann-Louise Eksborg

Monica J Wismar

Henrik Elinder

Per Widlundh

¹ Fjäderholmarna = Literally, The Feather Islands, a group of small islets within the Stockholm archipelago situated close to the city.

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L-073/01

Report finalized 2001-12-20

<i>Aircraft; registration, type</i>	SE-HVM, Agusta-Bell 204B
<i>Class, airworthiness</i>	Normal, valid certificate of airworthiness
<i>Owner/operator</i>	ABB Credit Finans AB/SWT Aero
<i>Time of occurrence</i>	2001-09-07, 18:50 hours in daylight <i>Note:</i> All times are given in Swedish daylight saving time = (UTC + 2 hours), with the exception of section 1.9
<i>Place</i>	Fjäderholmarna, AB county, Sweden, (pos. 5919N 01811E; at sea level)
<i>Type of flight</i>	Private
<i>Weather</i>	According to SMHI's ² analysis: southerly winds at approximately 10 knots, good visibility, 1-2/8 of cumulous cloud cover with cloud bases at 3,000 feet, temperature/dewpoint +16/+9 °C, QNH 999 hPa.
<i>Persons on board;</i>	
<i>crew</i>	1
<i>passengers</i>	4
<i>Injuries to persons</i>	One passenger was killed
<i>Damage to aircraft</i>	Substantially damaged
<i>Other damage</i>	None
<i>Pilot in Command:</i>	
<i>Age, certificate</i>	34 years old, Commercial Pilot's License with Instrument Rating and Commercial Helicopter License
<i>Total flying time</i>	1,270 hours, of which 803 helicopter hours, including 54 hours on the type
<i>Flying hours previous 90 days</i>	54 hours, of which 29 hours on the type
<i>Number of landings previous 90 days</i>	112, of which 95 on the type

The Board of Accident Investigation (SHK) was notified on 7 September 2001 that an accident had taken place involving a helicopter with registration SE-HVM, at Fjäderholmarna, AB county, Sweden on that same day at 18:50 hours.

The accident has been investigated by SHK represented by Ann-Louise Eksborg, Chairman, Monica J Wismar, Chief Investigator Flight Operations, Henrik Elinder, Chief Technical Investigator Aviation and Per Widlundh, Chief Investigator for Search and Rescue Services.

Lennart Samuelsson has assisted SHK as operational expert and Christer von Hedenberg as medical expert.

The investigation was followed by the Swedish Civil Aviation Administration represented by Gun Ström.

² SMHI = Swedish Meteorological and Hydrological Institute

Summary

The pilot took-off with the helicopter from Järva Krog with nine passengers aboard in order to fly them to Fjäderholmarna. He performed a normal descent and approach towards the intended place of landing, the so-called steamboat pier, a concrete dock situated on the east side of Fjäderholmarna.

The pilot hovered the helicopter in towards the edge of the dock with the nose of the aircraft towards land and the tail section out over the water.

Subsequent to the landing he exited the cockpit and assisted the passengers to deplane the helicopter. When five of the eight passengers in the aft section of the cabin had exited the helicopter, the pilot thought that the helicopter began to “bounce” and ordered the rest of the passengers to remain in the helicopter while simultaneously he quickly resumed his position in the cockpit. As soon as the pilot had taken his seat he applied full engine power and attempted to lift the collective but the helicopter tipped-over backwards over the edge of the dock, which resulted in the tail rotor coming in contact with the surface of the water. Thereafter the pilot succeeded in getting the helicopter to ascend and climb a few meters above the surface of the water. At this point the helicopter was uncontrollable with respect to yaw and began to rotate to the right. The pilot chose to set the helicopter down on the water.

The helicopter took in water rapidly, tipped over on its back and sank. The passenger who was seated in the left-hand pilot chair remained in the helicopter. Despite several dive attempts the pilot did not succeed in rescuing the passenger to the surface.

Search and rescue divers arrived on the scene after approximately 20 minutes. They were able to quickly locate the helicopter at a depth of approximately 20 meters and bring-up the remaining passenger, who at that time lacked any vital signs.

No technical failure that could have influenced the sequence of events has been found.

Landing authorization is required to land at Fjäderholmarna and this is issued by The Royal Administration of Djurgården. According to the pilot, he had obtained landing authorization. However, according to The Royal Administration of Djurgården, no such authorization had been issued.

According to BCL-D³, Section 1.2 the landing area did not satisfy the minimum requirements established for private flights.

The accident was caused by the pilot leaving the cockpit with the engine running, while the helicopter was parked with too little margin to the edge of the dock.

Recommendations

None.

³ BCL-D – Civil Aviation Regulations – Operational Regulations

1 FACTUAL INFORMATION

1.1 History of the flight

Together with one passenger, the pilot was to fly from Stockholm/Bromma airport to Järva Krog, and from there they were to transport passengers to Fjäderholmarna during two separate sorties. Earlier that day he had accomplished a flight with the helicopter without problem.

At 18:36 hours he reported to air traffic control that they were aboard the helicopter and prepared for takeoff. He received clearance to hover-taxi to takeoff lane 12 for takeoff and after takeoff to fly at 1,500 feet (approximately 500 meters) or below. The takeoff took place one minute later.

The helicopter was dual control equipped and the pilot flew from the right-hand pilot position. The passenger, who was sitting in the left-hand pilot position, had no flying experience but had accompanied pilots on several earlier flights and was according to the pilot informed as to how to evacuate the helicopter during an emergency.

At Järva Krog they landed on a mowed grass field where the passengers were awaiting. The pilot allowed the engine to continue running and exited the cockpit in order to assist the passengers aboard. When eight passengers had boarded, the pilot checked to see that they all had put-on their safety belts prior to departure. According to the passengers, no specific safety information was given concerning the flight. At time 18:43 the pilot reported to the air traffic controller in the Bromma tower that they had taken off and were at an altitude of 600 feet (approximately 200 meters), climbing to 1,500 feet. The pilot has stated that they flew along the northern extremity of the downtown Stockholm area, mostly over water, so as not to cause any noise disturbance from the helicopter.

The flight proceeded normally and at 18:47 the pilot reported that they had initiated the descent for landing at Fjäderholmarna. The pilot performed a normal descent and approach towards the intended landing site, the so-called steamboat pier, a concrete dock situated on the east side of Fjäderholmarna. He had utilized this landing site on several earlier occasions.

The pilot hovered the helicopter in towards the edge of the dock with the nose of the aircraft towards land and the tail section out over the water. Upon landing one of the passengers began to open the left-hand sliding door to the passenger cabin but received instructions from the pilot that they were to use the right-hand door instead.

During touchdown the pilot utilized the exterior rearview mirrors of the aircraft to ascertain the positioning of the helicopter. His personal opinion is that both of the helicopter's landing gear skids were well inside the edge of the dock after touchdown. However several witnesses, some in a boat just outside the dock and others on the shore, felt that the aft portion of both landing gear skids protruded out over the edge of the dock, at a length of almost $\frac{1}{4}$ the entire length of the skids. The consensus of opinion among the eight passengers is that at least one of the landing skids had its trailing edge sticking out over the edge of the dock.

Subsequent to the landing, the pilot reduced engine power to idle and locked the flight controls. Thereafter he exited the cockpit and assisted the passengers to deplane, which took place through the right-hand passenger door. When five of the eight passengers in the aft section of the cabin had exited the helicopter, the pilot thought that the helicopter began to "bounce" and ordered the rest of the passengers to remain in the helicopter while simultaneously he quickly resumed his position in the cockpit. The

passengers did not feel any particular vibrations in the helicopter but felt that it slowly began to turn to the right.

As soon as the pilot had taken his seat, he applied full engine power and attempted to lift the collective but was delayed a few seconds in this maneuver because he had to unlock the flight controls first. Before the main rotor had developed sufficient lift, the helicopter tipped-over backwards over the edge of the dock, which resulted in the tail rotor coming in contact with the surface of the water. Thereafter the pilot succeeded in getting the helicopter to ascend and climb a few meters above the surface of the water. At this point the helicopter was uncontrollable with respect to yaw and began to rotate to the right. The pilot chose to set the helicopter down on the water and bank it to the left in order not to risk injuring the persons on the dock. Upon touchdown on the water the pilot shouted to the passenger on his left to pull the red handle for emergency opening of the door.

After touchdown the helicopter tipped over onto its left side and rapidly took in water. Shortly thereafter it tipped over on its back and sank approximately 20 meters from the dock. The pilot and the three passengers in the aft section of the helicopter succeeded in evacuating the helicopter before it sank. The passenger who had been sitting in the left-hand pilot position remained in the helicopter. Despite several dive attempts the pilot did not succeed in rescuing the passenger to the surface.

The passengers who were on the dock located a life preserver, which they threw out into the water, however it did not land far enough out to reach those in distress. After a short while these were assisted ashore by people aboard boats, who had witnessed the accident and had proceeded to the site.

Several people alerted the search and rescue services. Divers arrived on the scene after approximately 20 minutes. They were able to quickly locate the helicopter at a depth of approximately 20 meters and bring-up the remaining passenger, who at that time lacked any vital signs.

The accident occurred at position 5919N 01811E, at sea level.

1.2 Injuries to persons

	<i>Crew</i>	<i>Passengers</i>	<i>Other</i>	<i>Total</i>
Fatal	–	1	–	1
Serious	–	–	–	–
Minor	–	–	–	–
None	1	3	–	4
Total	1	4	–	5

1.3 Damage to aircraft

Substantially damaged.

1.4 Other damage

None.

1.5 Personnel information

The pilot in command was 34 years old at the time and held a valid Commercial Pilot's License (aircraft) with Instrument Rating and a valid Commercial Helicopter Pilot's License.

Flying hours

<i>Latest</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	1	54	1,270
Helicopter	1	54	803
This type	1	29	54

Number of landings this type previous 90 days: 95.

Flight training on type concluded 2001-05-06.

Latest PFT (periodic flight training) carried out 2001-05-06 on the BH04.

1.6 The aircraft

1.6.1 *General*

AIRCRAFT

Manufacturer	Costruzioni Aeronautiche Giovanni Agusta
Type	Agusta-Bell 204B
Serial number	3211
Year of manufacture	1986
Gross weight	Max authorized 3,400 kg, actual app. 3,000 kg
Center of gravity	Within allowable limits
Total flying time	11,761 hours
Number of cycles	Unknown
Flying time since latest inspection	13 hours
Fuel loaded before event	Jet A1

ENGINE

Manufacturer	Lycoming
Model	T5311A
Number of engines	1
Total operating time	13,101
Operating time since overhaul	2,037
Cycles after overhaul	8,350

ROTOR

Manufacturer	Agusta-Bell
Operating time since latest overhaul	
Main rotor, hours	1,991
Tail rotor, hours	961

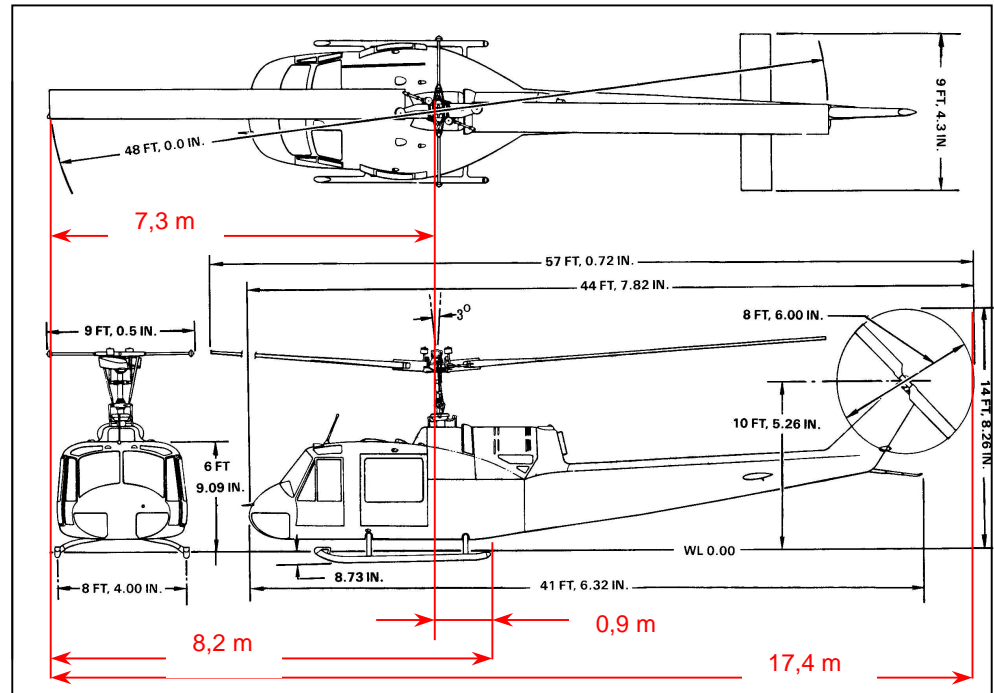
The aircraft had a valid Certificate of Airworthiness.

1.6.2 *Design and dimensions*

The helicopter has a cockpit with two pilot positions and dual flight controls. Access to the cockpit is gained through a small door on either side of the aircraft. The passenger area, which has a capacity of nine passengers, has a sliding door on each side of the aircraft as shown in the sketch below.

According to the aircraft type certificate, the passengers shall be placed on two “sofas”, one for four aft-facing passengers placed farthest forward in the cabin and one for five forward-facing passengers placed farthest aft in the cabin.

On this particular helicopter both passenger sofas had been placed in the forward facing position because, according to information received, this allowed for greater possibility to adjust the seats in the cockpit. In both configurations the pilots and the passengers are placed forward of the helicopter’s primary center of gravity point.



1.7 Meteorological information

According to SMHI’s analysis: southerly wind at approximately 10 knots, good visibility, 1-2/8 of cumulus cloud cover with cloud bases at 3,000 feet, temperature/dewpoint +16/+9 °C, QNH 999 hPa.

An extensive area of low pressure with unstable weather existed in the Stockholm area. At the time of the accident there was a north-south line of heavy cumulonimbus clouds 20 km west of Stockholm.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Recording transcript relating to helicopter SE-HVM, Bromma 2001-09-07

”Radio traffic

1636 UTC

SEHVM: Well, good evening to you. Helicopter VM.

AD1 SB: Helicopter VM, good evening.

S-VM: The heliport two persons and Krogen (Järva Krog) one thousand QNH then, and transponder 5000.

AD1 SB: Helicopter VM hover to takeoff lane twelve, and then it's clear to takeoff for Krogen 1,500 feet or lower.

S-VM: Out to number twelve and 1,500 minus towards Krogen, VM, and also cleared for takeoff.

1638 UTC

S-VM: VM, now we're landing Krogen, get back to you airborne.

S-VM: Ah, VM, what are your winds like?

AD1 SB: Ah, southerly wind and between five and ten knots.

1643 UTC

S-VM: Bromma VM.

AD1 SB: VM Bromma.

S-VM: We have now departed Krogen and ten persons request exit to Fjäderholmarna.

AD1 SB: Helicopter VM proceed towards Fjäderholmarna 1,500 feet.

S-VM: 1,500 Fjäderholmarna and 600 climbing now. VM.

AD1 SB: Yes, traffic, a Cherokee over Östermalm at 1,500.

S-VM: VM yes. VM contact.

1647 UTC

S-VM: VM, we're descending now.

AD1 SB: VM.

S-VM: Bye.

1659 UTC "

Cefyl calls.

AD1 SB= Air Traffic Controller at Bromma

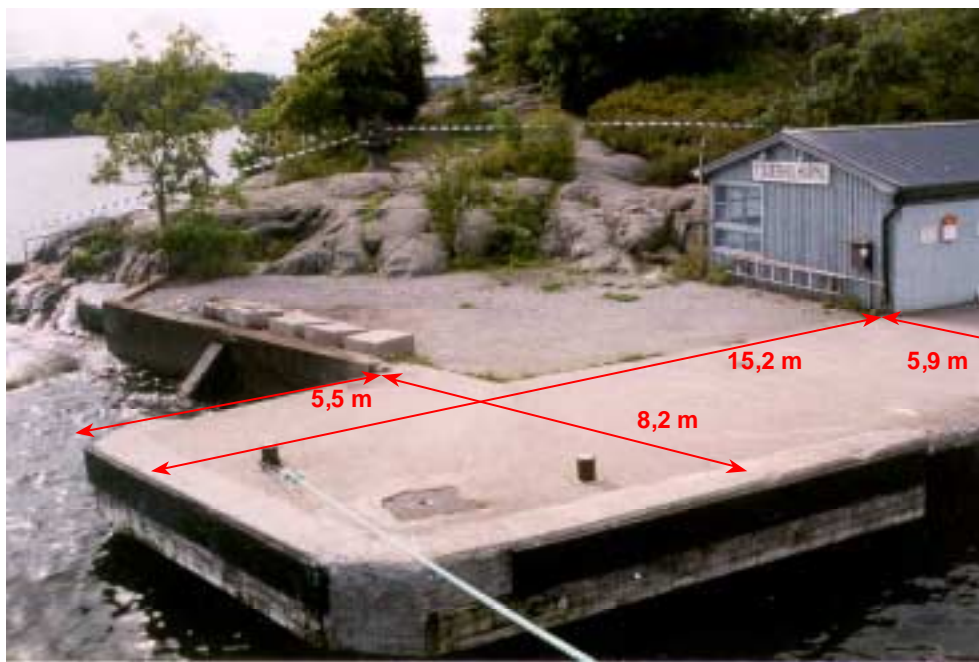
S-VM= the helicopter SE-HVM

Cefyl = The Air Rescue Service

1.10 Landing area

A general landing prohibition for private flights is in force at Fjäderholmarna during the time between May and August. Special authorization is required in order to be able to land with a helicopter. This is issued by The Royal Administration of Djurgården. The pilot has stated that he received such authorization. According to the responsible party at Djurgården's Administration, no such authorization was issued for the flight in question.

The landing was accomplished on the so-called steamboat pier, which is situated on the easterly edge of the largest island in the group. The pier consists of a concrete dock along the water with a height of a little more than one meter over the surface of the water. On the concrete pier, which has a somewhat rough surface, there are two metal bollards approximately 30 centimeters in height. Directly adjacent to the pier there is a wooden building, that is used as a waiting area for passengers. The applicable sections of the pier have been measured by the police according to the photograph below.



1.11 Flight recorders

There was no requirement to carry a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR) on board the aircraft and neither was fitted.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

After the helicopter had lifted-off from the pier it ended-up in the water and sank to a depth of 20 meters, at a position approximately 20 meters from the edge of the dock. The sea floor here consists of loose mud and the helicopter came to rest on its left side, approximately 45 degrees from the inverted position.

1.12.2 Aircraft wreckage

The helicopter was salvaged the day after the accident with the assistance of personnel and boats from the Coast Guard. The 90-degree gearing on the tail rotor was fractured and the rotor had separated from the tail boom. The tail rotor was located on the seabed in the vicinity of the edge of the pier. The right-hand cockpit door was missing.

1.13 Medical information

Nothing indicates that the physical or mental condition of the pilot had been impaired before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

When the helicopter was set down on the water both left and right passenger doors were partially open. The helicopter turned-over on its left side and was rapidly filled with water and sank.

The remaining passengers in the cabin had released their safety belts so as to exit the helicopter and did not have time to put their safety belts on again. They were able to quickly evacuate through the right-hand sliding door when the helicopter ended-up in the water. One of the passengers was a non-swimmer but received assistance from a friend to remain afloat until help arrived. The pilot, who had not put his safety belt back on either, used the emergency opening of the right-hand cockpit door and evacuated through that exit.

The possibility for the passenger in the cockpit to quickly evacuate the helicopter was significantly worse. She sat on the left side of the helicopter with a four-point safety belt on; the portion of the helicopter that was first to be water-filled. The left-hand cockpit door remained closed and there is limited space in the cockpit with several protruding control levers and objects that one can become entangled on. The forensic medical investigation showed that she had received certain external head injuries but the cause of death however, was drowning.

The persons aboard did not use life-vests. According to the pilot there were life-vests for all onboard in the baggage compartment of the helicopter, for use on longer overwater flights. Subsequent to the salvage effort, two life-vests were found on board the helicopter. These were of type Hoover Industries, Miami Florida p/n 3505-101 model: FV-35E Adult/child. Reinspection Date: AUG 1994.

1.16 Tests and research

A primary technical investigation and documentation of the helicopter was accomplished directly after the salvaging. At this time it was ascertained that the helicopter was, with the exception of the missing tail rotor and right-hand cockpit door, intact and that the damage that was noted, had probably arisen in connection with the accident. The collective was in the full climb position and the throttle lever in the full-throttle position. The flight control system's fixed-position unit, so-called Force Trim System, was activated.

A complementary technical investigation, based on directives from SHK and technicians responsible for the helicopter, was accomplished thereafter by a certified helicopter workshop. During the investigation (among other things) the helicopter's Force Trim System, flight control system and landing gear attachments were examined. Nothing in the investigation indicates that the helicopter was impaired by any technical fault that could have influenced the sequence of events.

It was found that both landing gear skids were bent upwards between the landing gear struts approximately under the center of gravity of the helicopter. At the point of bending the clearance to the ground was a little less than five cm. Furthermore it was noted that the emergency lever on the left-hand cockpit door had been activated. An emergency opening of the door was possible if a moderate force was applied to the door from the inside while the emergency lever was activated.

SHK established that it is difficult to determine the exact position on the ground of both landing gear skids by only relying on the helicopter's exterior mirrors.

1.17 Organizational and management information

SWT Aero is part of the SWT group of companies. The company employed the pilot and the helicopter had been acquired during the year. The helicopter was used for corporate flights and the eight passengers that were picked-up at Järva Krog were employees within the group. The company had applied to the Civil Aviation Administration's Department of Inspection for a permit to undertake utility aviation, but this had not been granted at the time of the accident.

1.18 Search and rescue

1.18.1 *Search and rescue service in Stockholm*

The Stockholm Fire Department operates in cooperation with the search and rescue services of the communities of Lidingö, Solna, Ekerö, Nacka and Värmdö in various ways. Fire stations are placed within this area so that all objectives can be reached within a specifically determined effort time (the time from the receipt of the alarm at the station until the first action taken at the site). For densely populated areas the effort time is 10 minutes while more remotely situated places shall be reached within 30 minutes. In the case of an accidental occurrence the deployment shall take place from the most closely situated fire station. The composition of the deployment force for each separate alarm depends upon the nature of the occurrence. Upon notification of drowning, several stations with rescue personnel, boats, divers and surface rescue personnel, together with ambulances and police are sent to the scene immediately.

There is a special aquatic diving unit assigned to the Kungsholmen fire station for drowning accidents. The objective is to be able to dive simultaneously at two separate accident sites. The aquatic divers can be transported to the accident site by several different methods: with their own special vehicles, with the Fire Department boats, with other boats or with helicopters. With carefully acquired routines and utilization of several modes of transportation, the time from the alarm to the rescue effort can be reduced to the shortest possible. Several communities within the Stockholm area utilize the aquatic diving unit.

Additionally there is a large search and rescue boat, that is manned by personnel from the Katarina Fire Station and a high-speed search and rescue boat, that is manned by personnel from the Östermalm Fire Station.

1.18.2 *The rescue effort*

(Source: COORD-COM protocol and the Fire Department's rescue effort report)

<i>Time</i>	<i>Occurrence</i>
18:51	Phone call is received at SOS-center on # 112
18:52	Katarina Fire Station acknowledges that they are in-route to the search and rescue boat
18:53	Kungsholmen Fire Station acknowledges that they are in-route to Blockhusudden
18:56	Helicopter 998 acknowledges that they are in-route to Fjäderholmarna
18:58	Östermalm Fire Station acknowledges that they are in-route to the search and rescue boat and Blockhusudden
18:59	Helicopter 994 acknowledges that they are in-route to Fjäderholmarna

19:01	The Chief External Firemaster (CEF) acknowledges that he is in-route to Blockhusudden	
19:05	The on-call official at the Stockholm County Council is notified	
19:07	Lidingö Fire Station acknowledges that they are in-route to Fjäderholmarna	
19:07	Helicopter 998 reports that they have arrived at Fjäderholmarna	
19:08	CEF reports that he has arrived at Blockhusudden	
19:14	The aquatic diving unit from Kungsholmen and the search and rescue boat report that they have arrived at Fjäderholmarna	
19:15	<i>Divers locate a person in the helicopter at a depth of 20 meters, immediately bring her up to the surface, CPR is initiated (This record is taken from interviews with personnel involved).</i>	
19:21	Ambulance 902 acknowledges that they are in-route to Blockhusudden	
19:43	Ambulance 931	-"-
19:53	Ambulance 921	-"-
19:57	Ambulance 907	-"-
20:00	Ambulance 912	-"-
20:05	Ambulance 917	-"-
21:31	Ambulance 931	-"-
21:35	Ambulance 912	-"-

The alarm was received on the emergency number 112 at 18:51 hours and was answered within 30 seconds. The first search and rescue unit was called-out at 18:52 and the ambulance helicopter at 18:56.

The SOS Center first called-out Katarina Fire Station for manning of the search and rescue boat and Kungsholmen Fire Station with the aquatic diver unit. Thereafter Östermalm Fire Station, CEF and Lidingö Fire Station were called-out. All units were informed that the rescue effort concerned a helicopter in the water with several passengers aboard.

CEF, who became the rescue effort leader, decided that Blockhusudden would be the "breakpoint", i.e. the area where all units would gather. Furthermore, this site became the command point. The aquatic diving unit proceeded there immediately, as well as CEF and a portion of the Östermalm unit. Personnel from Katarina Fire Station manned the search and rescue boat, which was moored in Central Stockholm (Gamla Stan), and proceeded thereafter towards Blockhusudden to fetch the aquatic diving unit. A unit from the Östermalm Fire Station manned a second search and rescue boat, which was positioned near the Technical Museum, and proceeded directly towards Fjäderholmarna. Lidingö Fire Station also manned a search and rescue boat and proceeded directly towards Fjäderholmarna.

All in all, the SOS Center called-out two helicopters and six ambulances.

Upon receipt of the alarm, the Kungsholmen Fire Station, with the aquatic diving unit, proceeded towards Blockhusudden. On the way, the Fire Chief decided not to utilize helicopter transport, as he determined that the transport should be quicker with the station's own search and rescue boat, which was also under way to Blockhusudden. The diving unit was quickly loaded aboard the search and rescue boat and transported out to Fjäderholmarna. Upon arrival, this unit found the search and rescue boat from the Östermalm Fire Station already at the scene, and were directed by them to the point where the helicopter had sank. The divers were also informed that a least one person was still in the helicopter. The first diver entered the water immediately upon arrival at the scene and he located the helicopter right away. It was lying up side down at a depth of approximately

20 meters. The right-hand cockpit door was open and the diver found the missing person at once. Her seat belt was not fastened and the diver removed her from the helicopter immediately. Thereafter he brought her quickly up to the surface, where she was taken aboard a boat. Resuscitation attempts were initiated immediately and continued during the entire transportation time to Karolinska Hospital. The woman was taken to Blockhusudden after being transferred to a search and rescue boat.

Together with an additional diver, the first diver returned down into the water, searched the area surrounding the helicopter and attached a marker buoy to the aircraft.

The pilot and the other passengers had already received attention by people at the scene before the search and rescue personnel arrived at the accident site. Among other things, a person who was unable to swim had been rescued from the water. The passengers were subsequently conveyed to Blockhusudden, and from there transported to Söder Hospital for examination and medical attention. The pilot was transported to Karolinska Hospital.

1.19 Additional information

1.19.1 Radar plot

Aided by information from The Swedish Military Intelligence & Security Service (MUST) it has been possible to reconstruct the route flown by the helicopter from the time it departed Stockholm/Bromma airport, and via Järva Krog flew to Fjäderholmarna.



1.19.2 Information to passengers

BCL-D⁴ 4.1 paragraph 5.9 prescribes the information which a pilot conducting a private helicopter flight shall provide to passengers concerning, among other things, safety instructions, emergency equipment and emergency evacuation.

⁴ BCL-D – Civil Aviation Regulations – Operational Regulations

1.19.3 *Over-water flights*

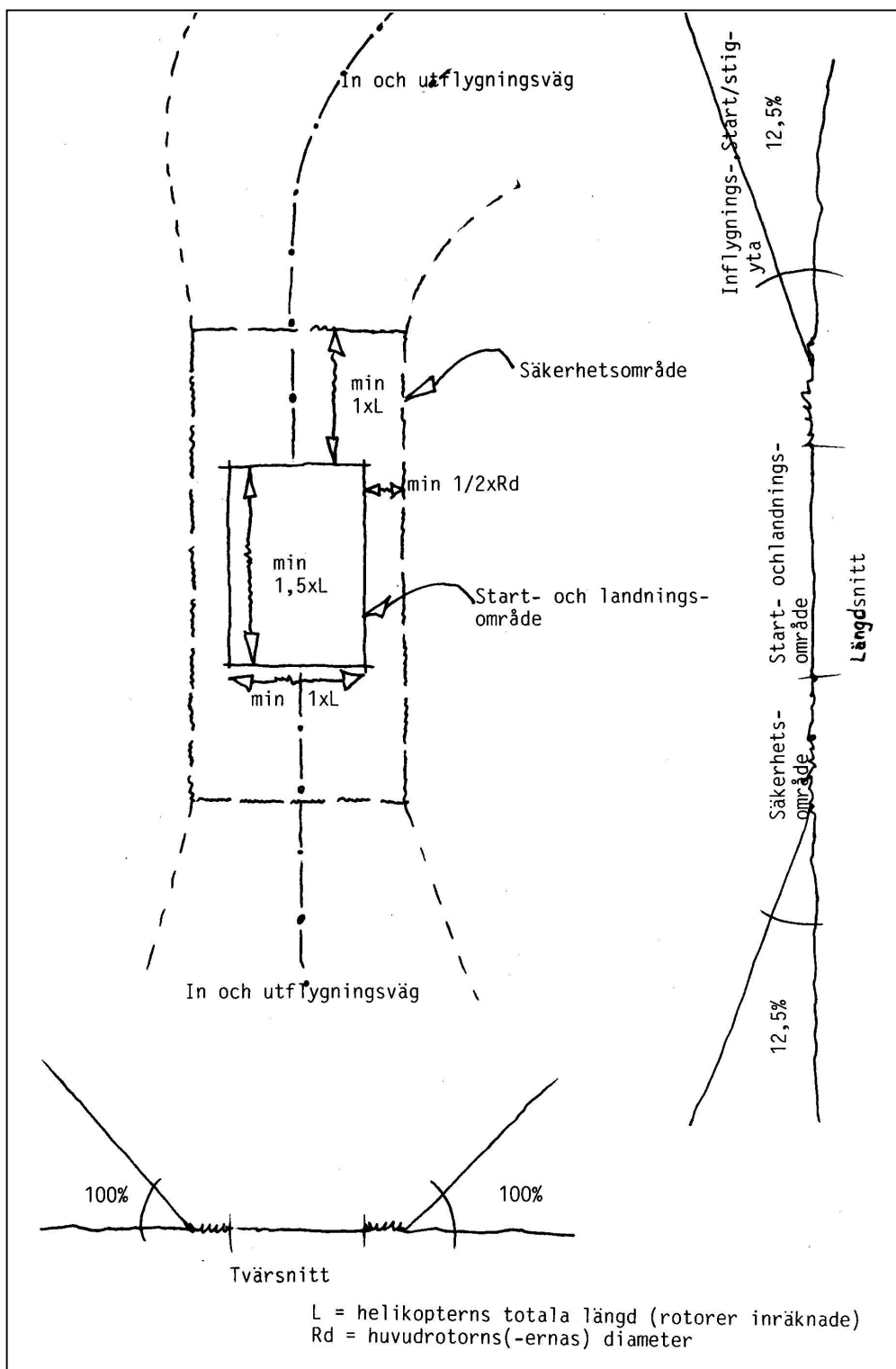
BCL-D 4.1 paragraph 10.7 directs that flights over water with a single-engine helicopter that is not equipped with floats (emergency floats) shall, if passengers are onboard, be conducted within auto-rotation distance from land. There is no requirement for life-vests.

1.19.4 *Regulations concerning takeoff and landing area*

Regulations concerning takeoff and landing areas are stated in BCL-D 1.2. In paragraph 3.1 it is prescribed that, prior to takeoff and landing on areas other than approved airports, the landowner's permission may be required. In paragraph 3.2 it is stated that the pilot in command of an aircraft shall assure himself that a takeoff and landing area, taking into account the aircraft's performance and prevailing external conditions, meets with adequate dimensions, obstacle clearance and satisfactory surface characteristics, plus adequate ground equipment with respect to the type of flight.

Occasional helicopter landing areas shall meet the requirements concerning takeoff and landing areas, safety zones and approach zones according to the sketch in BCL-D 1.2, Appendix 5 (see below).

According to paragraph 4.5.1 in regards to commercial flights, other forms of the safety zones and the takeoff and climb sector may be accepted for a permanent landing site, upon approval of the company's Chief of Operations. According to paragraph 4.5.3 areas judged to be suitable by the pilot in command, considering (among other things) the performance of the helicopter, may be utilized as occasional takeoff and landing sites during commercial flights. However, in this context, the minimum clearance from the helicopter's rotor tips to a moveable obstacle shall not be less than the rotor diameter and the minimum clearance from the rotor tip to a stationary obstacle shall not be less than three meters.



1.19.5 Parking of a helicopter with the engine running

In BCL-D 1.2, paragraph 7.5.1 it is prescribed that, among other things, a helicopter may be temporarily left with the pilot's position unmanned and the engine/rotor running provided that an authorized pilot or mechanic remains in the immediate vicinity of the helicopter.

2 ANALYSIS

2.1 The flight

No technical fault has been found that could have influenced the sequence of events. Nor did the pilot notice anything abnormal with the helicopter during the actual flight, or during the earlier flights that day.

As depicted in section 1.10 the landing site consists of a flat surface that is limited in three directions by the edges of the dock and in the fourth direction has a stationary obstacle in the form of a building. There are in addition, two permanently attached metal bollards on the surface of the dock.

The flight here under investigation was a private flight. For such a flight with this helicopter type, according to BCL-D 1.2 it should have required a takeoff and landing area with the minimum dimensions of just over 26 x 17 meters and a takeoff and landing area inclusive of a safety area of just over 60 x 32 meters. Since the greatest distance between the edge of the dock and the building was only a bit less than 16 meters, the landing site utilized did not satisfy the minimum requirements. (See sections 1.6.2, 1.10 and 1.19.4.)

The landing site could, under certain conditions, satisfy the applicable minimum requirements for commercial flights, which may have been contributory to the pilot's – who held a Commercial Pilot's License – landing there. This was however, a site that placed great demands upon his method of planning the landing and his ability to maneuver the helicopter.

Maneuvering to the touchdown, he was on the one hand obliged to make sure that the landing gear did not come to rest too close to the edge of the pier, and on the other hand be assured that the main rotor disk did not get too close to the adjacent building. At the same time, he had to watch that the landing gear did not catch on either of the bollards on the dock.

It was correct of the pilot to land the helicopter so that the tail rotor extended outside the edge of the dock, thereby not constituting any risk to the departing passengers. Even if his intention to assist the passengers out of the helicopter was good, he should not have left the cockpit with the engine running, considering the landing site's limited area, its surface characteristics and adjacent obstacles.

The pilot's opinion is that both landing gear skids were inside the edge of the dock after touchdown. However, several uninvolved witnesses and some of the passengers are of the opinion that the helicopter settled so close to the edge of the dock, that one or both of the landing gear skids protruded out over the water. SHK has established that it is difficult to determine the exact parking position of the helicopter by only relying on the exterior mirrors and there is a lot that would indicate that the latter opinion concerning the parking position of the helicopter is the correct one.

It is a well-known fact that helicopters of the type in question have a proportionately high level of vertical vibration. The amplitude of these oscillations can be high, especially when the helicopter is light, has been parked on a rigid surface and the main rotor rpm is low (engine at ground-idle). If, in addition, the surface that the helicopter is standing on is uneven, as in this case, it is quite possible that the helicopter can spontaneously begin to move along the surface.

Therefore, everything indicates that the margin to the edge of the dock was too small and that the helicopter, in conjunction with such vibrations, began to move itself somewhat backwards so that its center of gravity ended-up over the edge of the dock, whereupon it tipped over the edge.

Contributory to this, was that the center of gravity was moved aft when the pilot and the five passengers exited the helicopter, because they were earlier situated forward of the point of the center of gravity.

This sequence of events is supported by the bending damage that was found on both of the helicopter's landing gear skids. This damage very likely arose at the moment when the helicopter was "balanced" on the edge of the dock and the landing gear skids were loaded with the entire weight of the helicopter at these two points.

When the helicopter tipped backwards over the edge of the dock, this caused the tail rotor to come in contact with the water, which resulted in the fracturing of the 90° gearing of the tail rotor and the rotor's separation from the tail boom. Subsequently, when the pilot managed to get the helicopter to ascend, there was no yaw control available and for all practicable purposes the pilot hardly had any other possibility than to set it down on the water.

Prior to the flight the pilot did not provide the passengers in the cabin with safety information according to BCL-D 4.1 paragraph 5.9. It is difficult to determine if this had any influence upon the sequence of events.

The fact that one of the passenger sofas in the cabin was not placed according to applicable instructions probably did not have any influence upon the sequence of events.

2.2 The search and rescue services

The rescue effort was carried out quickly and effectively.

3 CONCLUSIONS

3.1 Findings

- a) The pilot was qualified to perform the flight.
- b) The helicopter had a Valid Certificate of Airworthiness.
- c) One of the passenger sofas was not placed according to applicable instructions.
- d) The pilot did not provide safety information to the passengers in the cabin.
- e) No technical fault has been found on the helicopter.
- f) The landing site did not fulfil applicable minimum requirements for private flights.
- g) The touchdown took place with too little margin to the edge of the dock.
- h) Under prevailing circumstances it was inappropriate for the pilot to leave the cockpit with the engine running.

3.2 Causes of the accident

The accident was caused by the pilot leaving the cockpit with the engine running while the helicopter was parked with too little margin to the edge of the dock.

4 RECOMMENDATIONS

None.

