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Report RL 2001: 20e

Accident involving aircraft SE-KGH north of Ljungby/Feringe airport, G county, Sweden, on the 1st of December 2000

Case L-115/00

The report is also available on our web site: www.havkom.se

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

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

2001-07-06 L-115/00

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2001: 20e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an accident that occurred on the 1st of December 2000, north of Ljungby/Feringe airport, G county Sweden, involving an aircraft with registration SE-KGH.

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

Contents

Abbreviations

ADF Automatic Direction Finding equipment

AFIS Automatic information service for dispersal of significant information to aircraft at uncontrolled airports

BCL-C Civil Aviation Regulations– License regulations

°C Degrees Celsius

COM Communication

CRM Crew Resource Management

DA/DH Decision Altitude/Decision Height

DHB Operations Manual

DME Distance Measuring Equipment

DP Decision Point

FL Flight Level

GPS Global Positioning System

HDG Heading

hPa Hectopascal

HSI Horizontal Situation Indicator

IAL-kort Instrument Approach and Landing chart

IAS Indicated Air Speed

IFR Instrument Flight Rules

ILS Instrument Landing System

IMC Instrument Meteorological Conditions

JAA Joint Aviation Authority

JAR-FCL Joint Aviation Requirements – Flight Certifications and Licences

JAR-OPS Joint Aviation Requirements – Operations

km Kilometers

LFV Civil Aviation Administration

LLZ Localizer

m Meters

MA/MH Minimum Altitude/Minimum Height

MCC Multi Crew Co-operation

MKR Marker Radio Beacon

mph Miles Per Hour

MUST Military Intelligence & Security Service (Swedish)

NAV Navigation/Navigator

NDB Non Directional Radio Beacon

NM Nautical mile

OM Outer Marker

1/P Flying pilot

2/P Non-flying pilot

PAPI Equipment for visual glideslope indication that gives continuous information about vertical deviation from the desired glideslope during the final approach phase.

PC Proficiency check

PFT Periodic Flight Training

PIC Pilot in Command

QNH Atmospheric pressure at Mean Sea Level

RMI Radio Magnetic Indicator

RNAV Area Navigation

s Seconds

SMHI Institute of Meteorology & Hydrology (Swedish)

VHF Very High Frequency

VOR Very high frequency Omnidirectional Radiorange

VMC Visual Meteorological Conditions

UTC Universal Time Coordinated

Report RL 2001: 20e

L-115/00
Report finalized 2001-07-06

Aircraft: registration, type	**SE-KGH, Piper PA-31-350**
Class/airworthiness	Normal, valid certificate of airworthiness
Owner/Operator	Swanfly AB, Box 235, 371 24 Karlskrona / Smålandsflyg AB, Björnbärsvägen 11, 341 34 Ljungby
Date and time	1 December 2000 at time 18.57 during darkness *Note*: All times in the report refer to Swedish Standard Time = UTC + 1 hour
Place of occurrence	North of Ljungby/Feringe airport, G county, Sweden (pos 5659.28N 1357.16E, approximately 185 m above sea level)
Type of flight	Air taxi operation/Ferry flight operation
Weather	Reported weather from Ljungby/Feringe airport at approximately 18.55 hrs: wind 170°/8 knots, visibility 1,500 m, cloud cover 8/8 with the cloud base at 400 feet, QNH 1012 hPa.
Persons on board: crew	2
passengers	–
Injuries to persons	None
Damage to aircraft	Substantially damaged
Collateral damage	Damage to forest
Commander:	
Age, certificate	55 years old, Commercial Pilot's License with Instrument Rating
total flying time	9,890 hours, of which 300 hours on the type
flying hours previous 90 days	28 hours of which 7.5 hours on the type
number of landings previous 90 days	90, of which 6 on the type
Co-pilot:	
Age, certificate	24 years old, Commercial Pilot's License with Instrument Rating
total flying time	660 hours, of which 352 hours on the type
flying hours previous 90 days	79 hours, all on the type
number of landings previous 90 days	49

The Board of Accident Investigation (SHK) was notified on the 1st of December 2000 that an accident had occurred involving an aircraft with registration SE-KGH north of Ljungby/Feringe airport, G County, Sweden, on that same day at 18:57 hours.

The accident has been investigated by SHK represented by Ann-Louise Eksborg, Chairman, Monica J Wismar, Chief investigator flight operations, andHenrik Elinder, Chief technical investigator aviation.

Kristina Pollack has assisted the Board as aviation human-factor expert.

The investigation was followed by Kåre Jernling representing The Swedish Civil Aviation Administration.

Summary

On the 1st of December 2000 the two pilots were to fly from Kalmar airport to Ljungby/Feringe airport.

They departed Kalmar at 18:17 hours, with the co-pilot as the flying pilot. Upon initial contact with Feringe the AFIS-officer suggested that the pilots should use runway 19 and relayed weather information to them. After a few minutes the pilots reported that they passed the outer locator (OF) inbound and the AFIS-officer informed them that the wind was 160 degrees at 9 knots and that the high intensity approach lights were on at 100 percent.

As the aircraft descended to low altitude the pilots were not able to see the approach lights. They therefore initiated a missed approach. At the same instant a bang was heard and the aircraft contracted a substantial bank disturbance to the right. The pilots informed air traffic control that they had a serious flight control problem. They were radar vectored to Halmstad airport where they landed at 19:27 hours.

After landing it was ascertained that the aircraft had collided with trees. At the collision one meter of the right wing was torn off.

No technical fault has been found with the aircraft instrumentation or with the airport's navigation equipment.

During the investigation is has been found that several deviations from applicable routines were made during the flight and that several deficiencies existed in the company's operational routines.

There were large differences in flying experience between the two pilots and they had dissimilar methods of communication. Their age and personality differences were also contributory to the existence of misunderstanding between them.

The commander had long experience of flying but to a certain extent he utilized his own routines and procedures during flight. He also had a serious hearing impairment. The commander was, according to SHK:s judgment, not suitable to serve as commander on the actual flights. In addition, the commander was engaged as an inspector by the Civil Aviation Administration.

Deficiencies have been found concerning the Civil Aviation Administration's supervision of aviation companies and its selection of inspectors.

The causes of the accident were that;

- the commander erroneously reported that the aircraft had passed the outer locator, and reset both ADFs to the inner locator, resulting in the co-pilot's initiation of the final descent approximately one minute too early,
- during the final approach phase the pilots had inadequate monitoring of the aircraft's position and altitude,
- a misunderstanding arose between the commander and the co-pilot about who was flying the aircraft,
- the aircraft descended below minimum decision altitude and collided with trees.

Recommendations

The Swedish Civil Aviation Administration is recommended to:

- revise the routines for the supervision of smaller air traffic companies licensed to pursue operational aviation activities *(RL 2001:20e R1)*,
- revise the routines for the appointment of inspectors *(RL 2001:20e R2)*.

1 FACTUAL INFORMATION

1.1 History of the flight

On the 1st of December 2000 the two pilots were to fly from Kalmar airport to Ljungby/Feringe airport after having dropped off seven passengers in Kalmar. Two days earlier they had flown the passengers to Riga in Latvia and had waited there in order to fly them back to Sweden.

They departed runway 34 from Kalmar at 18:17 hours, with the call sign "Gordon 302" and with the first officer, herein refered to as the co-pilot, as the flying pilot. They climbed to flight level 060 (1,829 meters) on a direct course towards Feringe. Upon passage of Växjö they were cleared to descend to 2,000 feet on QNH 1013 hPa. When they approached Feringe they were handed over to Feringe AFIS. Upon initial contact with Feringe the AFIS-officer suggested that they should use runway 19 and relayed weather information to them. The wind was reported to be 170 degrees at 8 knots, the cloud base was at 400 feet with a visibility of 1,500 meters and the QNH 1012 hPa. They were requested to report passing Oskar Foxtrot outbound (OF, outer locator NDB for runway 19, ref. 1.10). After a few minutes they reported passing outbound and at that time were informed by the AFIS-officer that the wind was 160 degrees at 9 knots and were requested to report passing OF inbound. A few minutes later Gordon 302 reported "OF in". The AFIS-officer informed them that the wind was 160 degrees at 9 knots and that the high intensity approach lights were on at 100 percent. He did not, however, note the time of the reported OF passage.

As the aircraft descended to low altitude the pilots were not able to see the approach lights. They therefore initiated a missed approach. At the same instant a bang was heard and the aircraft contracted a substantial bank disturbance to the right.

Approximately one minute after the pilots reported "OF in" they made a rapid and unclear report on the frequency. It sounded somewhat like "Yes 302 new approach". The AFIS-officer requested that they remain on the frequency and asked if they wanted to proceed to Ängelholm or Halmstad instead. The Commander then responded that they wanted to go to Ängelholm. At this time they were cleared to climb to 5,000 feet on QNH 1012 hPa direct to Ängelholm and to change frequency to Malmö Control.

The co-pilot contacted Malmö Control and reported that they were 3 NM (5.5 km) south of Feringe and that they were requesting radar vectors for the shortest route to Ängelholm due to flight control problems. The air traffic controller observed on his radar screen that the aircraft echo drifted-off to the left, informed them of this and requested that they turn 30 degrees to the right. The co-pilot informed him that they had damaged the right wing. The commander related that they were forced to constantly maintain a large left rudder input, that they were in a 45-degree bank and that they were having difficulties maneuvering the aircraft. The air traffic controller alerted Ängelholm of an emergency situation for Gordon 302. A few minutes later the air traffic controller informed them that they had a distance of 40 NM (74 km) to Ängelholm. He informed them that the wind in Halmstad was 150 degrees at 6 knots, visibility 6 km in haze, cloud cover 3-4/8 with the could base at 700 feet and 5-7/8 with the base at 2,000 feet and that they were now only 23 NM (ca 43 km) from Halmstad. The crew decided to fly to Halmstad. The air traffic controller radar vectored them towards Halmstad, informed the air traffic controller in the Halmstad tower about the emergency situation and that they had 15 minutes to landing. The commander requested radar vectors for a long final, as he intended to

perform a high-speed landing. Furthermore he let it be known that he was requesting the rescue personnel's readiness. The air traffic controller vectored him for a 10 NM (18.5 km) final for an ILS runway 19. They landed at 19:27 hours and were able to taxi the aircraft to a parking stand.

After the aircraft was parked, both pilots, who were exhausted, were attended to by the airport search and rescue services. They met with a crisis management group prior to being driven home.

Subsequently is has been ascertained that the aircraft collided with trees which tore off one meter of the right wing.

The accident took place at position 5659.28N 1357.16E, approximately 185 meters above sea level.

1.2 Injuries to persons

	Crew	*Passengers*	*Other*	*Total*
Fatal	–	–	–	–
Serious injuries	–	–	–	–
Minor injuries	–	–	–	–
None	2	–	–	2
Total	2	–	–	2

1.3 Damage to aircraft

Substantial.

1.4 Collateral damage

Damage to forest.

1.5 The crew

1.5.1 The commander

The commander was 55 years old at the time and held a valid Commercial Pilot's License with an Instrument Rating.

Flying hours previous	*24 hours*	*90 days*	*Total*
All types	1.8	28	9 890
This type	1.8	7.5	300

Number of landings this type previous 90 days: 6.
Flight training on the type concluded in 1989.
Latest PC carried-out 2000-11-13 on the PA-31.

The commander served in the Swedish Air Force between the years of 1965 and 1979 as a pilot on, among other aircraft, the J 35 Dragon. Thereafter he worked at Swedair AB and flew commercial traffic on the Twin Otter and the SAAB 340 aircraft types until the mid 1980s. Subsequent to this he has had short-term employment at several smaller aviation businesses as commander where he performed both scheduled and non-scheduled traffic.

In 1989 he underwent flight instructor training and has since then trained pilots for private pilot licenses and instrument ratings. Since

January of 1999 he has also been an inspector for the Civil Aviation Administration during PC-flights.

In 1999, before being employed with a small aviation company with international missions, he initiated training with Flight Safety Atlanta on the aircraft type utilized in the company. He did not succeed in achieving adequate results and was removed from the training.

Professionally the commander was through the years considered to be proficient in handling aircraft. However points of view have been presented concerning his method of communicating and conducting himself with his surroundings as a crewmember.

The commander was employed with Smålandsflyg AB in November of 2000.

1.5.2 The Co-pilot

The co-pilot was 24 years old at the time and held a valid Commercial Pilot's License with an Instrument Rating.

Flying hours previous	*24 hours*	*90 days*	*Total*
All types	1.8	79	660
This type	1.8	79	352

Number of landings this type previous 90 days: 49.
Flight training on the type was concluded in June of 1999.
Latest PC carried-out 2000-09-03 on the PA-31.

The co-pilot underwent a commercial pilot training course in the USA during 1998. He thereafter returned to Sweden and converted his FAA certificate to a Swedish certificate in January of 1999. He continued with flight and type training at The College of Commercial Flight Training (TFHS) in Ljungbyhed, Sweden, during the summer of that same year. Thereafter he completed his studies of the Swedish D-theory (Commercial Aviation Theory Syllabus) during the fall of 1999.

The co-pilot was employed with Smålandsflyg in February of 2000.

1.6 The aircraft

THE AIRCRAFT

Manufacturer:	Piper
Type:	PA-31 Chieftain
Serial number:	31-7305007
Year of manufacture:	1973
Gross weight:	Maximum allowable 3,190 kg, actual 2,650 kg
Center of gravity:	Within allowable limits
Total flight hours:	8,841.5 hours
Number of cycles:	
Flight hours since latest periodic check:	39.3 hours
Fuel uplifted prior to the event:	Avgas 100LL
amount at time of departure:	700 liter

ENGINE

Engine manufacturer:	Textron Lycoming
Engine model:	TIO-540-J2BD/LTIO-540-J2BD

Number of engines:	2	
Engine	*Nr 1*	*Nr 2*
Total operating time (hrs.)	6,004.6	5,894.5
Time since overhaul: (hrs.)	*814.6*	*275.5*

PROPELLER

Propeller manufacturer:	Hartzell Propeller Inc.
Operating hours since latest overhaul	
Propeller 1:	1,230.3 hours
Propeller 2:	275.5 hours

The aircraft had a valid Certificate of Airworthiness.

1.7 Meteorological information

A weak high-pressure ridge covered southern Sweden with extensive areas of stratus clouds and fog.

The reported weather from Ljungby/Feringe airport at approximately 18:55 hours: wind 170°/8 knots, visibility 1,500 meters, cloud cover 8/8 with the cloud base at 400 feet, QNH 1012 hPa.

According to an analysis by SMHI of the weather in the area surrounding Ljungby/Feringe, based on readings from their automatic weather station approximately 10 km south of the airport: wind southwesterly at approximately 5 knots, visibility 1–2 km in haze, stratus cloud overcast with the base of the clouds at 100–200 feet, temperature/dewpoint +8/+7 °C, QNH approximately 1014 hPa.

An inversion existed at a height of approximately 1,000 feet with a temperature increase of about five degrees. Above the inversion the wind was southwesterly with a force of 15–20 knots.

Actual weather for Halmstad at 19:50 hours: wind 140°/7 knots, visibility 5,000 meters in haze, cloud cover 3–4/8 with the base at 700 feet, 5–7/8 with the base at 12,000 feet, temperature/dewpoint +8/+6 °C, QNH 1012 hPa.

1.8 Aids to navigation

The aircraft was equipped for instrument flight. The following instrumentation existed for navigation:

Number	*Instrument*	*Manufacturer/type*
1	VHF-com/nav	King KX-165
1	VHF-com	King KY-196
1	VOR + ILS/LLZ	King KNR-600A
1	MKR	King GKM-691
1	RNAV	Narco DME 190 TSO
2	ADF	King KDF-800
1	Encoder	Narco AR-850
1	HSI	Bendix-831A
1	GPS	Garmin 150

1.9 Communications

A transcript of the radio communications is presented in appendix 2. The Ljungby/Feringe airport voice recorder of type ASC ASN 200D lacks time registration.

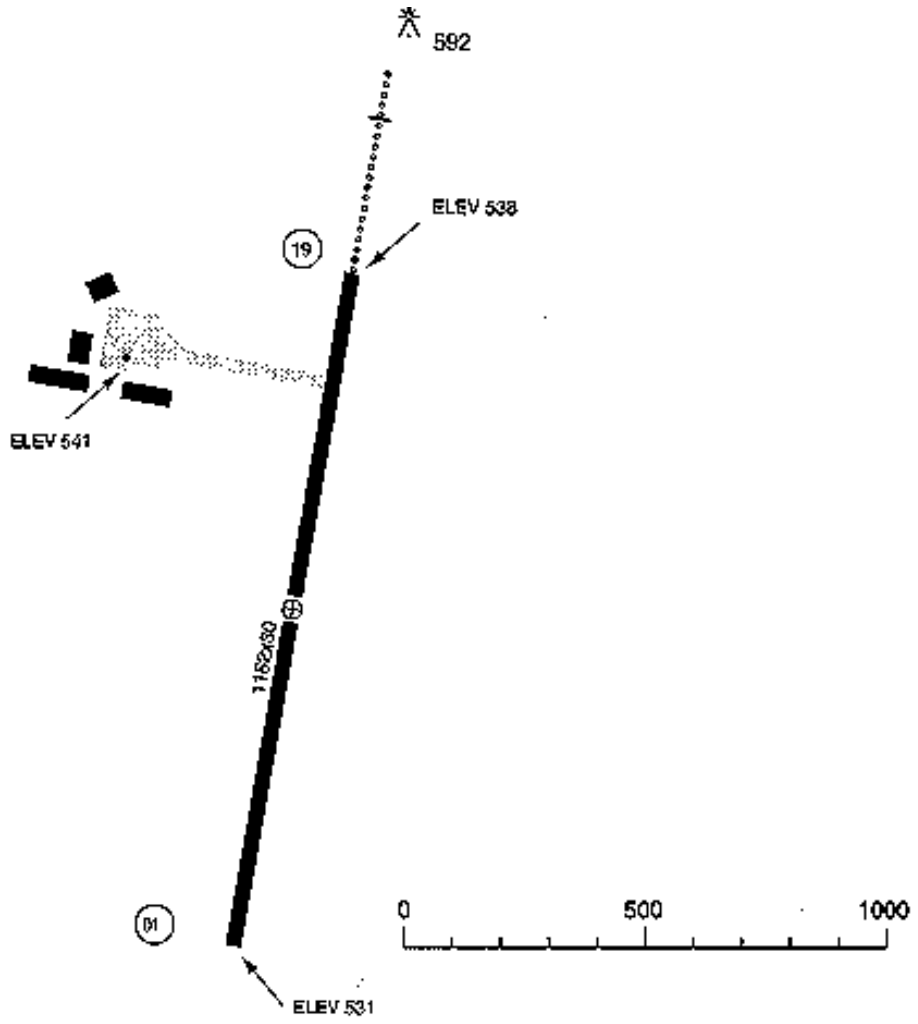
1.10 Aerodrome information

1.10.1 General

Ljungby/Feringe airport has a 1,152-meter long and 30 meter wide asphalt runway with magnetic headings of 016/196 degrees. Runway 19 is equipped with PAPI and 400 meters of approach lights prior to the runway threshold. The elevation of the runway is 538 feet (164m) above sea level.

During instrument flight with runway 19 in use one must follow an NDB-procedure, a so-called non-precision approach[1]. The runway does not have an outer marker that illuminates an outer marker light in the aircraft, a so-called OM.

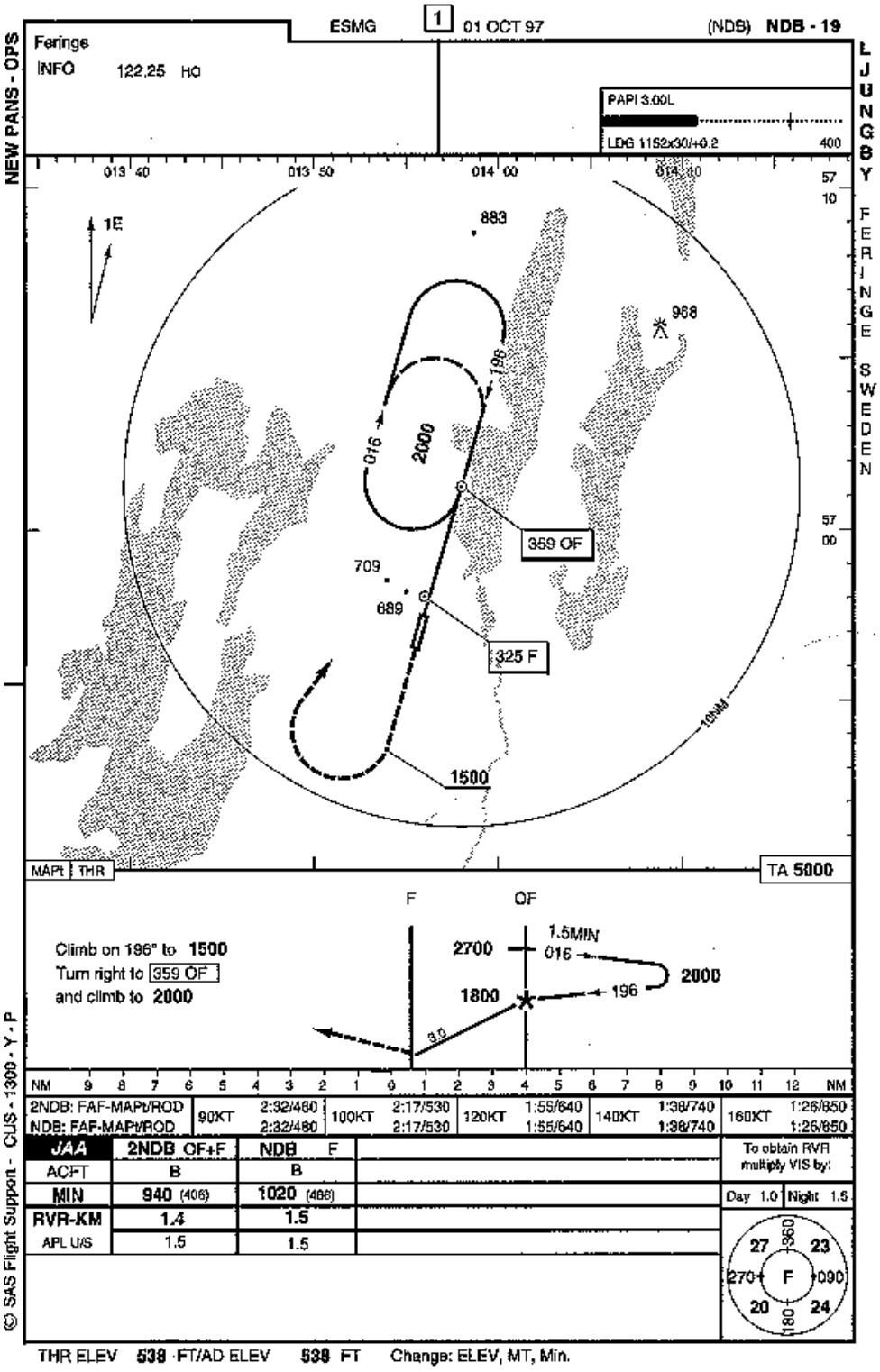
The airport is situated about 1.5 km south of the community of Vittaryd.



[1] Non-precision approach– An instrument approach that is performed with the help of navigational radio aids that only provide continuous information about the aircraft's lateral deviations from the desired approach track.

1.10.2 NDB-procedure

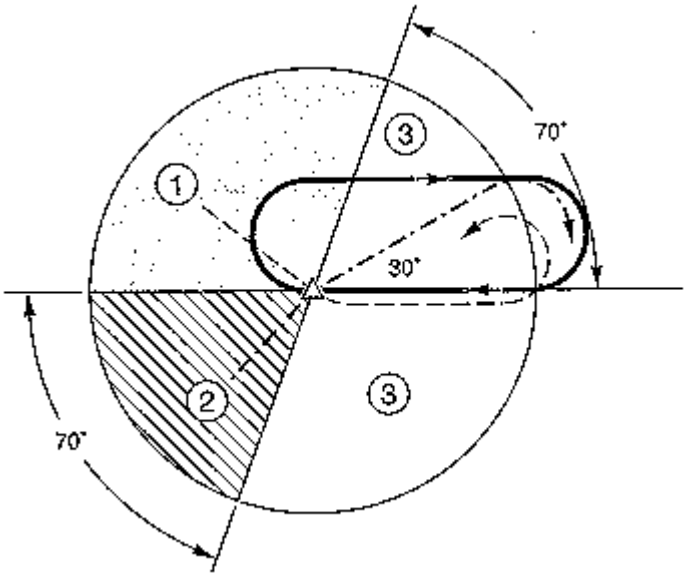
NDB procedure according to SAS-IAL-chart.



Note: The right-hand column (NDB F) should, by right, refer to NDB OF. This has been pointed out to SAS Flight Support and will be changed.

The NDB-procedure at Ljungby/Feringe involves the aircraft passing overhead OF at the lowest sector altitude. In the case in question they should have joined the procedure through a so-called offset or teardrop entry (line 2 on the figure below) at 2,400 feet. Thereafter they were to fly

on a heading of 346 degrees during 1.5 minutes, with correction for the force and direction of the wind, while descending to 2,000 feet. The inbound turn towards OF was to have been initiated after 1.5 minutes. When the aircraft was established on the inbound approach course (+/- 5°) they were to descend down to 1,800 feet until overhead OF. After passing OF a new timing was to have been initiated. Different elapsed times are applicable, depending on the speed of the aircraft during the final approach, when a missed approach is to be initiated if one does not have visual contact with the runway. In the case at hand the minimum altitude chosen was 940 feet (310 m) and the time 1 minute and 55 seconds.



When two ADFs are installed onboard the aircraft, one of these can be selected to the inner locator after outer locator passage, in this case F. By doing so the possibility is increased of obtaining an indication concerning the position of the aircraft laterally with respect to the final approach course, as now one of the needles is pointing forward and the other to the rear.

Applicable to 1,020 feet minimum:
- NDB "OF" is functioning
- One or two ADFs are selected to "OF"

Applicable to 940 feet minimum:
- Both NDBs "OF" and "F" are functioning
- Two ADFs onboard and after passage of "OF", one ADF selected to "OF" and the other selected to "F".

1.10.3 The NDB locator OF

The airport personnel have noted no indication that any failure of the NDB locator OF could have existed during the actual occasion.

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

The site of the accident was localized to an area about 3.5 km north of the airport. Pieces of the wingtip were recovered at the site but the majority of the wing section that was torn off was first found about six months later about 20 km south of the impact site. Signs of impact on spruce and pine trees, at a height of about 20 meters above the ground, were found at the accident site.

1.12.2 Aircraft wreckage

About one meter of the right wing was torn off in connection with the collision with the trees. The right-hand aileron was broken lose from its hinges but remained hanging from the wing by its supporting rod.

1.13 Medical information

1.13.1 Commander

The commander has had a known hearing impairment for several years. He was granted an exemption by LFV from the hearing standards in BCL-C as early as 1979. A follow-up by LFV has taken place on a regular basis and an extension of the exemption was last granted in the year of 1995, after an extended hearing test, with among other things, a speech audiogram, produced acceptable results.

In connection with certificate renewal, according to the new rules in JAR-FCL 3 that were introduced the 1st of January 2000, a transition has taken place to medical approval in a separate document. A so-called Medical Affidavit[2]/Medical Certificate[3] that is issued by the aviation physician directly to the pilot. For a Class 1 Medical Affidavit a special auditory examination and an audiogram are to be performed more frequently than that which is prescribed in BCL-C. According to a rule of transition, all pilots were given the entire year of 2000 to supplement their medical examinations with these special examinations.

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[2] Medical Affidavit – for national certificates, only gives the right to fly aircraft of Swedish Registry.

[3] Medical Certificate – for JAA certificates, valid in all JAA states.

The latest ear examination that the commander had was performed in 1981 and the latest audiogram in 1998.

The commander's first Medical Affidavit was issued by LFV on the 1st of August 2000 and was valid until the 20th of December 2000. On the 14th of November 2000 the commander underwent a routine aviation medical examination. The authorized examining aviation physician then extended this six months. As the ear examination and the audiogram were not current at both of these two times, the requirements were not met according to JAR-FCL, and therefore the Medical Affidavits were only of national validity.

A new examination and a new audiogram were performed on the 20th of November 2000, and the affidavits were received at LFV the 6th of December 2000. Due to an accumulation of cases the handling of this case was first begun on the 4th of February 2001. It was then noted that the earlier hearing impairment had increased substantially. A request for complementary investigation with a speech audiogram was sent to the commander on the 5th of February 2001.

The investigatory speech audiogram showed that the hearing impairment was such that the experts at LFV agreed that measures must be taken before the commander could be given continued exemption.

1.13.2 Co-pilot

The co-pilot held a Class 1 Medical Affidavit with no medical restrictions noted.

1.14 Fire

There was no fire.

1.15 Survival aspects

The aircraft was extremely close to crashing into the forest and it is doubtful if anyone onboard had survived this. After the collision with the trees it was so strenuous for the commander to fly the damaged aircraft that he experienced muscle pain for several days.

The Emergency Locator Transmitter (ELT) was not activated at the accident.

1.16 Tests and research

1.16.1 The aircraft

Prior to the collision with the trees the crew did not experience any technical fault on the aircraft. With the exception of a visual inspection of the aircraft and the resultant damage, no technical investigations have been performed except concerning the instrumentation according to the below.

1.16.2 Air data instrumentation

The aircraft was equipped with the following air data instruments:

Number	*Instrument*	*Manufacturer/type*
1	Encoding altimeter	Kollsman C4552104102
1	Altimeter	EDO-aire 1U171-003-1

2 Air speed indicator Aeromarin 549

The instruments have been functionally tested in the aircraft on the ground with the help of a Druck ADTS 405 Air data tester. During the test the static and dynamic pressure of both aircraft air data systems was simulated between 0 and 3,000 feet altitude and between 0 and 260 knots airspeed.

The test indicated that the internal friction in both altimeters was high. This resulted in a lagging behind of the altitude indication of 50 to 100 feet. The lag would be less during flight as a result of the vibrations that then exist. The actual lag during flight was therefore less than that which was measured during the testing.

Otherwise no fault or abnormality existed in the air data system.

1.16.3 The ADF-instruments

Both ADF receivers and the RMI and ADF indicators have been removed from the aircraft and inspected at an instrument workshop. During the investigation nothing was found that would indicate that any functional failure existed in the ADF system during the flight.

1.17 Organizational and management information

1.17.1 The company's structure

Smålandsflyg AB was founded in 1993 and has since operated on a permit according to BCL-Operations Regulations 2.2. The activity has mainly consisted of taxi flights. The company has had a maximum of three aircraft of type Piper PA-31 in traffic.

During a period of three years the company has worked with the implementation of the new JAR-OPS regulations and while awaiting the company's JAA approval the permit has been extended accordingly. The delay in the approval has been due in part to the existence of a high workload at LFV and in part because the documentation from the company has not been complete.

Since 1996 the company has one owner who is also the president of the company. He works actively within the business with economy, customer contacts and recruitment, and partially with training and diverse duties in connection with the flights. He also worked as an AFIS officer at Ljungby/Feringe airport. He has however another principal employer.

A full-time employee is responsible for the practical preparatory work concerning the flights, such as flight plans, acquisition of weather information, crew transportation, aircraft refueling and catering. He is also responsible for the required manuals and routine office work.

The Chief of flight operations has a part-time position since 1996 and is responsible for recruitment of pilots together with the president, crew composition, aircraft type training when required and proficiency checks concerning both theory and flying, etc.

A JAR 145-approved company in Gothenburg is responsible for the technical maintenance. This company also offers technical training when required.

At the time of the accident Smålandsflyg AB had nine pilots, four pilots in command and five co-pilots, employed by the company on a work-required basis. This means that they received payment for the days that they flew. There was no fixed schedule but notification was given 3–7 days prior to when a mission was to be flown.

1.17.2 Operational inspections

LFV has performed annual operational inspections up to and including 1997. Criticism has been directed at the operations manual, self-inspections and follow-up of how the pilots live up to stated routines.

Because of the new rules and regulations that have been implemented within Swedish aviation during the past few years, LFV has not had the resources to perform operational inspections to the extent that was intended. The critique documented during the latest operational inspection in 1997 mainly concerned changes in the operations manual. A revision of the appropriate areas was issued during February of 1998.

1.17.3 The operations manual

The operations manual is a documentation of the company's policies and work rules that is required by and must be approved by LFV. All employees must be very familiar with the contents of the operations manual.

There were ten copies of the operations manual within the company, divided among LFV and different employees of the company. Two copies were reserved for the company pilots. The operations manual that was sent to SHK for inspection after the accident was copy number 9. In this copy the page numbers, the page dates and the register of revisions were missing. The latest revision (NR. 6) was dated 1995-08-03 and was recorded on the applicable page. The organizational plan with the holders of official positions dated from 1995.

Upon inspection of a photostat of a copy belonging to LFV, it was found that this was a later edition with the latest revision as NR. 11 dated 1998-02-04. The revision informed of which pages with page numbers were to be changed. The operations manual was still lacking page numbers with the exception of those pages included in the latest revision.

1.17.4 Operational routines

The aircraft type, Piper PA-31 is certified to be flown by one pilot but the company's policy is that the aircraft shall be manned by two pilots during passenger transport, a commander and a co-pilot or two pilots in command. During flight without passengers one pilot may man the aircraft.

In Chapter 3.5 of the operations manual a description of how the two-pilot system shall be carried out is described. A few excerpts from this chapter are presented below:

3.5.1 General

"As a general rule the pilot flying i.e. the 1/P, shall concentrate his attention on the flight and give orders to the 2/P, who shall perform all instrumentation selections and switching."

3.5.2 Handling of controls

"Approach and landing – in good time prior to landing that is expected to take place during IMC with the cloud base under the sector altitude, 1/P shall give an approach briefing according to the below. During IMC with the cloud base above the sector altitude and during VMC the briefing shall include the applicable portions.

1. Intended approach procedure and runway in use.
2. Minimum sector altitude.
3. Minimum altitude over the outer marker, inbound and outbound.
4. Timing from the outer marker to the DP.

5. DA/DH or MA/MH.
6. The missed approach procedure.
7. State which "CALL OUTS" he wants (obligatory is – 100 ft above minimums, minimums and time out).

1/P handles the controls himself.

Missed approach – when 2/P has called-out "NO CONTACT", 1/P gives the order "GO AROUND" while simultaneously advancing the throttles to climb power. 2/P verifies and makes fine adjustments to the throttle setting."

3.5.3 Use of the autopilot

"The autopilot shall always be used whenever possible in order to facilitate the duties in the cockpit. When the autopilot is engaged the primary task of the 1/P is to monitor the flight and operate the autopilot. Setting and adjustment of controls and such shall be taken care of by the 2/P."

"1/P shall have his feet on the rudder pedals, one hand on the control wheel and the other hand on the throttles, during the entire approach. In order to make it possible to continue with a manual approach the 1/P shall always be prepared to disengage the autopilot."

3.5.4 Emergency situation

"If the commander is acting as 2/P he has the right to take over the roll as 1/P and subsequently give orders to the 2/P.

To avoid possible misunderstandings, standard phraseology shall be used."

3.5.5 Use of checklists and standard phrases

"When the crew consists of two pilots the following is applicable:
The fundamental principle of a two-pilot system (one pilot concentrates on flying the aircraft, while the other pilot assists him with checklist reading, instrument monitoring, radio communication and navigation) must always be complimented by the pilots monitoring of each other. This is achieved by checklist items being read distinctly by the 2/P and being acknowledged by the 1/P. Established phraseology shall be used."

"Standard phraseology

The English language shall be used in all normal and emergency procedures. The standard phrases stated in "Normal" and "Emergency Checklists" shall be used.

Change of 1/P – 2/P functions:

"YOUR CONTROLS" – an order from 1/P to 2/P to assume control of the aircraft.

"MY CONTROLS"– acknowledgement from the former 2/P that he has assumed control of the aircraft from 1/P."

"Missed approach:

1/P
"GO AROUND" – signifies that the 1/P has decided to perform a "Missed approach procedure".

2/P
"GO AROUND" – an order from 2/P to 1/P to discontinue the approach and perform a "Missed approach procedure"."

1.17.5 Recruitment

Previously the intention within the company was that a commander should have at least 1,500 flying hours and a co-pilot at least 500 hours in order to be employed. It has been written into the operations manual that a commander shall have a minimum of 900 flying hours. With the pilot turnover that takes place from this company to other larger airlines, about 30-35 pilots during a five-year period, the requirements have had to be reduced. On the average a pilot remains with the company six months.

The commander was employed on the 13th of November 2000. The chief of flight operations was previously acquainted with the commander, however, only superficially. He was aware that the pilot had a long list of qualifications, such as long flying experience, working as a flight instructor and serving as an inspector for LFV. During the flight for his proficiency check on the 13th of November 2000 the commander performed a few NDB approaches in IMC to Feringe during a period of 40 minutes. There was nothing to criticize about his flying; rather the chief of operations was impressed with the precision that the commander had during the flight.

The chief of flight operations did not consider it necessary to contact any personal references in this case with the thought in mind of the prior experience that the commander had.

Other companies have thought and acted in the same manner where this commander has been commercially engaged.

The co-pilot was employed in February 2000 through personal references from a pilot within the company.

1.17.6 Training

According to the company's routines, before new pilots may perform flights for the company, they have to undergo theoretical instruction concerning company policy, operational routines, rules and regulations and the route manual that is utilized. The company president gives this instruction. The responsible technician, if required, conducts the technical training on the aircraft type. The chief of flight operations gives the practical instructions on the aircraft and check flights. In the operations manual it is stated:
"To be approved as commander for the company the pilot shall:
- have completed approved type training according to BCL-C
- completed prescribed PFT
- completed emergency training
- completed a technical course concerning daily inspections
- completed a course of the company operations manual and other company regulations
- completed an LFV approved commander course
- and in addition have been tested in subjects deemed to be required by the chief of operations"

The commander's in-company instruction took place during a one-day self-study of the operations manual and thereafter a written test. Later that same day he performed a PC flight with the chief of operations.

The co-pilot had as well, through self-study and after a short review with the chief of operations taken a written test prior to his employment. A proficiency flight was then performed with the chief of flight operations.

Prior to his employment the co-pilot had not flown with any two-pilot system. In this respect he only had experience from his commercial pilot training.

1.18 Additional information

1.18.1 The pilots' accounts of the occurence

The commander

On Monday the 27th of November 2000 the commander received notice of the flight which was to take place two days later. The planned time of departure was 15:00 hours. Due to bad weather in Oskarshamn where the passengers were to be picked-up, it was arranged so that they were picked-up in Kalmar instead.

The commander was at the Ljungby/Feringe airport in time to prepare for the flight. The co-pilot arrived late, after the planned departure time. There was no extra time to have any briefing prior to the flight. Upon arrival at the aircraft they discovered that they did not have any approach plates for the flight and that there was no catering aboard. This irritated the commander. They departed from Feringe at 16:16 hours with the co-pilot as the flying pilot. The flight elapsed normally and they landed at Kalmar airport at 16:46 hrs.

The co-pilot fetched the passengers and they took off again at 17:45 hrs. towards Riga with the commander as the flying pilot.

The two pilots did not know each other and the commander has stated that they had different working methods. English was spoken during checklist reading and radio communication; otherwise they spoke Swedish. During the ground stop in Riga they spent some – but not all – time together.

On the 1st of December 2000 the pilots were driven out to the airport with more than enough time to plan the flight back to Kalmar. The passengers arrived during the afternoon and the aircraft departed at 15:25 hours with the commander as the pilot flying. After landing in Kalmar they telephoned Feringe and received the actual weather information. They decided to uplift a little extra fuel for the flight and to continue to Feringe and make an attempt to land. They chose Ängelholm and Halmstad as alternates should it be impossible to land at Feringe.

The co-pilot flew the airplane to Feringe. They followed the checklist routines and the co-pilot gave a briefing on the NDB approach procedure for runway 19. After passing overhead OF he flew outbound on a heading of 346 degrees for one minute and then parallel to the inbound course for 30 seconds. The commander did the timing and said to him "you fly and I look out to see the approach lights". The co-pilot answered "I fly and you look out". Then he descended down to 1,900 feet and turned inbound towards OF. During the turn inbound to OF the co-pilot transferred the controls of the aircraft over to the commander so that he (the co-pilot) could enter a coordinate on the GPS. This took only a moment and then the co-pilot took over the controls again. When they had turned inbound towards OF the commander noted that they were within 5 degrees of the inbound track, 196 degrees, and asked the co-pilot if he wanted the gear down. The speed was

approximately 140 mph. The co-pilot replied "gear down" and the commander lowered the landing gear and continued with the checklist items. The commander extended the flaps to 15 degrees and the speed decreased to approximately 130 mph. Both ADF instruments were tuned to OF and indicated that they were somewhat left of the inbound track. The commander stated this. They passed the outer locator OF and the commander also heard the aural signal from the OM and saw the blue light for the OM on the instrument panel blinking. They continued the descent to minimum altitude 940 feet. The commander started the timing and selected both ADF to the inner locator F. He looked outside a short time to see if he could catch a glimpse of the approach lights. When he looked at the ADF heading indicators again they indicated 200 degrees; the altimeter was indicating around 700 feet altitude and the vertical speed indicator showed that the aircraft was in a descent. He then simultaneously advanced both throttles to full power and rotated the nose to 10–15 degrees nose-up on the attitude indicator in order to initiate a climb. At the same instant a bang was heard and the aircraft contracted a substantial roll disturbance to the right. The commander who was now flying the aircraft was forced to apply full left aileron in order to maintain wings level flight. Thereafter he retracted the landing gear and flaps. During flap retraction they once again developed a roll tendency. During the entire flight to Halmstad the aircraft wanted to roll to the right. When they reduced power they descended and upon increasing power the roll tendency increased. The landing in Halmstad was accomplished with high speed; landing flaps were not used.

The co-pilot

Earlier in the day on the 29th of November 2000 the co-pilot had been requested to drive to Gothenburg to fetch one of the company's aircrafts and fly it to Feringe. Upon arrival at Gothenburg the weather in Feringe was below landing minimums and he was asked to drive to Feringe instead. He arrived just after the planned departure time for the taxi flight. This irritated the commander. Several misunderstandings and sources of irritation arose between the two pilots during the flight and during the ground stop in Riga. The co-pilot felt that the commander had problems in the use of the radio and the navigation instruments. He used a different phraseology during the flight than that which the co-pilot was accustomed to and they had different working methods. The co-pilot called the office from Riga and informed the president that they had experienced problems with cooperation and was told that it would be looked into when they returned to Feringe.

During takeoff from Riga, according to the co-pilot, the commander lifted the aircraft off the runway much too early, thus activating the stall warning[4]. The co-pilot pointed out to the commander that he shouldn't maintain such a nose-up attitude during the climb, which he did not bother to change.

The flight from Kalmar to Feringe proceeded largely in the manner stated by the commander with the exception of the latter part of the approach to the airport. The co-pilot performed a briefing on the approach procedure and stated that the minimum altitude that he should descend to was 940 feet. He used the GPS as an extra aid. It was selected to OF (outer locator), and indicated distance and bearing. When the commander stated that they had passed OF inbound and that he had selected both ADF s to F, which no one had mentioned earlier and which the co-pilot was not accustomed to

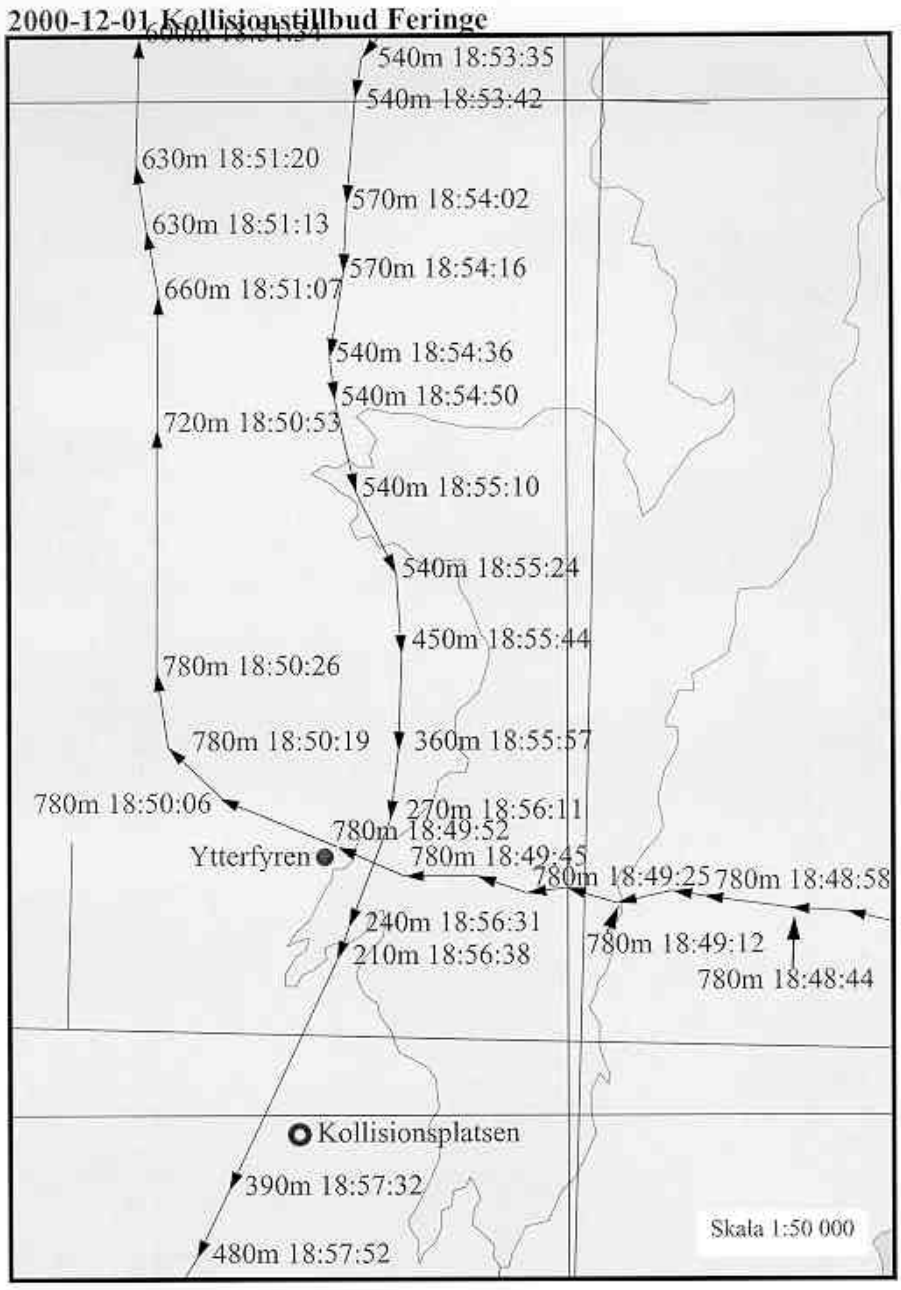
[4] stall warning – produces an aural signal to indicate that the airplane is close to the stall limit

either, the co-pilot – who had the autopilot engaged – set the vertical speed wheel to a rate of descent of approximately 400–500 feet per minute, which initially gave a descent of approximately 700–900 feet per minute. The co-pilot cannot recall that he saw an indication of OF passage on the ADF needles or the GPS. Thereafter he asked the commander to set the airport coordinates into the GPS, which was still set on OF. The commander had difficulties in inserting the coordinates, so the co-pilot said something like "take over and I will insert it instead". He thought that it would be quicker if he programmed it. He received an affirmative answer from the commander. Immediately thereafter the commander said that they were five degrees off-course to the left and asked the co-pilot to turn five degrees to the right, which he did, but simultaneously as he had the thought that it really was not he who was flying the commander applied full throttle and the sound of an impact was heard in the aircraft.

1.18.2 The radar plot

With the support of information from MUST, the flight path and altitude of the aircraft has been able to be reconstructed from the time the aircraft initiated the approach to Ljungby/Feringe. The aircraft's altitude reporting transponder signal, with an accuracy of ±50 feet (±15 m), has been used as altitude information.

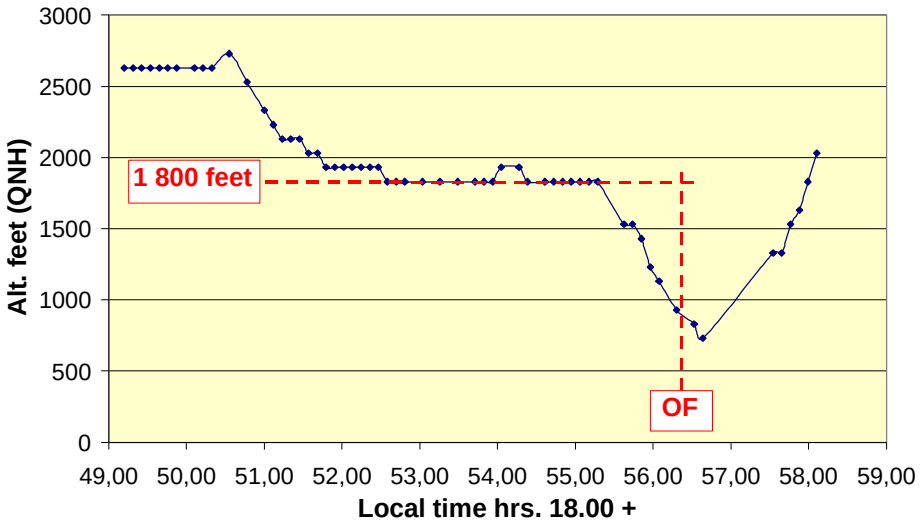
The flight path with accompanying time references for each radar echo is plotted below.



Note. Between the time points 18:56:38 and 18:57:32 the aircraft has been at such a low altitude that radar echoes have not been noted.

1.18.3 Flight altitude

Based on the information in the above radar plot the approach altitude graph below has been constructed. The x-axis depicts local time.



1.18.4 The pilots' background

Owing to the fact that the pilots have supplied contradictory information concerning what took place during the flight, SHK has obtained information about the conditions at the commander's previous places of employment.

The commander has been considered to be a "lone wolf" by colleagues and superiors of previous airline companies and has had certain difficulties with co-operation within two-pilot systems. He has had difficulties in following flying procedures during instrument flight, shown deficiencies in space conception during flight and deviated from company routines. He has had his own ideas and has gotten caught-up in his own thoughts. Taken together, this was the reason for the short duration of the employment at these companies.

The co-pilot has been described as a young ambitious pilot with a non-chalant attitude at times. He has significantly less experience of life than the commander and has in comparison to him modest experience of flying as well as of the two-pilot system.

The co-pilot has mostly flown with a commander that is a few years older than himself and the person that recommended him to the company.

1.18.5 Selection to instructor pilot training

It is evident from the documentation that the commander underwent an aviation psychology examination that is obligatory for acceptance to instructor pilot training. He was accepted in 1989. Instructors recollect that during the training he had his own ideas about the procedures. Otherwise he was a reserved person.

1.18.6 Selection of inspectors

When LFV is to appoint someone to be an inspector during check-flights for certificates or PC flights, first an assessment is made of within which areas and for which aircraft types inspectors are needed. Then, to be accepted the applicant shall have a valid certificate and qualification on the aircraft type in question. When these requirements are met LFV performs a suitability examination through the gathering of references.

As a consequence of the new rules that were introduced in 2000 (JAR-FCL) the demand for inspectors has increased from approximately 70 persons to approximately 400 persons.

The instruction takes place under the auspices of LFV during a five-day period for certificate check-flight inspectors and a two-day period for PC-inspectors.

Qualification renewal takes place every third year.

1.18.7 Personal references

The Swedish pilot corps within commercial traffic is relatively small and therefore it is not difficult to obtain personal references. Some information exists at each of the following: LFV's certificate office, inspection office, and flight operations office.

The actual commander's earlier vocational activity was known at both the inspection and the flight operations offices.

1.18.8 CRM and MCC

During investigations of accidents and incidents world-wide in the past few years, it has become more frequent to be able to point-out that inadequate co-operation and poor communication between crewmembers has been the primary or the contributory cause of the occurrence. This fact has led to a program for better crew co-operation, so-called CRM.

CRM means optimal use of the knowledge and resources that are available within the crew of an aircraft, in order that one shall achieve maximum safety, effectiveness and comfort during flight. In CRM great emphasis is placed upon communication among the crewmembers and upon how a good co-operation and a "team feeling", onboard as well as outside the aircraft, can be achieved.

Since the implementation of JAR-OPS within airlines, CRM is a requirement. All operators who are certified according to JAR-OPS shall furnish CRM training, regardless of the size of the company. The training is obligatory for new pilot recruits. Thereafter a training opportunity is due each year. Even when a co-pilot is upgraded to commander he is to have CRM training.

MCC is a requirement according to JAR-FCL and is a course that is included in commercial pilot training since JAR-FCL was implemented. Its purpose is to train pilots in co-operation with respect to flying with multi-pilot crews.

In companies with multi-pilot crews CRM becomes a natural supplement to MCC with a focus on the company's own procedures and conditions.

1.18.9 In-company training

In addition to the basic training that a pilot has for his license and qualification when he applies for employment with an operator, most companies have their own training regarding aircraft type and company routines. SHK knows from experience that the length of this training can vary from one week to five months, depending for one thing on whether a technical course and simulator training are included or not. Even if the pilot has flown the aircraft type previously a brush-up course is attended. Subsequent to the theoretical and practical training the pilot flies with the chief of flight operations or an instructor for a number of flights in active service, so-called route training, prior to him/her being scheduled with the other line pilots.

1.18.10 Approach aids at airports

Flight safety committees and civil aviation authorities around the world work with various concepts in order to improve instrument approach procedures. Non-precision approach procedures are over represented in the accident statistics. The Swedish civil aviation authority is considering the installation of precision approach aids on all landing runways at airports with a runway code of 3 or 4. This means that airports with runways of 1,200 m or longer would have an approach aid installed on all runways that even provides vertical guidance.

2 ANALYSIS

2.1 The flight

The flight under investigation appears to have elapsed normally at first without problems. Both pilots were aware that the weather at Feringe airport was marginal.

On the basis of SMHI's readings which were taken approximately 10 km south of the airport, indicating a cloud base of 100-200 feet, it can be questioned whether the cloud base at the airport wasn't lower than the 400 feet reported by the AFIS-officer.

The pilots were to perform an NDB approach to runway 19. Both ADF instruments and the GPS were set on the outer locator, OF. The pilots, however, differ in their perception concerning the sequence of events after the aircraft had passed OF at an altitude of approximately 2,600 feet and initiated the approach procedure.

The commander's recollection is that he took control of the aircraft only for a short moment in connection with the in-bound turn towards OF, so that the co-pilot could update the GPS. Thereafter the aircraft passed OF on the inbound course, which he reported to the co-pilot. At that time the altitude was 1,900 feet and he also heard the aural signal from the OM and saw the blue indicator light for the OM blinking.

The co-pilot has the conception that he first handed over the controls to the commander after he had reported OF passage and the co-pilot had reset the autopilot for descent. The reason for the control transfer at that time was that he wanted to reset the GPS from OF to the airport coordinates; something the commander had difficulties in achieving. According to the co-pilot, he thereafter never resumed control of the aircraft from the commander prior to the collision with the trees.

It is evident from the radar plot in section 1.18.2 that the aircraft performed an NDB approach to runway 19, though not so precisely, but initially with normal altitude control. The aircraft leveled-off at an altitude of 1,800 feet, which is the lowest allowable altitude for obstacle clearance prior to passage of OF. However it is clear from the altitude graph in section 1.18.3 that the aircraft initiated the final descent as early as approximately one minute before arrival overhead OF, corresponding to slightly more than 2.5 km too early.

It is improbable that the co-pilot, who did not monitor the ADF instruments himself, spontaneously initiated the descent before the commander had reported passage of OF. The subsequent descent took place with a rate of descent that is well consistent with that which the co-pilot, according to his own testimony, had selected on the autopilot.

Everything indicates that the commander, for reasons unknown, erroneously perceived that the aircraft had passed OF and reported this to the co-

pilot. No technical fault with the aircraft instrumentation or with the airport NDB equipment has been found that could explain this. The fact that the commander also has a recollection that he heard the OM signal and that the blue light for the OM blinked, which is an impossibility, as the airport does not have this type of equipment, can be interpreted as the commander beeing to a certain extent temporarily disoriented. It can also be a question of a residual lingering recollection from an earlier flight.

The commander reset both of the ADFs to the inner locator. He therewith deviated from the planned procedure that was pre-briefed by the co-pilot and even deviated from that which is customary during NDB approaches. He did not inform the co-pilot about why he did so nor state that with this setting a different minimum descent altitude was applicable, which meant that they were only allowed to descend to 1,020 feet.

The co-pilot's assertion that he wanted to have the GPS set on the airport coordinates as an extra back up for the final approach, after the presumed passage of OF, is in fact credible. To program navigational aids and to switch cockpit duties in this late stage of the approach was however directly inappropriate. Especially because the transfer of controls took place without the use of clear and correct phraseology.

In the case at hand this led to the appearance of a fatal misunderstanding between the pilots about who was flying the aircraft. Contributory to this can have been the commander's serious auditory impairment. It is therefore likely that no one was flying the aircraft when it, with the autopilot engaged, continued the descent below the predetermined minimum descent altitude of 940 feet. This is supported by the fact that the aircraft managed after all to descend down to approximately 700 feet before the commander reacted to the low altitude. Due to the fact that the aircraft was now quite far from the airport approach lights the pilots did not receive any external visual warning about the low altitude either.

Fortunate circumstances can be attributed to the fact that the commander, at this stage, observed the situation, immediately abandoned the approach and applied full engine thrust in order to climb. In spite of this the aircraft managed to descend so low that it collided with trees at an altitude of approximately 600 feet (183 m) above sea level, which indicates that the aircraft was extremely close to crashing in the forest.

The aircraft was severely damaged in the collision with the trees. Besides the powerful yaw element that must have arisen at the time of the collision, when a portion of the right wing including the aileron was torn off, the damage implied that the aircraft became aerodynamically unsymmetrical. Therefore during the continued flight the aircraft had a severe yaw and roll disturbance to the right. The commander, who had now taken over the flight, here demonstrated an example of great flying proficiency by successfully getting the damaged aircraft to climb to safe altitude and thereafter flying and landing it at an alternate airport 20 minutes after the collision with the trees.

During the flight to Halmstad the crew received good assistance from the air traffic controller at Malmö Control.

2.2 Operational routines

2.2.1 Commander recruitment and training

SHK sympathizes with the fact that it can be difficult for a small air traffic company to recruit experienced pilots. This is particularly valid with respect to pilots that are to serve as commander due to the special responsibility that this entails. This is a responsibility that often includes instructing less experienced co-pilots in a developed two-pilot system. It is moreover described in detail in the company's DHB what training the company pilots shall undergo prior to their being able to serve as commander.

Prior to the employment the chief of flight operations only knew the commander superficially. Despite this, he was allowed to fly as commander during an advanced passenger flight after only a one-day in-company training, which included a PC. The commander completed his flight training and the technical course on the aircraft type in 1989. It can be questioned whether the appointment was made in violation of the company's own instructions and indicates that they had a shortage of pilots in command and that they relied far too much upon the commander's long list of qualifications.

The investigation has shown that the commander had the need for further training, despite long flying experience, and was not suitable to serve as commander on the actual flights. If the company management had done a closer inquiry of his flying background prior to the appointment, it probably would have been clear to them that complementary instruction and extensive follow-up of his command characteristics was necessary.

2.2.2 Crew composition

The person responsible for crew composition, in this case the chief of flight operations, is expected to know his pilots in order to achieve a functioning two-pilot system. In larger airlines, where there are many pilots with differing flying backgrounds upon employment, training is provided within the company with the purpose of making everyone capable of working in a common system and having clear communications with standard phraseology in order to avoid misunderstanding. This training is the same for all new employees regardless of earlier experience. By this method one has the opportunity to discover discrepancies in behavior and routines and can correct these, or in some cases remove the pilot from the training.

In the case in question the two pilots had significant differences in flying experience and different methods of communicating. Even the difference in their ages and personalities contributed to the misunderstanding that arose between them.

2.2.3 The flight in question

Several shortcomings existed during the actual flight and deviations were made from the applicable operational rules in the company's DHB:

- The pilots did not follow applicable routines for the two-pilot system.
- The pilots did not use stipulated phraseology.
- The commander used a non-standard NDB procedure that the co-pilot was unfamiliar with.
- The NDB procedure used meant that the decision altitude was 1,020 feet instead of 940 feet.
- The pilots 'monitoring of the aircraft's position and altitude was insufficient.

– The commander lacked required knowledge of the aircraft instrumentation.
– The pilots exchanged duties during a late phase of the approach.

These circumstances disclose serious deficiencies in the operational routines of the company. It is the responsibility of the company's chief of flight operations that the company has such functional routines.

2.3 Supervisory responsibility

2.3.1 Operational inspections

LFV's inspectors have within the frame work of the authority's supervisory responsibility a comprehensive responsibility for flight safety through the inspections that they perform to determine that approved air traffic companies comply with the published technical and operational requirements.

One of the prerequisites for an air traffic company to obtain an operating license from LFV it that is has an approved flight operations manual; in this case a DHB. Such a manual shall be updated and revised according to a system that exists to ensure that its contents are correct. The manual shall also be distributed to or easily accessible for everyone within the company, as it directs and regulates all operative activity.

SHK therefore finds it remarkable that LFV as early as in conjunction with the admittance inspection (the primary operations inspection) of the company, in 1993, accepted that the company's DHB lacked a list of revisions and page numbering with revision dates. It is also strange that during regular operational inspections it was not pointed out that not all pilots had access to their own copy of the DHB and that remarks were not made about the deficiencies in the follow-up concerning the in-company training of the pilots.

2.3.2 Appointment of inspectors

It must be presumed that the inspectors that are appointed by LFV to check pilots 'theoretical and practical competence themselves possess at least equal competence, but also have a certain ability to reveal possible deficiencies concerning the judgement and psychological balance of the pilots.

As mentioned in section 1.5.1, the commander was qualified to serve as a licensed air traffic inspector during PC flights. Considering the inadequacies that were disclosed concerning both his own theoretical and practical competence for IFR flying and his shortcomings as a commander, it can be questioned whether he was suitable for this task.

SHK understands that it can be difficult for LFV to procure a sufficient number of inspectors in time to comply with the new JAR-FCL demands. At the same time, SHK would like to stress the importance of this not being allowed to lead to a decline in the demands placed on the suitability and competence of inspectors; and if such was the case, the consequences that this could entail for the safety of flight. The authorization of the commander in question can be an example of the demands being set too low.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) No technical failure has been found in the aircraft instrumentation or with the airport's navigational equipment.
d) Several deviations from applicable routines were made during the flight.
e) Several deficiencies were found in the company's operational routines.
f) The commander was not suitable to act as commander on the flight.
g) The commander had a serious hearing impairment.
h) The commander's medical affidavit was renewed for six months without the required ear examination and audiogram being accomplished.
i) Deficiencies were found concerning LFV's inspection operations.

3.2 Causes of the accident

The causes of the accident were that;

– the commander erroneously reported that the aircraft had passed the outer locator, and reset both ADFs to the inner locator, resulting in the co-pilot's initiation of the final descent approximately one minute too early,
– during the final approach phase the pilots had inadequate monitoring of the aircraft's position and altitude,
– a misunderstanding arose between the commander and the co-pilot about who was flying the aircraft,
– the aircraft descended below minimum decision altitude and collided with trees.

4 RECOMMENDATIONS

The Swedish Civil Aviation Administration is recommended to:

– revise the routines for supervision of smaller air traffic companies licensed to pursue operational aviation activities *(RL 2001:20e R1)*,
– revise the routines for the appointment of inspectors *(RL 2001:20e R2)*.