Investigation report

Translation of the original report

B 2/2005 L

Aircraft accident at Helsinki–Vantaa airport on 31 January, 2005

SE-KYH

C208B

Accident Investigation Board Finland

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SUMMARY

On Monday 31.1.2005, an aircraft accident occurred at around 17:00 co-ordinated universal time (UTC) at Helsinki–Vantaa airport. A Swedish Cessna 208B aircraft registered SE-KYH, owned by Nord-Flyg AB and transporting air freight to Sweden, crashed into the ground within the air-side after takeoff. The pilot suffered minor injuries. The aircraft was completely destroyed. On 2.2.2005, the Accident Investigation Board Finland (AIB) decided to appoint an investigation commission, B 2/2005 L, for this accident. Air accident investigator Hannu Melaranta was named investigator-in-charge with investigators Hannu Vartiainen and Esko Tilli as members of the commission. On 17.3.2005, the AIB augmented the commission by nominating investigators Martti Lantela and Jari Hiltunen as Search and Rescue (SAR) experts.

The aircraft arrived from Sweden on 31.1.2005, landing at Helsinki–Vantaa airport around 02:47. According to standard company policy, Nord-Flyg AB operates with a two person crew. However, on the day in question the co-pilot had taken ill and the flight was flown without a co-pilot. The pilot checked in for duty at the airport at around 14:30 to prepare for the return leg. It had been snowing at the airport until 09:20 and the temperature was hovering at around zero degrees Celsius. After having arrived at the airport, the pilot began to brush the accumulated snow and frozen snow melt off the upper surfaces of the aircraft. As per his account, there was a great deal of snow and ice on the aircraft. He did not, however, manage to brush all of the impurities off of the surfaces of the aircraft. The cargo going to Sweden did not arrive in time for him to fly it to Skavsta, his primary destination. Therefore, he phoned in a change to the flight plan choosing Örebro instead as his destination. He took off from runway 22L. All went well until he reached the height of 800-1000 ft (250-300 m) and retracted the trailing edge flaps. Immediately after flap retraction, the pilot lost control of the aircraft, which began turning to the right. The pilot attempted to fly the aircraft to the end section of runway 22R to make an emergency landing but the aircraft crashed into the terrain between the runways.

Investigation revealed that the pilot did not succeed in brushing the snow and ice off of the upper surfaces of the wings, fuselage and stabilizers. When the wreckage was examined, it was estimated that the coat of snow, frozen slush and ice on the upper surface of the wings and on the sides of the fuselage varied between 0.5-1.5 cm in thickness. As the pilot retracted the flaps from the takeoff setting, the compacted snow and ice on the upper surface of the wing disturbed the lift enough to induce a stall. The aircraft rolled to the right and lost altitude. The pilot was unable to recover and the aircraft hit the ground at a shallow dive angle and was destroyed. At the time of impact the trailing edge flaps were in the clean configuration. The Emergency Locator Transmitter (ELT) was activated in the crash. An aircraft accident alarm was immediately sounded. A Border Guard helicopter located the wreckage of the plane approximately half an hour after the accident took place.

The primary cause of the accident was that the pilot executed a takeoff with an aircraft whose aerodynamic properties were fundamentally degraded due to the accumulated ice and snow on the upper surface of the wing. During the initial climb and immediately after flap retraction, airflow separated from the surface of the wing and the pilot did not manage to regain control of the

aircraft. The pilot did not recognize the stall and did not act in the manner required to recover from one or, it might be that he had not received sufficient training for such situations.

The investigation commission issued four safety recommendations. The recommendation for the Civil Aviation Administration is that measures be taken to incorporate a condition in the European Joint Aviation Requirements pursuant to which stall recovery techniques during takeoff and during trailing edge flap retraction should be practiced in the flight training syllabi of commercial pilot's licences and single-engine certifications. The Swedish aviation authority Luftfartsstyrelsen is advised to audit the company's operational practices and pilot training so as to guarantee the conditions for safe flight operations. The proposal for all entities participating in Search and Rescue (SAR) activities at Helsinki–Vantaa is to consider arranging joint training for everyone. Furthermore, they should establish how all parties can be guaranteed rapid access to the air-side in emergencies.

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ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
ADF	Automatic Direction-Finding equipment
AIP	Aeronautical Information Publication
APP	Approach Control
ARCC	Aeronautical Rescue Co-ordination Centre
CAVOK	Visibility, cloud and present weather better than prescribed values or conditions
cm	centimetre(s)
DEP	Departure
DF	Direction Finder
E	East or eastern longitude
ELT	Emergency Locator Transmitter
FT	Feet (dimensional unit)
GAFOR	General Area Forecast
GEOSAR	Geostationary Search and Rescue-system
GND	Ground Control
GPS	Global Positioning System
h	hour(s)
hPa	Hectopascal
HSI	Horizontal Situation Indicator
IAF	Initial Approach Fix
JAR	Joint Aviation Requirements
kg	kilogram(mes)
km	kilometre(s)
KT	Knots
LEOSAR	Low-altitude Earth Orbit Search and Rescue system
LFS	Luftfartsstyrelsen (Swedish aviation authority)
LUT	Local User Terminal
m	metre(s)
M	Medium (wake turbulence category)
MCC	Multi Crew Co-operation
MCC	Mission Control Centre
MHz	Megahertz
min	minute(s)
MRCC	Marine Rescue Coordination Centre
MRSC	Marine Rescue Sub-Centre
N	North or northern latitude
NM	Nautical Mile(s)

NVG	Night Vision Goggles
°C	Degrees Celsius
OM	Operations Manual
POH	Pilot's Operating Handbook
QNH	Altimeter sub-scale setting
RNAV	Area Navigation
SAR	Search and Rescue
SET	Single-engine Turboprop
SWC	Significant Weather Chart
TAF	Aerodrome Forecast
TODA	Take-off Distance Available
TOW	Take-off Weight
TWR	Aerodrome Control Tower or Aerodrome Control
VFR	Visual Flight Rules
ZFW	Zero Fuel Weight

FOREWORD

All times in the report are Coordinated Universal Time (UTC).

An aircraft accident occurred at Helsinki–Vantaa airport on 31.1.2005 when a single-engine, freight configured, high-wing Cessna 208B aeroplane crashed into the ground immediately after takeoff. The aircraft registration was SE-KYH. The operator of the aircraft was Nord-Flyg AB, a Swedish aviation company. The flight number was NEF007 and the call sign Nordex 007. The purpose of the flight was to transport air freight to Örebro airport (ESOE) in Sweden. The accident occurred at around 17:00. Night-VFR conditions prevailed at the time of the accident. The aircraft impacted into a mound of sand on the right side of RWY 22L extension at Helsinki–Vantaa airport. The pilot sustained minor injuries and the aircraft was destroyed.

The Accident Investigation Board Finland was notified of the event immediately after the aircraft crashed. Accident site and technical investigations commenced immediately and were continued on the following day. On 2.2.2005, the Accident Investigation Board Finland appointed the investigation commission B 2/2005 L. The investigator-in-charge was air accident investigator Hannu Melaranta, Accident Investigation Board Finland, and members were investigators Hannu Vartiainen and Esko Tilli. On 17.3.2005, the commission was augmented by nominating investigators Martti Lantela and Jari Hiltunen as Search and Rescue (SAR) experts.

The accident was reported to the investigative authorities of the aircraft's country of registration, country of manufacturer and the country of the engine manufacturer, all of whom designated representatives to the investigation. Furthermore, notification of the accident was sent to the aircraft manufacturer which, with permission of the investigation commission, dispatched a representative to collect information on the accident. Air traffic control notified the aircraft operator of the accident the evening of the event.

The investigation established the events prior to takeoff, the factors that led to the crash into the ground as well as the conduct of Search and Rescue operations. The draft investigation report was promulgated for statement and comments on 6.6.2006. Responses received are partly taken into consideration in the final version of the investigation report. The investigation was completed on 30.11.2006.

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Events before the flight

The aircraft landed at Helsinki–Vantaa airport at around 02:47 on Monday, 31.1.2005. After landing, the pilot taxied to apron number four in the southeastern corner of the aerodrome and unloaded the cargo from Sweden. After having done that he left the airport and went to a suite the company reserves for the crew to rest before the return leg to Sweden, which was planned for the following afternoon. The pilot has worked for the company for approximately five years. As per standard policy, the company operates the aircraft with a two person crew. On the day in question the co-pilot had taken ill and the pilot had flown alone. The return leg to Sweden was also planned as a one-person crew flight.

The following morning the aircraft was refuelled with 420 l of Jet A-1, in accordance with the pilot's instructions. All in all ca. 725 kg of fuel was reserved for the return leg. According to his account, the pilot checked in for duty at the airport at around 14:30. After arriving, the pilot began to brush the accumulated snow and frozen snow melt off the upper surfaces of the aircraft. He said that there was a great deal of snow and ice on the aircraft.

The cargo that was to go to Sweden did not arrive in time for him to fly it to Skavsta, his primary destination. Therefore, he phoned in a change to the flight plan, choosing Örebro instead as his destination. Örebro was a better choice regarding follow-on transport of the freight.

The pilot had outdated meteorological information for the return leg and the operational flight plan form was inadequately filed in. The flight plan was inadvertently filed for another tail number. Information which should be included such as date, crew, prevailing upper winds, estimates to different waypoints, fuel calculations and pilot signatures were omitted from the flight plan. The pilot had not left a copy of the operational flight plan for the ground crew. No weight and balance calculation for the flight was to be found in the cockpit. It had been left in the ground handling service's briefing room but had been correctly calculated. The pilot did not have access to the latest aeronautical information for the return leg. Printouts of aeronautical information for the inbound leg were found in the cockpit of the wreckage.

1.1.2 Events during the accident flight

At 16:52:45 the pilot acknowledged on Helsinki Control Tower (TWR) frequency 118.600 MHz that he was taxiing to takeoff position RWY 22L at intersection Y.

At 16:54:40 TWR gave him takeoff clearance from that intersection and gave him the wind direction. The pilot later said that he executed a normal takeoff, using 10 degrees of flaps. The aircraft lifted off at the normal speed of 80-90 KT.

At 16:56:05 the pilot called TWR on 118.600 MHz saying “TOWER” just once.

As per the pilot’s account everything went well until he reached the height of 800-1000 ft (250-300 m) at which point he retracted the trailing edge flaps. Immediately after flap retraction, the pilot lost control of the aircraft, which began turning to the right. The pilot attempted to fly the aircraft to the end section of runway 22R for an emergency landing. Shortly before crashing to the right side of the extension of runway 22L the pilot managed to get the wings level. He lost consciousness in the crash.

1.2 Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	---	---	---
Serious	---	---	---
Minor/none	1	---	---

1.3 Damage to aircraft

The aircraft was destroyed.

Figure 1. Aircraft Wreckage.

1.4 Other damage

Approximately 10 l of engine oil and at least 400 l (estimate) of kerosene leaked onto the ground. Also, some of the aircraft hydraulic fluid leaked onto the impact site.

1.5 Personnel information

Pilot:	age 34.
Licences	Commercial pilot's licence, valid until 25.2.2007.
Medical certificate:	JAR class 1, valid until 27.2.2005.
Ratings:	Multi-engine piston aeroplanes (land), valid until 31.10.2005.
	Night rating.
	Multi Crew Co-operation (MCC).
	B737-300-900 first officer rating, valid until 30.11.2005.
	CessnaSET, valid until 31.5.2005.
	Instrument rating for multi-engine single-pilot aeroplanes, valid until 30.11.2005.

Instrument rating for single-engine single-pilot aeroplanes, valid until 31.5.2005.

Additionally, the pilot had the theoretical training required for an airline transport pilot's licence.

Flying experience	Last 24 h	Last 30 days	Last 90 days	Total hours and landings
All types	2 h 42 min 1 landing	46 h 52 landings	112 h 109 landings	3 886 h 3 972 landings
On type	2 h 42 min 1 landing	46 h 52 landings	112 h 109 landings	3 657 h

1.6 Aircraft information

Basic information

The aircraft was an all-metal, high-wing, single-engine turboprop with fixed undercarriage. It was an all-cargo variant with no side windows in the rear fuselage. The aircraft was certified for flight in moderate icing conditions.

Aircraft

Type and model:	Cessna 208B
Registration:	SE-KYH
Manufacturer:	Cessna Aircraft Company Wichita, KS, USA
Year of Manufacture:	2000
Serial number:	208B/ 0817
Maximum Takeoff Weight:	4 110 kg
Owner:	ABB Credit Finans AB
Operator:	Nord-Flyg AB
Total airframe time:	6 126 h

Engine

Manufacturer:	Pratt & Whitney Canada, Inc.
Type:	PT6A-114A
Serial number:	PCE-PC0760
Total hours:	6 818 h
Recommended Fuel Type(s):	JET A-1

Propeller

Manufacturer:	McCauley Propeller
Type:	3GFR34C703-B constant speed propeller
Serial number:	993381

Airworthiness

Certificate of registration:	Issued on 5.4.2000
Certificate of airworthiness:	Valid until 30.4.2005

Weight and balance

No dedicated weight and balance (centre of gravity) calculation for said flight was found in the cockpit. The ground handling service delivered the calculation which had been left at their premises. Pursuant to the calculation the weight of the aircraft, notwithstanding the weight of the ice that had accumulated on top of the wing and fuselage, was within the certified limits.

The maximum allowable takeoff weight of the aeroplane was 4 110 kg. Aside from the impurities, the takeoff weight of the aircraft was 4 070 kg. The Swedish aviation authority had permitted the aircraft to use an increased takeoff weight.

1.7 Meteorological information

It had been snowing at the airport until 09:20 and the ambient temperature was hovering at around zero degrees Celsius. The temperature fell below zero at 13:50 and at takeoff it was -4°C.

Prevailing weather at Helsinki–Vantaa airport on 31.1.2005 at 16:50:

Wind 160 degrees, 6 KT, CAVOK, temperature -4°C, dew point -5°C, QNH 991 hPa, no significant changes to the weather expected (NOSIG).

Neither the TAFs, nor the GAFORs or SWCs were considered relevant to the investigation. Similarly, upper wind charts, weather warnings and weather radar pictures were also considered irrelevant.

No pilot reports of weather conditions in flight that would have been deemed important from the perspective of the accident flight were published at the time of the event. The sun had set at 14:30 and night conditions prevailed.

1.8 Aids to navigation

Aids to navigation played no part in the occurrence.

1.9 Communications

Prior to startup the pilot called Helsinki Ground Control (GND) on 118.125 MHz for startup permission and enroute clearance. Helsinki GND gave him taxi instructions on 121.800 MHz.

At 16:54:40 Helsinki TWR gave takeoff clearance and wind direction on 118.600 MHz. The pilot acknowledged the takeoff clearance from RWY 22L.

After takeoff, as per standard departure procedure, the pilot was supposed to contact Helsinki radar (DEP) on 119.100 MHz. Communications functioned normally up until takeoff. The pilot's last transmission was heard on TWR East frequency.

At 16:56:05 the pilot attempted to contact TWR by saying "TOWER" once.

At 16:57:10 TWR called the aircraft for the first time with no response.

At 16:57:30 TWR called the aircraft for the second time with no response.

At 16:58:40 a radar controller said on 119.100 MHz that an Emergency Locator Transmitter (ELT) had begun to transmit on 121.500 MHz.

At 16:59:25 TWR called the aircraft for the third time with no response.

Helsinki radar and TWR also called the aircraft on 119.100 MHz with no response.

1.10 Aerodrome information

Helsinki–Vantaa is a main international airport. The Aerodrome Reference Point is at N 60° 19' 02 " and E 024° 57' 48" and the elevation is 55 m (179 FT MSL). There are three runways, 04L/22R, 04R/22L and 15/33, all of which are 60 m wide. Runway lengths are 3 060 m, 3 440 m and 2 901 m, respectively.

The available takeoff distance (TODA) from intersection Y on RWY 22L, used for this takeoff, is 2 648 metres.

1.11 Flight recorders

There were no flight recorders.

1.12 Wreckage and Impact Information

The accident site is located within the fenced area of Helsinki–Vantaa airport, in the terrain between runways 22L and 22R approximately 380 m from the end of RWY 22L at the magnetic bearing of 280 degrees. The first impact marks were found ca. 300 m from the end of RWY 22L. At the first impact point there is a rocky knoll. The marks in the

terrain were left by the undercarriage, the propeller and the bottom of the fuselage. The aircraft probably crashed into the ground fuselage bottom and landing gear first.

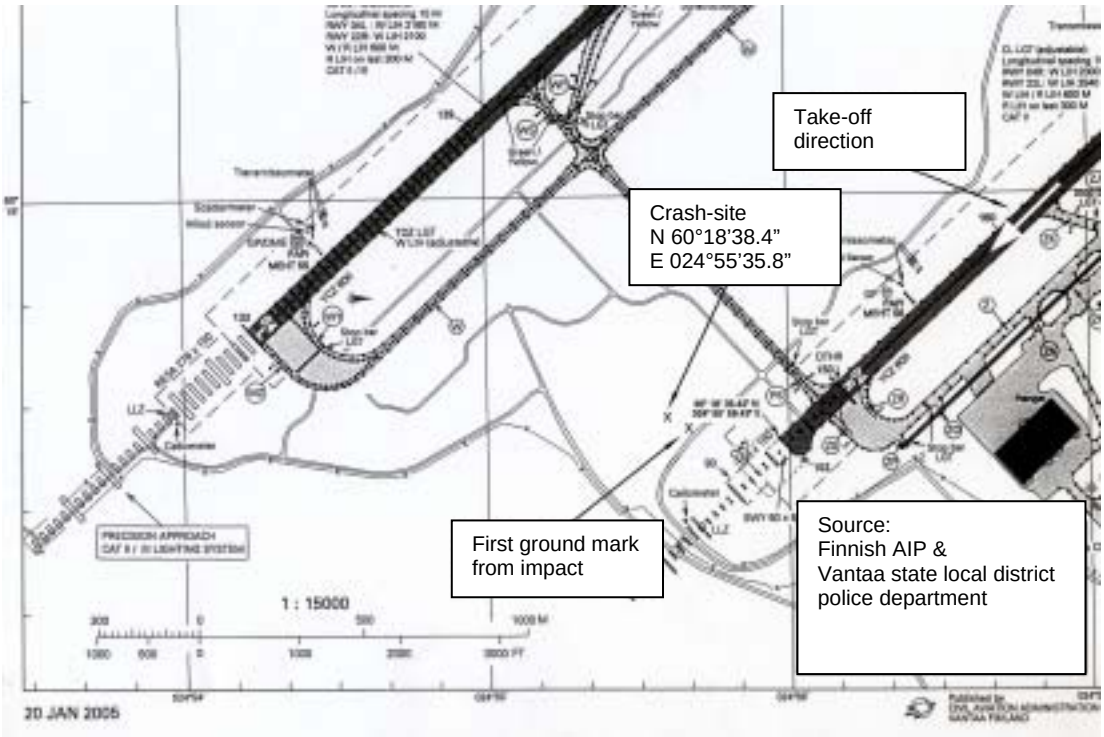


Figure 2. Accident site location

The landing gear wheels were torn off in the first impact with the ground. The nose gear shock strut broke above the nose wheel fork. The first impact mark was 13 m long. Thereafter, the aircraft bounced back into the air and hit the ground again approximately 25 m farther on.

The aircraft came down left wing first when it hit the ground the second time. The impact point was level ground and lower than the first point. The second impact resulted in a torn left wing. The wing strut remained attached to the wing at the upper end but the lower end detached. The propeller came loose after having been broken at the planetary reduction drive mounting flange seam.

After the second impact the aircraft still vaulted for ca. 20 m and pivoted around the nose before finally coming to rest. At the same time the right wing tip grazed a pile of macadam that was on the right side in the travel direction. The rear fuselage was almost completely separated from the cockpit and lay inverted in a 90 degree angle to the left in relation to the cockpit. The cockpit remained upright. The right wing had detached from its mounts and lay on the right side of the cockpit. The engine lay in front of the cockpit. The engine mounting frame had detached from its firewall mounting points.

Some of the cargo that was being transported as freight remained inside the fuselage and some of it was outside next to and under the fuselage.

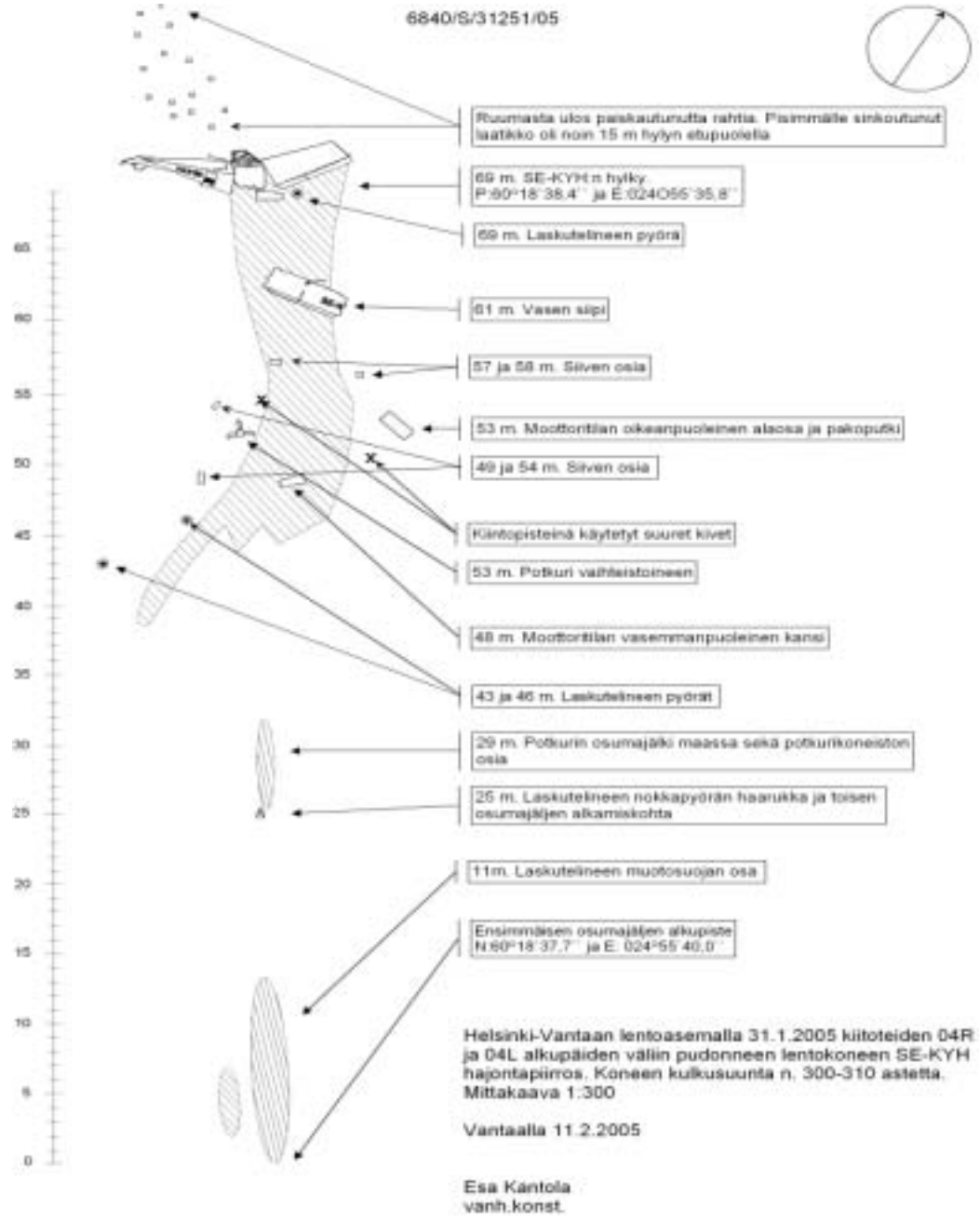


Figure 3. Accident site diagram
(Source: Vantaa state local district police department)

1.13 Medical and pathological information

A breathalyser test was performed on the pilot showing zero blood alcohol.

1.14 Fire

There was no fire.

1.15 Rescue operations and survival aspects

This paragraph details the SAR operation in chronological order.

Time	*Event*
16:54:45	NEF007 took off from RWY 22L.
16:56:01	A short, anxious radio call “tower” was heard on the Helsinki Control Tower (HKTWR) frequency. The transmission broke off in mid-sentence.
16:56:10	An Emergency Locator Transmitter (ELT) signal was detected on the emergency and distress frequency 121.500.
16:56:40	Helsinki Approach Control (HKAPP) requested HKTWR to report the location of NEF007. HKTWR said that they had neither visual nor radar contact with it. Neither did HKAPP detect NEF007 on its radar display. HKTWR and HKAPP called NEF007 several times on their own respective frequencies, to no avail.
16:57:45	At the behest of HKAPP, HKTWR sounded an alarm. The alarm was relayed as an “aircraft accident alarm” to the airport rescue stations as well as to the airport police and to the Helsinki Emergency Response Centre (ERC). After the alarm was given, startup clearances were not issued to departing aircraft. Three incoming aircraft received landing clearances to RWY 15, whereafter the airport was closed to air traffic.
16:58:20	HKAPP called Helsinki ERC by telephone and declared an emergency due to a probable aircraft accident. HKAPP said that a single-engine aircraft that took off from the old main runway towards the west a short time ago disappeared from the radar and that an ELT had activated. HKAPP estimated that there were 1–2 persons onboard and that the accident site was somewhere in the terrain between the air-side and the buildings of the Finnish Post.
16:58:25	Helsinki ERC initiated action in accordance with the alarm.
16:58:40	Lento P3 (Helsinki–Vantaa airport rescue service on-call supervisor) requested HKTWR to provide more details of the accident over the radio. HKTWR replied that a utility aircraft, a C208 with 1-4 persons onboard, had crashed to the west of the airport outside the air-side. The plane had taken off from RWY 22L and turned to the right. Lento P3 asked whether the estimated site location was in the direction of Ruskeasanta area. HKTWR replied that the ELT signal was coming on the magnetic bearing of 233 degrees, from the direction of the old secondary fire station, and that the exact crash site was still unknown. Lento P3 dispersed his rescue units to search for the wreckage both within and outside the security fence. The units of rescue station one, led by Lento P3, initially concentrated on searching the northeastern corner of the air-side. Rescue station three’s units focused on exploring the area between taxiway S and the road to Tikkurila.

16:58:50 BLF286, which had taken off just ahead of NEF007, reported to HKAPP that it read an ELT signal on 121.500 MHz.

16:58:55 The municipal rescue units of the city of Vantaa received an aircraft accident alarm and within approximately a minute of the alarm Vantaa P3 (Vantaa on-call fire chief) reported that he was on his way to the freight terminal two gate. The gate was closed and, therefore, Vantaa P3 decided to lead his units to the gate next to freight terminal one, from where they were escorted to the air-side. Lento P3 informed Vantaa P3 that a light aircraft had crashed on the magnetic bearing of 233 degrees from the old secondary fire station outside the air-side. Lento P3 said that he was driving on the old utility road. Vantaa P3 confirmed the response centre's capacity for search in terrain.

16:59:00 Vantaa police were notified of an aircraft accident. The police were in the process of changing shifts and, hence, the police field command became operational without delay. The gathering point for the police was established in the direction of the crash. Vantaa police supervisor requested other state local district police departments for assistance in routine police activities. The voluntary rescue service were given advance notice of the accident. Furthermore, the police sounded the other relevant alarms and made the necessary notifications required.

17:00:30 HKAPP informed Tampere Area Control Centre (ESACC) of a possible aircraft accident to the west of the airport, concerning NEF007 that had taken off from RWY 22L, and that an ELT had been activated. The ESACC supervisor activated the Aeronautical Rescue Coordination Centre (ARCC).

17:00:45 HKAPP requested airport maintenance to check RWY 22L for any possible fallen aircraft parts. Thereafter HKAPP requested airport Briefing to provide NEF007's supplementary flight plan.

17:01:00 Helsinki ERC alerted the air ambulance Medi-Heli 01 (MH01, BO105). As the alarm was coming in, MH01 ground unit was already on its way on Junckers road. After receiving the alarm, the MH01 pilot telephoned HKTWR and was informed that a light aircraft had taken off from RWY 22L and disappeared from the radar. HKTWR said that an ELT was transmitting and estimated that there were 1–2 persons onboard.

17:01:00 HKTWR's radar display showed an aircraft flying along the coast near Sipoo squawking a code reserved for Border Guard aircraft.

17:01:14 HKAPP informed ESACC that they were not accepting any more incoming traffic and that said traffic would have to be recleared to Initial Approach Fixes (IAF).

17:01:34 HKTWR notified HKAPP that they had made radar contact with a Border Guard helicopter. HKTWR and HKAPP decided to request the helicopter to fly a SAR mission.

17:01:40 Rescue station 3 rescue units reported that they were on their way to search for the target.

17:01:58 As Helsinki-Malmi airport TWR was closed at the time, HKTWR called the Border Guard helicopter on Helsinki-Malmi TWR frequency. OH-HVE (AB412) responded. HKTWR requested executive assistance for a SAR mission. OH-HVE replied that it would turn and fly directly towards Helsinki–Vantaa airport. HKTWR informed them that a moment ago a light aircraft had taken off from RWY 22L, only to disappear after takeoff. OH-HVE was assigned RWY 22L as its starting point for the search. HKTWR said that it would later give more detailed search instructions. OH-HVE informed HKTWR that it was an on-call helicopter with a full crew equipped with Night Vision Goggles, (NVG). HKTWR instructed OH-HVE to continue towards the threshold of RWY 04R. HKTWR also advised OH-HVE of the ELT signal which was received almost immediately after the aircraft in question took off from RWY 22L and had turned to the right and that the transmission was coming on the magnetic bearing of 233 degrees. OH-HVE asked for the number of persons onboard the aircraft that had disappeared. HKTWR replied that the exact number was unknown and that the situation involved a light aircraft with approximately 1–4 persons onboard.

17:02:00 The MH01 ground unit turned back and while enroute to base it informed Vantaa P3 and the ambulance units that it would begin an aerial search by helicopter.

17:02:37 ARCC requested NEF007-related radar and ELT information from the Finnish Air Force 3rd sector operations centre.

17:03:00 HKTWR informed Lento P3 that he was proceeding in the wrong direction. In addition, HKTWR said that the aircraft had taken off from intersection Y, RWY 22L, and turned towards the west heading 260 degrees then disappeared immediately after takeoff. Lento P3 told HKTWR that he would swing by the end of RWY 22L. A moment later rescue unit Lento 12 told Lento P3 that the opposite direction was the correct one. National Traffic Police units approached the estimated accident site from several directions.

17:04:50 Airport police requested more detailed accident information from HKTWR because their red alert lights had come on. HKTWR advised that a single-engine aircraft had just taken off and disappeared and that they estimated two persons were onboard.

17:05:50 Vantaa P3 asked Lento P3 whether the accident site had been located.

17:06:20 HKTWR assigned the zone between the threshold of RWY 04R and Ring III as the primary search sector for OH-HVE and said that they should look for a single-engine Cessna 208.

17:06:52 ARCC declared an emergency to the Helsinki ERC informing them that a single-engine cargo plane had taken off from Helsinki–Vantaa RWY 22L and that the flight was headed west-southwest, bearing towards the city of Espoo. ARCC informed them that the aeroplane vanished off the radar almost immediately after takeoff and estimated that the aircraft had made an emergency landing. The ERC already had the information on the incident.

An emergency condition was in effect and rescue units had been dispatched to the presumed accident site.

17:06:57 HKTWR requested fire engines to check taxiway S.

17:07:10 HKAPP alerted Accident Investigation Board Finland of a possible aircraft accident to the west of the airport and without delay also informed the Director-General of the Civil Aviation Administration.

17:08:20 HKTWR made radio contact with air ambulance MH01 which was on emergency standby at Helsinki–Vantaa airport. MH01 was on the ground with engines running. HKTWR advised them of the upcoming SAR mission between RWY 04R and Ring III, where the Border Guard helicopter was by now flying a similar mission.

17:08:32 ARCC requested executive assistance from Marine Rescue Coordination Centre Turku (MRCC) for a helicopter fitted with a Direction Finder (DF) to be dispatched on a SAR mission. ARCC said that the request involved a probable aircraft accident in the vicinity of Helsinki–Vantaa airport. MRCC replied that OH-HVE (AB412) was already airborne in Helsinki. ARCC and MRCC decided that OH-HVE would change over to HKTWR frequency.

17:09:40 Airport maintenance unit Kunto 3 reported that it had checked RWY 04R from intersection Y all the way to its threshold and had found no fallen aircraft parts. Kunto 3 said that it would proceed to check taxiway S. At the request of HKTWR, Kunto 3 also checked RWY 15.

17:09:50 OH-HVE commenced the SAR mission by first flying around the assigned sector to outline the contours of the terrain and to record any obstructions relevant to the mission. Simultaneously, MH01 took off for a SAR mission in the zone between RWY 22L and Ring III, as designated by HKTWR. Both helicopters had visual contact with each other and were able to maintain separation. In addition, OH-HVE was fitted with an Airborne Collision Avoidance System (ACAS) with which the whereabouts of MH01 could be tracked. After a general sweep over the sector, when nothing out of the ordinary was found, OH-HVE began searching by using the ELT signal Timed Fade-out Search procedure and by using the DF.

17:10:02 HKAPP requested ESACC to provide endurance and alternate airport information on the aircraft which were holding at IAF LAKUT. It was decided that traffic arriving via IAF ORIMAA be cleared to hold at ORIMAA.

17:12:00 Lento P3 reported that he would proceed to rescue station three to rethink the situation.

17:12:15 OH-HVE reported that it had momentarily touched down between runways 04L and 04R, where the ELT transmission faded, and informed them that they were moving on to the south of Ring III.

17:12:33 The ESACC supervisor interrupted the breaks of two ATC controllers and directed them to activate the ESACC feeding sectors, through which traffic via IAF LAKUT and IAF ORIMAA enroute to Helsinki–Vantaa is controlled.

This was done because HKAPP had said that it was not accepting traffic until further notice.

17:13:48 HKAPP told HKTWR that according to their last radar contact NEF007 had turned to the right after takeoff. HKTWR instructed MH01 to move towards the final approach lines of RWY 04L and OH-HVE to search in the direction of RWY 04R.

17:14:50 HKAPP informed ESACC of problems in the airport's rescue service classification because all airport rescue units were deployed to the search. This meant that arriving aircraft would possibly have to divert to alternate airports. Simultaneously, it was agreed that holding points at IAF LAKUT and IAF ORIMAA be taken into use. In order to delineate the SAR sector, ARCC requested NEF007's time airborne from takeoff, the last radar contact and the maximum height reached.

17:15:10 OH-HVE reported that it would return to the air-side because the ELT signal had earlier disappeared from the south of the airport rather than from the north side.

17:16:10 Because of HKTWR's request, the rescue station inquired whether it was possible to move one rescue unit to the side of RWY15 in order to safeguard the landings of arriving aircraft. Lento P3 informed them that rescue units Lento 21 and Lento 22 were returning to station one. OH-HVE reported that it would move to the right of RWY 04R to continue with the Timed Fade-out Search procedure.

17:18:03 The 3rd sector operations centre gave ARCC the last relevant radar plots. NEF007's climb had been visible on the radar and the flight had headed west. Before crossing the motorway to Hämeenlinna it began to lose altitude. Its maximum height was 300 m and the minimum detected height was 240 m a little before the motorway. Seven seconds before vanishing from radar the position of the aircraft was N 60° 18' 56" and E 024° 51' 52". It was heading 283 degrees and its airspeed was 181 km/h.

17:21:08 ARCC relayed this information to HKAPP.

17:24:40 HKAPP reported the aforementioned information to OH-HVE. ARCC mapped the search sector utilizing the last relevant radar plots. The centre point of the SAR zone was the last radar plot received from the 3rd sector operations centre and the radius of the SAR area was defined as two kilometres.

17:25:25 Rescue unit Lento 21 advised HKTWR that RWY 15 could be reopened for arrivals.

17:25:47 ESACC asked HKAPP whether the airport would be entirely closed for traffic. HKAPP advised that rescue service readiness would be returning within approximately five minutes, whereafter they would again accept arriving traffic to RWY 15.

17:26:00 The flight mechanic of OH-HVE spotted an irregular target next to the edge of a mound of sand. After further inspection the target proved to be NEF007. By this point in time the police had dispatched 20 patrols to this mission.

17:26:10 OH-HVE reported that it had located the SAR target within the air-side and said that it would remain in hover above the site. MH01 advised that it would land in the area between the site location and a close by utility road.

17:27:30 MH01 landed. The flight assistant and the doctor performed initial assessments of both the safety of the target and the medical condition of the casualty. The pilot of the occurrence aircraft was conscious and his breathing and circulation were satisfactory. The pilot was not pinned in but he was unable to exit the wreckage on his own. MH01 was on the ground and its pilot illuminated the target with the helicopter searchlight.

17:27:39 HKAPP reported to ARCC that NEF007 had been found.

17:28:01 OH-HVE reported that it was still in hover and that it would continue to illuminate the accident site to support the MH01 crew as well as to direct other rescue units to the location.

17:31:10 OH-HVE notified HKTWR of the best route to the accident site. HKTWR then relayed this information to rescue units.

17:34:00 Rescue unit Lento 11 arrived at the scene. Its crew brought along hydraulic extrication gear, sprayed foam around the leaking fuel tank and freed the injured pilot from the wreckage. MH01 informed Lento P3 that there was only one patient. Ambulance unit V691 was selected as the preferred mode of casualty transportation and was escorted by the police along the utility road to the site. Police patrol 965 reported that the aeroplane had crashed next to the runway.

17:36:00 Police units were advised to use Pakkala utility road to the site.

17:38:02 OH-HVE touched down and left behind a radio and the rescue swimmer as a liaison officer at the accident site in view of any possible further measures.

17:38:30 MH01 requested OH-HVE to continue with the illumination of the site because the other available lighting was inadequate. The MH01 pilot tried to contact the MH01 doctor over the public authority network VIRVE but did not succeed due to the great volume of radio traffic at that time.

17:44:00 The MH01 doctor managed to make contact with his pilot and asked him to turn off the helicopter engines and to bring the equipment designed to keep patients warm. Rescue unit V35 continued to illuminate the target and rescue unit Lento 31 drove right up next to the occurrence aircraft.

17:50:00 The injured pilot of the occurrence aeroplane was carried on aluminium break-apart stretchers to ambulance unit V691 where he was examined and questioned in more detail. The pilot was conscious, remembered his date of birth but could not recall events in detail. He was also surprised to hear that he was in Helsinki on the way to the hospital. The pilot’s head showed

contusions and his symptoms were indicative of a concussion. No other injuries were found.

18:02:00 Vantaa ambulance unit V691 took off to Töölö hospital with the injured pilot, accompanied by the MH01 doctor.

1.16 Test and research

The following describes the condition and positions of the aeroplane's most important systems and controls. The position of control levers, switches etc. may change as a result of a crash to the ground and during rescue operations and, therefore, no explicit conclusions should be drawn from this information.

1.16.1 Flight control systems

The ailerons, the elevator and rudder were destroyed to such extent in the crash that it was impossible to exactly evaluate their condition.

1.16.2 Trailing edge flap system

The trailing edge flap control lever was in the "down" position. The flap angle indicator showed that the aircraft was in the clean configuration at impact. In addition, the examination of the flap mechanism showed that flaps were fully retracted at the time of impact. The pilot said that he had retracted the flaps in the normal manner.

The examination of the flap bellcranks proved that they were undamaged. A bellcrank inspection, pursuant to Airworthiness Directive AD 2004-17-01, had been performed on the aircraft.

1.16.3 Fuel system

The aircraft was fuelled in accordance with the weight and balance calculation to approximately 725 kg of fuel in the tanks.

During the inspection of the wreckage it was noticed that the left fuel tank selector lever was fully open. The right hand side fuel tank selector was half open. The engine gets enough fuel to run even if one of the selector levers is fully closed. Nothing out of the ordinary was discovered in the inspection of the engine fuel filter.

No anti-freeze agent was added during refuelling. According to the Pilot's Operation Handbook (POH), anti-freeze must always be added.

1.16.4 Powerplant

Nothing out of the ordinary was discovered in the inspection of the engine oil filter. Likewise, nothing out of the ordinary was discovered in the inspection of the engine's pneumatic power control system filter. It was impossible to infer the engine power

setting at impact from the torque indicator. According to the pilot's statement, the engine operated normally and it was on a take-off power setting during the whole sequence of events.

1.16.5 Engine control system

The power level was pushed to the front while the emergency power lever was in its normal position, almost all the way back. The fuel condition lever was in the "low-idle" position. Its normal position during takeoff should be "high-idle" (front). The propeller RPM lever was pushed to the front (high RPM).

The inspection of the engine control system produced no noteworthy results because the engine, controlled from the cockpit by pushrods and cables, had broken loose from its mounting frame.

1.16.6 Cockpit instruments

Altimeters

The altimeters were nearly intact. They were set to different barometric settings. The barometric setting on the left altimeter was 996 hPa and the right altimeter setting was the standard pressure 1013 hPa. The left altimeter's setting corresponded to the airport QNH. Both altimeters indicated negative heights.

Airspeed indicators

Both airspeed indicators showed zero.

Heading indicators

The left gyrocompass indicated 289 degrees and the desired heading indicator was set at 280 degrees. The right gyrocompass indicated the heading 046 degrees.

Variometer

The left variometer indicated +18 ft/min and the right one +175ft/min, respectively.

Attitude indicators

The left attitude indicator showed a 21 degree bank to the left and a 30 degree pitch down. The right attitude indicator showed a 22 degree bank to the left and a 5 degree pitch up.

Turn and bank indicator

The aeroplane silhouette was in the middle (the "no turn") position and the ball the distance of its own diameter to the right.

Magnetic compass

The magnetic compass indicated the heading 150 degrees.

Course indicators

The right side Horizontal Situation Indicator was set to 260 degrees with the OBS knob. The left Horizontal Situation Indicator was set to 290 degrees.

Clock

The clock had stopped at 06:51.

1.16.7 Electric switches

Battery switch

The battery switch was on.

COM switches

The COM1 main switch was on. The COM2 main switch was off.

De-icing system

The pitot tube heater was on. Propeller de-icing was off. The stall warning system heater was off.

Illumination and light switches

Cockpit lights and instruments lights were on. Navigation and landing lights were on. The strobe and the beacon were on.

Ignition switch

The ignition switch was on.

1.16.8 Air conditioning system

The air conditioning and windscreen defrosting system was off.

1.16.9 COM/NAV switches

Both radios (COM1 and COM2) were on as were both navigation systems (NAV1 and NAV2). The respective frequencies were not recorded.

The ADF was on. The selected frequency was not recorded.

The GPS was on. The GPS database was over a year old and its date of expiration was 21.1.2004.

The transponder was on.

1.16.10 Landing gear

The aircraft had fixed undercarriage. All landing gear were destroyed in the crash.

1.17 Organizational and management information

The operator of the aircraft was Nord-Flyg AB from Eskilstuna, Sweden. The company has operated since 1952 dealing in air freight, parachute training, flight training, sightseeing flights, banner towing as well as counting wild game from aircraft. It has an accountable manager, a director of flight operations and a technical director. The company operates within the JAR requirements for technical maintenance but under national certification for flight operations. Technical services are outsourced to a JAR-145-certified maintenance company.

The company had the use of three Cessna 208B Caravan aeroplanes as well as one Piper Pa31 aeroplane. Two of the Cessna 208B Caravans were freight-configured only. The third one was used for, among other things, passenger transport and parachute training. The destroyed aircraft was owned by a financing company. Nord-Flyg AB had a valid, *Luftfartsstyrelsen* -certified (Swedish aviation authority LFS) Operations Manual.

The following documents were found in the wreckage:

- Flight Operations Manual (Drifthandbok), revised including the revision pages,
- Job Description (Arbetsbeskrivning), revised but not including the revision pages,
- A revised and abridged Operations Manual without the revision pages,
- Two company-made checklists for a two person crew,
- The aircraft manufacturer’s checklist and emergency procedures list for a one person crew. The pencil-in amendments were not made,
- The aircraft manufacturer’s Pilot’s Operating Handbook (POH),
- Charts covering the route in question as well as the alternative airports. The enroute chart had expired.

The Operations Manual (OM) and Job Descriptions as well as all company-internal checklists were made for a two person crew. The OM and operating instructions were drawn up in detail.

Pursuant to the company OM (part 2.6 p. 8) the aircraft must be carefully cleared of frost, ice and snow before takeoff. This is also in accordance with the existing

regulations. If there is a possibility that said impurities may reappear, the aeroplane must be treated with a de-icing agent. Detailed de-icing and de-icing agent application instructions are issued in the OM.

A brush for snow and ice removal as well as a garden pump dispenser containing de-icing fluid were found in the wreckage.

2 ANALYSIS

2.1 Events prior to takeoff

2.1.1 Prevailing weather during the aircraft's overnight layover

The prevailing weather at the time of the accident had no effect on the arising of the accident. However, snow accumulated on the wings and fuselage during the time the aircraft was standing outside and it also partly thawed and then refroze as the ambient temperature fell. As a result, there was a difficult to remove, uneven coat of ice on the aeroplane's surfaces.

2.1.2 Loading

According to the pilot's weight and balance calculations, takeoff weight was 4 070 kg. The freight compartment was divided into six partitions and the cargo was carried in partitions 2, 3 and 4. Total cargo weight, as per the weight and balance calculation, was 1 150 kg. Pursuant to the weight and balance calculation, takeoff weight was 4 070 kg with the maximum allowable takeoff weight being 4 110 kg. The pilot had not figured in the absence of the co-pilot. The actual takeoff weight was 4 070 kg minus 80 kg, i.e. 3 990 kg. The Zero Fuel Weight and Takeoff Weight centres of gravity were within the manufacturer limitations. The weight of the ice and snow that had accumulated on top of the wing, fuselage and empennage was not deemed to be a major increase in the total weight of the aeroplane.

The examination of the wreckage revealed that the pilot had not secured the cargo with the cargo net.

2.1.3 De-icing

After having checked in for duty at the Helsinki–Vantaa airport the pilot, unsuccessfully, tried to remove the snow and ice that had accumulated on the upper surfaces of the wing, fuselage and empennage. In conjunction with the examination of the wreckage it was estimated that the coat of snow, frozen slush and ice was 0.5-1.5 cm thick. These impurities had, in places, come loose in the crash. However, even after the crash to the ground, impurities abounded.

The pilot had not employed any of the other de-icing procedures detailed in the company OM. There are two ground service providers offering de-icing services at Helsinki–Vantaa airport. During the previous and ongoing winters the aviation firm in question had only once used one of the de-icing service providers. A contributing factor to the neglecting of the de-icing may have been a sense of hurry that the pilot had developed as he was trying to make it to his primary destination on time.

Figure 4. Impurities on the upper wing surface

2.2 Takeoff

The pilot took off from Helsinki–Vantaa airport RWY 22L, intersection Y. He had 2 648 m available for takeoff, which is enough for the aircraft in question.

2.2.1 Takeoff technique

The pilot executed the takeoff by selecting 10 degrees of flaps. According to the aeroplane manufacturer takeoff may be executed by selecting 0-20 degrees of flaps. A 20 degree flap setting during takeoff is warranted because this technique facilitates the fastest climb to a safe altitude in case of possible engine failure. Experiences show that when flaps are extended 20 degrees the extra drag incurred is insignificant compared to the considerable gain in additional lift.

2.2.2 Aerofoil aerodynamics and behaviour

The upper wing surface was entirely covered with frozen snow, slush and ice. During the examination of the wreckage the thickness of the coating was found to vary between 0.5–1.5 cm. These kinds of impurities are detrimental to aerofoil aerodynamics and may reduce the coefficient of lift of the wing even as much as 20–30%.

As the pilot retracted the flaps after takeoff, the aeroplane rolled to the right and began to descend once the wing stalled. As per his account, the pilot then pushed the nose

down and decreased the angle of attack. This manoeuvre, however, was not enough to effect a recovery and the plane continued to dive in an apparent stall all the way to the point of impact. Just before impact the pilot managed to get the wings level.

The pilot did not attempt to extend the flaps to a setting identical to or higher than the setting which preceded the moment of stall. This might have returned the separated airflow back to the surface of the wing. Training requirements in the Joint European Requirements do not include practicing stalls in which configuration is changed while the aeroplane is accelerating in the takeoff configuration at maximum takeoff weight and at low altitude.

Neither did the pilot attempt to effect a recovery from the stall by intentionally operating the engine beyond the approved limits. Approximately 30% more propeller power could have been gained by exceeding the engine manufacturer's limitations for normal operations. However, this option is not described in the aeroplane manual because the presumption is that the engine will be operated within the normal range.

2.3 Company culture

The operator of the aircraft is a relatively small company. However, the company Operation Manual has been very carefully drawn up. The effect of cost-cutting on this accident can not be verified. Buying de-icing services from an external service provider incurs additional expenses for the company. The pilot said that he probably would not have been "scolded" had he ordered a de-icing for the aeroplane.

2.4 Survival aspects

The first contact with the ground during the crash occurred at a shallow dive angle, albeit at a relatively high descent rate. Therefore, the forces of deceleration mainly worked from down to up, generated by the bottom of the fuselage hitting a rocky knoll. The main landing gear helped to absorb some of the shock. The pilot seat remained attached to the seat rails and the pilot remained in his seat in the five-point harness. The pilot lost consciousness in the impact. In the second ground contact the forces of deceleration worked from the front left as the left wing and the engine hit the ground. The pilot still remained in his seat and the seat remained attached to the rails. Somewhere along the way to the final stopping point the front fuselage roof structure caved in a little but the pilot was not pinned. When rescue crews reached the aeroplane, the pilot was strapped to his seat but not trapped. At that time he was conscious but unable to deplane of his own devices. The rescue crew carried him out of the plane.

The cockpit survived with relatively little mechanical damage and deformation. This is partly thanks to the triangular structure between the engine firewall and the bulkhead positioned at the rear of the cockpit door. A box frame structure, angled at 45 degrees between the bottom of the firewall and the top of the bulkhead at the rear of the cockpit door, acts as a brace and a load bearing structure. In addition, the rigid cargo barrier attached to the pilot seat rails and to the top of the bulkhead at the rear of the cockpit door prevented the cockpit from caving in. The barrier also prevented the pilot from

getting pinned between the seat and the roof structure. The cockpit doors remained closed during the entire chain of events and, for their part, also braced the cockpit.

2.5 Search and Rescue

2.5.1 Air traffic control operations

BLF289 (SB20/M) departed from RWY 22L at 16:52:25. NEF007, next in line, departed on the same runway at 16:54:45. The separation between the respective takeoffs was 2 minutes 20 seconds. The takeoff separation established for the wake turbulence categories of these two aircraft must be at least two minutes, which in this case materialized. NEF007 took off at ca. 16:54:45 and its ELT activated at 16:56:10. In other words, the aeroplane was airborne for about 1 minute 25 seconds before the accident. The control tower gave the alarm with red alarm lights (aircraft accident) 3 minutes after NEF007 took off. At that point 1 minute 35 seconds had elapsed from the crash. The aircraft accident alarm lights were communicated to the airport rescue stations, the airport police and the Helsinki ERC. The approach control phoned in the alarm to Helsinki ERC 3 minutes 35 seconds after takeoff and to the Air Rescue Coordination Centre 5 minutes 45 seconds after NEF007 took off. ARCC alerted Helsinki ERC some 7 minutes after NEF007 took off.

Once radar and radio contacts to NEF007 were lost, air traffic control sounded the alarm and made the emergency notifications without delay. After having noticed that the airport rescue units were headed in the wrong direction, HKTWR advised Lento P3 of this and said that the aircraft had taken off from intersection Y RWY 22L, heading west and that it had disappeared immediately after takeoff. According to HKAPP radar plots, the last radar contact indicated that NEF007 was approximately 0.2 NM from the end of RWY 22L in a right turn. When ATC notified the rescue units of the estimated site location, it did not utilize the established rescue grid to specify the accident area. Had the rescue grid been used, rescue units would have headed in the right direction sooner.

From the SAR perspective, an air controller working at HKTWR made an invaluable observation on his radar display. The transponder target was a Border Guard helicopter flying along the coast in the Sipoo area. The helicopter in question was flying with a full crew and was equipped with excellent SAR gear. This observation rapidly kicked off an effective and successful SAR mission. Normally, an on-call Border Guard helicopter is able to get airborne within one hour after office hours.

The relevant flight information from the 3rd sector operations centre to ARCC was precise and it suitably augmented the available information. ARCC determined the SAR area by virtue of the last observations of the flight. The last radar contact, received from the 3rd sector operations centre, was selected as the centre point of the search around which the SAR area was established. ARCC has pre-prepared tables and calculation formulas for determining a SAR area. Due to a calculation error, the SAR area became too small, as its radius was established at two kilometres. For the case in point the target would have been approximately 500 m outside the SAR area. The correct radius

was three kilometres. The information on the established SAR area reached the participating helicopters and rescue units only after the target was found.

Due to securing the SAR flights and because of insufficient rescue readiness the airport was closed for air traffic for about 30 minutes. Pursuant to Civil Aviation Administration directive (IAM SAR 16/23.7.1999), air traffic control made the required notifications with the exception of notifying the Director-General of the Flight Safety Authority.

2.5.2 Airport rescue service operations

HKTWR gave the alarm at 16:57:45. Lento P3 was on his way at 16:58:40 and radioed in to HKTWR asking for more information on the accident. HKTWR advised that a light aircraft, a C208 with 1–4 persons onboard, had crashed to the west of the airport outside the air-side. The plane had taken off from RWY 22L and turned to the right. Lento P3 asked whether the site was in the direction of Ruskeasanta. HKTWR said that the ELT signal was coming in on a magnetic bearing of 233 degrees, from the direction of the old secondary fire station, and that the exact crash site was still unknown. Lento P3 had proceeded in the wrong direction for four minutes when HKTWR informed him that the aircraft had taken off from intersection Y RWY 22L and turned towards the west heading 260 degrees and that it had disappeared immediately after takeoff. Lento P3 advised HKTWR that he would swing by the end of RWY 22L. A moment later rescue unit Lento 12 told Lento P3 that the opposite direction was the correct one.

The airport rescue service has two ELT tracking devices (Finntracker Oy/ Tracker FTV-468 CM) of which one is kept in the rescue command vehicle. This tracking device is a small, portable model. The device indicates the direction of the ELT but not the distance to it. By employing the cross tracking method, the ELT position can quite accurately be established. In this case the bent ELT airframe antenna was under the fuselage of the overturned aeroplane. Furthermore, there was a high mound of sand right next to the accident site. These factors would have hampered the tracking of the ELT. The tracking device in the airport rescue command vehicle was not used to locate the aircraft.

The first radio message from HKTWR gave Lento P3 the impression that the said aircraft had attempted to return to the air-side for a landing and this is why he had dispersed his units to search both inside and outside the security fence. In addition to Lento P3, five airport rescue units participated in SAR and seven fire fighters took part in the onsite rescue operation. At about 17:30 Lento P3 released rescue station two's rescue units to safeguard the air traffic which was about to restart.

2.5.3 Municipal emergency service operations

Central-Uusimaa rescue department's Vantaa station 3 received the alarm from Helsinki ERC at 16:58:21 and within about a minute Vantaa P3 reported that he was on his way to the gate at freight terminal two. Initially, Vantaa P3 had the impression that the situation involved an aircraft coming in for a landing. The gate was closed and, therefore, Vantaa P3 decided to lead his units to the gate at freight terminal one, from where they were escorted to the air-side. No radio communications existed between

Vantaa P3 and his escort. In addition to Vantaa P3, a total of 11 municipal rescue units were dispatched.

In the following figure the colour red represents the route taken by the municipal rescue service and the colour blue the airport rescue service, respectively.

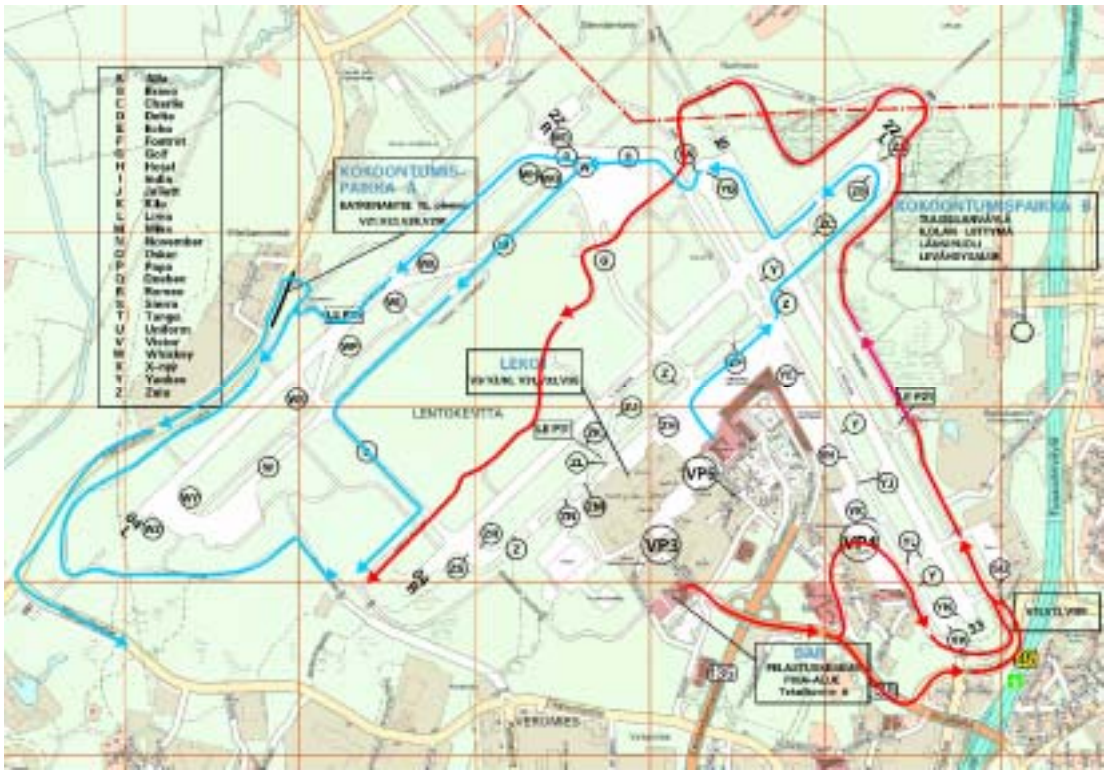


Figure 5. Rescue service routes
(Source: City of Vantaa, survey department)

2.5.4 Police operations

Airport police received the alarm from HKTWR at 16:57:45 and Vantaa police received the alarm from Helsinki ERC at around 16:59. Vantaa state local district police department was in overall command of police operations and they requested neighbouring state local district police departments to also dispatch patrols to assist theirs. The first patrol was dispatched at around 16:59. Altogether 20 police patrols were dispatched to the airport. In addition, Vantaa police gave advance warning to the voluntary rescue service Vapepa and after the wreckage was found, the police requested executive assistance from the Defence Forces for sentry duty. The target was found before the search area information determined by ARCC reached the police and, therefore, no systematic terrain search was organized. The police launched technical and tactical investigations.

2.5.5 Border Guard operations

At 17:01:58 HKTWR called the Border Guard helicopter on the Helsinki–Malmi airport tower frequency. OH-HVE acknowledged the radio call. It was flying in the Sipoo area. Once having received the executive assistance request, OH-HVE headed directly towards Helsinki–Vantaa airport. OH-HVE was equipped with DF, NVG and thermal imaging equipment. The entire four-person crew used Night Vision Goggles.

At around 17:09:50 OH-HVE commenced the SAR mission, which initially constituted a general sweep around the accident area, followed by locating the ELT by employing the Timed Fade-out Search procedure. The DF indication was intermittent but the ELT transmission read well on the radio. It was difficult to locate the ELT because the accident site was next to a mound of sand. Furthermore, NEF007's ELT airframe antenna was bent and was pointing towards the ground because the aircraft was overturned. Both of the said factors contributed to the irregular ELT signal pattern. After about 16 minutes of searching, OH-HVE's flight mechanic spotted the SAR target. OH-HVE operated in a professional and effective manner and cooperation with HKTWR was smooth.

2.5.6 Cospas-Sarsat

Cospas-Sarsat is an international search and rescue system, which utilizes satellites for detecting and locating aviation and maritime emergency beacons as well as personal use locating beacons. The system comprises the satellite network, Local User Terminals (LUT) and Mission Control Centres (MCC). When an emergency transmitter goes off and the satellite receives and relays the signal to the closest available LUT, the LUT calculates the location of the signal. After establishing the location, the LUT transmits a standardized emergency message to the MCC in the area of the country where the location has been calculated to be. Based on the geographical location of the ELT, the MCC of the country in question then forwards the alert data to appropriate rescue coordination centres. The Cospas-Sarsat system operates 24/7. In Finland there is no LUT; instead, emergency messages are mainly received from Norway. In Finland, the Maritime Rescue Coordination Centre (MRCC) in the city of Turku doubles as the MCC.

The Low-altitude Earth Orbit (LEOSAR) system operates via six satellites orbiting the Earth in near-polar orbits at a 1 000 km altitude. One orbit takes ca. 100 minutes. The satellites "listen" to the frequencies 121.5 /243 MHz and 406 MHz. This system does not provide global coverage because the satellites must fly over zones where transmitter signals can be received. In addition, a satellite must make contact with one of the LUTs before the alert data can be relayed. This system determines the location of the ELT using Doppler processing techniques. Locating accuracy is 20 m on average. There are also many false alarms. Some of the satellites in this system are fitted with memory units reserved for the 406 MHz frequency. Using digital technology, the satellite saves the coded information embedded in the 406.025 MHz transmission and when it arrives within range of the first available LUT it transmits the information. At this point the identification and the geographical position of the ELT are received. The locating accuracy of the system is approximately 5 km. On average, it takes about 45 minutes for

this system to relay the alarm. The LEOSAR system comprises 44 LEOLUT stations. The weaknesses of the LEOSAR system are the long time it takes to distribute the alert data and its mediocre locating accuracy. It does not cover the entire globe and identification information is not always obtained. The number of false alarms is also high.

The Geostationary Search and Rescue (GEOSAR) system operates via five geostationary satellites positioned over the Equator at a 36 000 km altitude. In addition, the system comprises 16 GEOLUT stations. Apart from the polar regions, which the LEOSAR covers well, the GEOSAR provides global coverage. The GEOSAR does not employ the Doppler locating technique. Instead, locating is based on geographic location and identification information which is digitally transmitted and satellite-relayed on the 406 MHz distress beacon frequency. The signal may make use of information in the navigation equipment of the aircraft or vessel. The signal also includes the transmitter's country of registration. The 406 MHz distress beacons also transmit a signal that can be located by a DF or a Homer. The average time elapsed from signal to alarm is 5 minutes and the average locating accuracy is 5 km, and even 100 m at best.

The Sarsat-9 satellite detected NEF007's ELT signal at around 17:52 and relayed the alert data to the Tromssa LUT in Norway. The signal was received on 121.499 MHz, which meant that the ELT had been attempted to be located using the Doppler technique. Sarsat-7 made the second signal detection and it also relayed the data to the LUT. From the activation of the ELT about 56 minutes elapsed before the first satellite detection. In this case it took approximately 10 minutes longer than normal before the first detection of the signal. Bodo MCC in Norway sent two alert data messages to Turku MRCC/MCC, which forwarded them to the ARCC and to Helsinki Maritime Rescue Sub-Centre (MRSC). Only two alert data messages were received because fairly soon after the wreckage was found its ELT was turned off to preclude any false alarms. In this particular case, the location information was irrelevant because the missing aircraft was found 26 minutes before the first satellite detected the signal.

In this case the Cospas-Sarsat system detected the ELT signal 54 minutes from activation and the locating accuracy was approximately 17 km. However, even this occurrence proved the worth of the Cospas-Sarsat system as an alerting and locating system. Had the SAR operation continued longer, other Cospas-Sarsat satellites would also have detected the signal, which would have improved the locating accuracy.

2.5.7 Medi-Heli operations

At approximately 17:01 Helsinki ERC dispatched MH01 and at approximately 17:10 MH01 was on its way to carry out a HKTWR-assigned SAR mission. After some 16 minutes into MH01's mission OH-HVE reported that it had found the target. At around 17:30 MH01 landed in the area between the wreckage and the nearby utility road. Within approximately three minutes from target detection a doctor-led medical team reached the site of the accident. MH01's medical team made an initial assessment of the safety of the target as well as of the condition of the pilot. After moving the pilot into an ambulance unit, the doctor interviewed and examined the conscious pilot more closely.

The ambulance transported the injured pilot to Töölö hospital, accompanied by the MH01 doctor.

2.5.8 Synopsis of SAR operations

The investigation revealed that no joint training, on for example accident site determining and reporting, is organized for those who participate in SAR operations at and around Helsinki–Vantaa airport.

After radar contact with NEF007 was lost and it did not acknowledge radio calls and its ELT activated, the ATC gave the mandatory aircraft accident alarms and notifications. The first alarm was sounded approximately 1 minute 35 seconds after the crash into the ground. An already airborne Border Guard helicopter, dispatched by the ATC, commenced the SAR mission at 17:09:50 and found the target 16 minutes into the mission. At that point approximately 30 minutes had elapsed from the accident. The situation involved the dark time of the day, the ground was covered by fresh snow and the colour of the missing aircraft was mostly white. Moreover, it lay inverted in the shade of a large mound of sand. Taking into account the aforementioned factors, the SAR mission was extremely successful. The Medi-Heli helicopter with its medical crew took off on a SAR mission at 17:10 and landed close to the wreckage approximately 34 minutes after the accident occurred.

Helsinki–Vantaa airport rescue service took off within 55 seconds of the alarm. Lento P3 and his units proceeded towards the old secondary fire station and radioed in to air traffic control for more alarm related information. Lento P3 got the impression that the aeroplane had taken off from RWY 22L making a right turn and that it had attempted to return for a landing. Lento P3 dispersed his units for visual search both within and outside of the security perimeter fence. The search sectors were in the area between RWY 04R/22L and RWY 04L/22R as well as the area between taxiway S and the road to Tikkurila. The visual search was hampered by darkness, the contour of the terrain at the site of the crash as well as to the fact that they were looking for a white aircraft in the midst of fresh snow. OH-HVE, in hover over the site location, directed the rescue units to the crash site. Rescue unit Lento 12 supported Lento P3's command activities in establishing the direction of the missing aircraft. The airport rescue service did not use their portable ELT tracker.

The Vantaa units of Central Uusimaa rescue service were dispatched at 16:58:21 and within a minute or so Vantaa P3 was on his way to the air-side. Once Lento P3 gave Vantaa P3 the information on the estimated accident area, Vantaa P3 advised that he would enter the area from the outside using the old utility road and rescue roads. This route, however, was blocked by a closed gate and the units then returned to the main gate, through which the units entered the area escorted by Securitas security personnel.

Vantaa P3 had the initial impression that the situation involved an aircraft coming in for a landing. Vantaa P3 confirmed that terrain-capable vehicles came to the search area. Once the aircraft was found, one rescue service unit remained at the site to illuminate

the accident area. The operation of the municipal rescue service was hampered by the closed gate and by having to wait behind the main gate for an escort.

The police received the alarm at 16:57:45 and their first patrol was dispatched at 16:59. Altogether 20 police patrols were dispatched for this mission. The police were in the process of changing shifts and, hence, police field command became operational without delay. The gathering point for the police was established in the direction of the crash. The target was found before the search area information determined by ARCC had reached the police and, therefore, no systematic terrain search was organized.

3 CONCLUSIONS

3.1 Findings

1. The pilot had the required licence and qualifications.

2. The airworthiness certificate and the certificate of registration were valid.

3. The company could not find a replacement for the co-pilot who had taken ill. Therefore, contrary to company practice, the flight was flown with a one person crew.

4. The pilot left the aeroplane outside, exposed to weather, even though as per the company operations manual the plane could have been placed in a hangar for the duration of the layover.

5. The pilot neglected the pre-flight briefing by not submitting the operational flight plan, by not acquiring relevant meteorological information and by not following procedures described in the operations manual for clearing the aeroplane of accumulated snow, slush and ice.

6. There was a garden pump dispenser in the aeroplane containing an alcohol/glycol solution. This type of pump is unsuitable for de-icing.

7. The company used partially out-of-date documents.

8. The aeroplane was certified for Basic-RNAV operations in such a manner that the GPS could be used as primary navigation equipment. The GPS databank, however, had expired.

9. There was an enroute chart in the aeroplane that was more than a year old. Since the version of the chart which was found, the valid enroute chart had been updated several times.

10. Considering the circumstances, the pilot checked in too late for duty at the airport.

11. The pilot failed to secure the cargo with the cargo net.

12. The pilot executed the takeoff by using too little flap for the situation. He had only selected 10 degrees of flaps.

13. The right wing stalled during flap retraction and the aeroplane rolled to the right. The stall warning system did not provide a warning to the pilot either because the stall warning system heater was not on or because the impurities induced a stall before the normal operating range of the stall warning system.

14. Radio and radar contacts to NEF007 were lost almost immediately after takeoff.

15. The pilot did not recognize the stall and, this being the case, did not attempt to reset the flaps to the position in which they were prior to stall. Neither did the pilot try to effect a recovery from the stall by intentionally overrevving the engine.

16. The pilot unsuccessfully attempted an emergency landing on runway 22R.

17. The Emergency Locator Transmitter onboard NEF007 was activated.

18. The air traffic control promptly sounded the alarm and made the emergency notifications.

19. The air traffic control did not use the rescue grid when indicating the accident site.

20. Lento P3 initially got the impression that the situation involved an aircraft attempting to return for a landing.

21. The air traffic control noticed that the rescue units were proceeding in the wrong direction and then radioed the instructions on how to reach the estimated site location.

22. Vantaa P3 initially got the impression that the situation involved an aircraft coming in for a landing.

23. The municipal rescue units had to wait behind closed gates for an escort to air-side.

24. No radio communications existed between the escort and the municipal rescue units.

25. An air traffic controller noticed an airborne Border Guard helicopter on his radar display and dispatched it to a SAR mission.

26. Radar plots received from the Air Force sector operations centre focused the estimated accident site more closely and helped to determine the SAR area.

27. The Air Rescue Control Centre made an error while determining the SAR area but the wreckage was found before the search area was assigned to the SAR units.

28. A Border Guard helicopter spotted the accident site and directed the rescue units to the location.

29. The wreckage was found before the police could set up an organized terrain search.

30. Two Cospas-Sarsat satellite alert data messages were received after the wreckage had been found.

31. Airport rescue service did not use their Tracker FTV-468 CM device, which is designed to locate a distress beacon.

32. The airport rescue director's manual does not provide for the usage of an ELT-tracker.

33. Not all of the VIRVE-network radio traffic was recorded.

3.2 Probable cause

3.2.1 Direct causal factors

The chain of events can be regarded as having begun when the aeroplane stood overnight on the tarmac, exposed to the weather. Snowfall accumulated on the upper surfaces of the fuselage, wings and stabilizers during the night forming a thick coat of ice and snow as it partly melted during the day and refroze when the ambient temperature dropped towards the evening.

The pilot noticed the impurities when he performed a walkaround check. However, he did not order a de-icing. Instead, he tried to remove the ice with a brush. It is only possible to remove dry and loose snow by brushing. In this case the frozen water that had trickled down remained stuck to surfaces.

The pilot executed a takeoff with an aircraft whose aerodynamic properties were fundamentally degraded due to impurities. During the initial climb, immediately after flap retraction, airflow separated from the surface of the wing and the pilot did not manage to regain control of the aircraft. The pilot did not recognize the stall for what is was and did not act in the required manner to recover or, then again, it could be that he had not received sufficient training for these kinds of situations.

3.2.2 Contributing causal factors

Several factors are considered to have affected the pilot's actions. He was either ignorant or negligent as to the effect of impurities on the aeroplane's aerodynamic properties. Furthermore, the pressure of keeping to the schedule during the early pre-flight briefing activities may have affected his decision, even though a change in the flight plan eliminated the actual rush. It is the impression of the investigation commission that these factors were the principal ones that contributed to the omission of proper de-icing.

A probable contributing factor, albeit one difficult to verify, could have been the financial aspect. The company may have considered buying de-icing services from an external service provider as an additional expense. Investigations showed that the operator in question had ordered aeroplane de-icing at Helsinki–Vantaa airport only once during the previous and ongoing winter season.

The company regularly flew to this airport. Processes were in place for pre-flight briefing as well as for freight forwarding. However, the flight schedules with reference to the opening times of the company's primary destination airport did not allow for long delays

in ground operations. This may have partly put pressure on the pilot to complete the other pre-flight activities as soon as possible.

As for the flap setting, the pilot's takeoff technique was not proper for the existing circumstances. Moreover, when the aeroplane stalled, the pilot did not execute any effective corrective action to regain control of the aircraft. These would have been, among other things: having reset the flaps to the position prior to the stall as well as having taken advantage of the engine power reserve. As per his account, the pilot did not utilize all available engine power. Instead, he stuck to the maximum value prescribed for normal operations as specified in the aircraft operations manual. The fact that the said flight was flown, contrary to normal operations with only a one person crew, can be considered a contributing factor.

4 SAFETY RECOMMENDATIONS

1. There is no condition in the Joint Aviation Requirements requiring practice of stall recovery techniques during takeoff and during trailing edge flap retraction in the flight training syllabi for commercial pilot's licences and single-engine certifications.

   The investigation commission recommends that the Civil Aviation Administration take the necessary measures to include said preparatory training in flight training and licence requirements.

2. The investigation revealed shortcomings in the pilot's actions, which may be indicative of inadequate training. In addition, the company's operation was found to be lacking because, among other things, up-to-date versions of enroute charts and navigation equipment databanks were not available.

   The investigation commission recommends that the Swedish aviation authority audit the company's operational practices and pilot training so as to guarantee the conditions for safe flight operations.

3. The investigation revealed that no joint training, on for example accident site determining and reporting, is organized for those who participate in SAR operations at and around Helsinki–Vantaa airport.

   The investigation commission recommends that Helsinki–Vantaa airport operator and municipal emergency services operator set together joint training and the content required.

4. The investigation revealed that municipal rescue units, on their own, do not have free access to the air-side and, thus, no prospect of rapidly participating in joint operations during aircraft accidents and incidents.

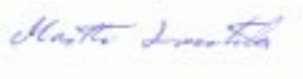
   The investigation commission recommends that Helsinki–Vantaa airport operator will establish how access to the area for all parties be guaranteed.

Helsinki 30.11.2006

Hannu Melaranta

Hannu Vartiainen

Esko Tilli



Martti Lantela

Jari Hiltunen

REFERENCES

The following reference material is filed at the Accident Board Investigation Finland (AIB):

1. The AIB decision on proceeding with an investigation
2. Reports made by licence-holders and others on the accident, damage or danger
3. Copy of the pilot's licence and a copy of the pilot's logbook
4. Transcript of pilot interviews
5. Flight training documents concerning the pilot
6. The aircraft's flight plan information and other information relevant to the flight
7. Aircraft information
8. Excerpts of the aircraft operations manual
9. Transcripts of recorded radio communications and telephone calls as well as recorded radar plots
10. Meteorological information at the time of the occurrence
11. Excerpts of the company's Operations Manual (OM), Quality Manual and of regulated company procedures
12. Excerpts of JAR regulations
13. Documents concerning alarm procedures and the rescue service
14. Maps, photos and diagrams of the accident site
15. The investigation commission's journal as well as germane correspondence, e.g. requests for statement as well as statements received.

FINAVIA
HELSINKI-VANTAA

LAUSUNTO 1 (2)

Päivämäärä 12.9.2006

Dnro 5/340/2005

Onnettomuustutkintakeskus
Hannu Melaranta
Sörnäisten rantatie 33 C
00580 HELSINKI

OTK:n lausuntopyyntö 164/5L, 8.6.2006

HELSINKI-VANTAAN LENTOASEMAN LAUSUNTO OTK:N TUTKINTASELOSTUKSEN B 2/2005 L LUONNOKSEEN

Onnettomuustutkintakeskus toteaa tutkintaselostuksessa s. 22 kohta 2.5.1: *"Lennonjohdon ilmoittaessa oletettua onnettomuuspaikkaa pelastusyksiköille, se ei käyttänyt voimassa ollutta pelastuspalveluruudukkoa onnettomuusalueen täsmentämiseksi. Pelastuspalveluruudukon käyttö olisi ohjannut pelastusyksiköt nopeammin oikeaan suuntaan."*

Helsinki-Vantaan lentoaseman lennonjohto käyttää yhteistoiminnassa pelastusyksiköiden kanssa tilanteeseen soveltuvinta määrittelyä ja ilmaisua onnettomuuspaikkaa ilmoittaessaan. Onnettomuustutkintalautakunnan toteamus voimassa olevasta pelastuspalveluruudukosta antaa ymmärtää, että se olisi nopein tapa ilmoittaa onnettomuusalue. Lentopelastuskäsikirjan osa 3 ALR toteaa: "Lähi- tai lähestymislennonjohto hälyttää lentoaseman pelastustoimen sekä ilmoittaa... 2. Onnettomuuspaikka/todennäköinen onnettomuuspaikka, sijaintitiedot paikka/pepa-ruututietona." Näkemyksemme mukaan ko. onnettomuustilanteessa ehdottomasti nopein tapa saada pelastusyksiköt oikeaan suuntaan liikkeelle, oli ilmoittaa onnettomuusalue paikkatietona eli käytetyn kiitotien suhteen ja ilmansuuntana siitä sekä selkein sanallisin paikkailmaisuin. Pelastuspalveluruudun määrittelyyn kuluu harjaantuneemmaltakin lennonjohtajalta muutama minuutti kaikkine tutkan asetuksineen ja ruudukon asetteluineen. Lähilennonjohdon käyttämä paikkatieto oli selkeä: *"...pudonnut kentän länsipuolelle kenttäalueen ulkopuolelle. Kone oli lähtenyt kiitotieltä 22L ja kaartanut oikealle. ELT lähetys tulee vanhalta sivupaloasemalta suuntaan 233 astetta."* PePa-ruudukkoa käyttäen ilmoitus olisi ollut "yhdeksäntoista otto kaksi celsius neljäkymmentäkaksi, neljäkymmentäkolme". On selvää, että oikeaan suuntaan lähteminen tapahtuu nopeammin ensimainitulla menettelyllä. Eri asia on, että jälkimmäinen saattaa olla tarkempi menettely, mutta nopeus on aivan tilanteen alussa tärkeämpi kriteeri. Etsintätehtävää helikoptereille antaessaan lennonjohto käytti koulutuksen mukaisesti maantieteellistä rajausta alueen määrittelyssä.

EFHK lennonjohdon henkilöstölle annettavassa onnettomuustilannekoulutuksessa on viime vuosina siirrytty PePa-ruudukon käytöstä WGS84-koordinaatiston käyttöön sekä katuosoitetiedon käyttöön. Tämä johtuu pelastuslaitosten toivomuksesta, koska näillä keinoilla he nykyään määrittelevät paikan myös ilmaliikenteen onnettomuustilanteissa. Alueellisen pelastustoimen ajoneuvoyksiköissä ei enää ole edes valmiutta PePa-

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APPENDIX 1 (2/2)

FINAVIA
HELSINKI-VANTAA

LAUSUNTO

Päivämäärä
12.9.2006

Dnro
5/340/2005

ruudukon käyttöön. Lennonjohdon Eurocat 2000 esitysjärjestelmä sekä Winradar ohjelma tukevat WGS84 koordinaatiston käyttöä.

Käsite voimassa oleva pelastuspalveluruudukko herättää lukijassa helposti käsityksen, että lennonjohdolla olisi velvollisuus käyttää sitä ja että muita "voimassa olevia" menetelmiä ei olisi. Lentopelastuskäsikirjan ALR osan sivut on päivätty vuodelle 1990 ja OPS osan sivut vuodelle 1982. Ilmailulaitos on vuoden 2005 lopussa määrännyt GEN osan poistettavaksi käytöstä vanhentumisen vuoksi.

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Date	6 September 2006
Pages	2 (this page included)

Comments from the Swedish CAA regarding the investigation of the accident at Helsinki-Vanta airport on 31 January 2005

After review of the investigation regarding the accident at Helsinki-Vantaa airport, the Swedish CAA has the following comments regarding recommendation 1 and recommendation 2.

Recommendation 1

The Joint Aviation Requirements, JAR-FCL, requiring training and skill test for flight at critically low airspeed including recognition of and recovery from incipient and full stalls. This is valid for both private pilot license and a commercial pilot license.
It shall include stalling:
- Clean stall and recovery with power
- Approach to stall descending turn with bank angle 20 degree, approach configuration
- Approach to stall in landing configuration

During the type rating training and skill test the applicant shall perform the following stall and recovery manoeuvres:
- Clean stall
- Approach to stall in descending turn with bank, with approach configuration and power
- Approach to stall, climbing turn with take-off flap and climb power (single engine aeroplane only).

In this case the pilot had received training and testing in "Early recognition and counter measures on approaching stall (up to activation of stall warning device) in take-off configuration (flaps in take-off position) in cruising flight configuration and in landing configuration (flaps in landing position, gear extended)"

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and in " Recovery from full stall or after activation of stall warning device in climb, cruise and approach configuration."

All type rating training has to be tailored depending of wich type of airplane the training take place. There is no simulator available for Cessna 208. All training has to be approved by the Authority.

With reference to the existing training requirements we don't see any need to add more requirements. Training for stall near the ground can be a very dangerous manoeuvre if performed in an aeroplane and not in flight simulator.

Recommendation 2

An extra audit was made at the company directly after the accident. Measures were taken to change the de-ice- and flight planning operations of the Operations Manual and Pilots Operating Handbook. A normal annual audit was made in September 2005 where changes were made to the company's personnel rehearsal training. The company received a renewed approval to operate with a national certificate. The next audit of the company will take place in the 18 September 2006.

Since the company is applying for JAR-OPS 1 the company is under special supervision and a full audit of the company and its operations is being performed by the Swedish CAA.

We thereby consider the recommendation all ready handled.

Yours sincerely,

Jacob Gramenius
Director Research, Evaluation and Analysis Department

Statens haverikommission
Swedish Accident Investigation Board

31 august 2006 INTL-01/05

Accident Investigation Board
Sörnäisten rantatie 33C
00580 Helsinki
Finland

Comments to the final draft report concerning accident involving SE-KYH at Helsinki/Vantaa 31 january 2005

In 2.2.1 and 3.1 (12) it is mentioned that the pilot executed the takeoff in violation of the POH by selecting 10 degrees of flaps.

We think it is wrong to blame the pilot for this since the OM approved by the Swedish CAA allowed this.

We can't find the information above mentioned in the factual part of the report. Maybe is would be appropriate to mention the exact wording in the OM and POH about the flap setting in the factual part.

We think that it would be better to concentrate on the fact that the approved OM was in violation with the POH.

We have no other comments on the report.

Best regards

Sakari Havbrandt

Statens haverikommission Swedish Accident Investigation Board

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