Engine damage at Helsinki-Vantaa Airport on 17th October, 2000

Micro-summary: **This A319 ingested an aluminum ladder into an engine.**

Event Date: **2000-10-17 at 1825 local**

Investigative Body: **Finland Accident Investigation Board (AIB), Finland**

Investigative Body's Web Site: **http://www.onnettomuustutkinta.fi/**

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Incident report

B 3/2000 L

Translation of the Finnish original report

Engine damage at Helsinki-Vantaa Airport on 17th October, 2000

OO-SSH
Airbus A319

Onnettomuustutkintakeskus
Centralen för undersökning av olyckor
Accident investigation board Finland

Osoite / Address: Yrjönkatu 36
FIN-00100 HELSINKI

Adress: Georgsgatan 36
00100 HELSINGFORS

Puhelin / Telefon: (09) 1825 7643
Telephone: +358 9 1825 7643

Fax: (09) 1825 7811
Fax: +358 9 1825 7811

Sähköposti: onnettomuustutkinta@om.fi tai etunimi.sukunimi@om.fi
E-post: onnettomuustutkinta@om.fi eller förnamn.släktnamn@om.fi
Email: onnettomuustutkinta@om.fi or forename.surname@om.fi

Internet: www.onnettomuustutkinta.fi

Henkilöstö / Personal / Personnel:

Johtaja / Direktör / Director	Kari Lehtola
Hallintopäällikkö / Förvaltningsdirektör / Administrative director	Pirjo Valkama-Joutsen
Osastosihteeri / Avdelningssekreterare / Assistant	Sini Järvi
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Johtava tutkija / Ledande utredare / Chief air accident investigator	Tero Lybeck
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Johtava tutkija / Ledande utredare / Chief rail accident investigator	Esko Värttiö
Erikoistutkija / Utredare / Rail accident investigator	Reijo Mynttinen
Vesiliikenneonnettomuudet / Sjöfartsolyckor / Maritime accidents	
Johtava tutkija / Ledande utredare / Chief maritime accident investigator	Martti Heikkilä
Erikoistutkija / Utredare / Maritime accident investigator	Risto Repo

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USED ABBREVIATIONS

Abbreviation:	English:
AIP	Aeronautical Information Publication
AIR	Aircraft and aviation equipment
AIS	Aeronautical Information Services
ANNEX	Annex to the convention on International Civil Aviation
ANS	Air Navigation Services Department
APIS	Aircraft Parking and Information System
ARP	Aerodrome Reference Point
ASR	Air Safety Report
BCAA	Belgium Civil Aviation Administration
ºC	Degrees Celsius (Centigrades)
CAVOK	Ceiling and Visibility OK
CFMI	Commercial Fan Motor International
CM	Centimeter
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DFO	Director of flight department
EFHK	Europe Finland Helsinki Airport
EGT	Exhaust Gas Temperature
ELEV	Elevation
FCAA	Finnish Civil Aviation Administration
FCOM	Flight Crew Operations Manual
FIDS	Flight Information Display System
FT	Feet (dimensional unit)
GND	Ground Control
H	Hour(s)
HPA	Hectopascal
HPC	High Pressure Compressor
HPT	High Pressure Turbine
HZ	Hertz (cycle per second)
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation

Abbreviation:	**English:**
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
KG	Kilogram
KM/H	Kilometers per hour
KT	Knot
LEO	Aircraft Maintenance Special Orders
LKK	Form Manual
LPC	Low Pressure Compressor
LPT	Low Pressure Turbine
M	Meter
MHZ	Megahertz
MIN	Minute
M/S	Meters per Second
N_1 %	Low Pressure Rotor Revolutions per Minute
N_2 %	High Pressure Rotor Revolutions per Minute
NOSIG	No Significant Change within 2 hours
OM-A	Operations Manual, Part A
OM-B	Operations Manual, Part B, Airbus 320 Flight Crew Operations Manual, FCOM
OM-D	Operation Manual, Part D, Training
OPS	Operations
QFGN	Qualiflyer Group Nordic
QNH	Altimeter sub-scale setting to obtain elevation from the mean sea level
S	Second(s)
SGHA	Standard Ground Handling Agreement
SN	Sabena Airline
SPM	Station Procedure Manual
STIDI	Station Information Display
STM	Station Manual

Abbreviation:	**English:**
TFIR	Technical Flight Incident Report
TOM	Training Operation Manual, OM-D
TPM	Technical Procedure Manual
TWR	Tower
UTC	Co-ordinated Universal Time

SYNOPSIS

On Tuesday October 17th 2000 at approximately 18.25 local Finnish time an incident occurred at the apron of Helsinki Vantaa Airport on aircraft stand number 25. The scheduled passenger flight SN2337 from Brussels to Helsinki, operated by N.V. Sabena S.A. aircraft Airbus A319 with register OO-SSH and call sign Sabena 42L had a severe damage to its left engine. Aluminum stepladder left at the aircraft stand, within the engine inlet danger area was sucked into engine at final parking phase of the aircraft. The maintenance stepladder was destroyed and the engine was severely damaged but no other damage occurred in connection with the incident. There were a total of 62 passengers on board and five crew members.

Accident Investigation Board Finland nominated on October 18th 2000 according to its letter of appointment Troubleshooting coordinator, Mr Heikki Tenhovuori to conduct the initial investigation on the incident.

Accident Investigation Board appointed through its decision, Number B 3/2000 L an investigation commission to conduct an investigation as a result of the occurrence. Upon his consent, Mr Heikki Tenhovuori was nominated as chairman of the investigation commission and Major (ret), Mr Vesa Palm as a member.

Belgium Civil Aviation Administration (BCAA) notified on October 23rd 2000, that they will not nominate an accredited representative for the investigation. Both Finland and Belgium belong to Joint Aviation Authority, JAA.

Accident Investigation Board and Sabena Airline agreed upon that the investigation commission would receive all relevant information in reference to investigation through the contact person appointed by Sabena. The initially acting contact person was Technical Pilot of A320-fleet and as of November 13th 2000 Flight Safety Officer of the company.

Investigation was initiated on October 17th 2000 immediately after the incident. During the investigation the hearings of 25 people were completed between October 17th 2000 thru January 15th 2001. First Officer onboard the incident aircraft did not appear at the hearing on December 2nd 2000 due to the fact that he was requested in for active flight duty on his free day. He was not interviewed later on, as the investigation commission did not find the hearing of the First Officer necessary.

The investigation commission requested 21 days after the occurrence on November 7th 2000 the contact person of Sabena to produce the recording of the cockpit voice recorder concerning the incident flight for investigation. The reply was not received until February 12th 2001. The investigation commission was informed that the recording was no longer available, as Sabena Flight Operation had assumed it being of no significance to the investigation.

An intermediate information letter to both involved parties as well as the Finnish and Belgium Civil Aviation Authorities was issued on November 15th 2000.

The investigation commission obtained on March 20th 2001 via E-mail in return the confirmation of the previously forwarded hearing record of Commander of the incident flight. Investigators received via mail a formal signed record on the April 12th 2001.

Sabena delivered the investigation commission on April 12th 2001 the borescope inspection report completed by Commercial Fan Motor International (CFMI) concerning the inspection of the damaged engine.

Draft of the Investigation Report was forwarded on August 3th 2001, according to the Decree of Accident Investigation number 79/1996 to Finnish Civil Aviation Authority for statement and Belgium Civil Aviation Authority, N.V. Sabena S.A. and Finnair Inc. to familiarize themselves with the report. Sabena S.A. did not respond and Finnair Inc. didn't have anything to comment about. Statements were obtained in return by September 22nd 2001 and are partly acknowledged in this Investigation Report.

Translation in made by Ms Susanna Halonen.

The investigation was completed on October 25th 2001

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Events at Helsinki Vantaa Airport prior the engine damage

When Helsinki line station unit of Finnair observed in August 2000 that the condition of the Zarges manufactured maintenance stepladders used by the unit was becoming poor the technical department ordered two new type of maintenance stepladders to be tested prior new acquiring. Stepladders were to be operated on the ramp during maintenance and ground service of the aircraft. Manufacturer of the A-type aluminum stepladders is Suomi Tikas Inc. The height of the stepladders is 205 cm, the width is 50cm and the horizontal dimensions when expanded are at the bottom 103 cm and at the top part 47cm. The stepladder weighs 14.5 kg.

The test stepladders were slightly differently equipped. One of the stepladders had wheels and the other one not. They were positioned in maintenance vehicles S-44 and S-55 of Finnair Helsinki line station. The previous maintenance stepladders of the vehicles were removed to the depot to be used as spare stepladders. When commencing the test use a notification to inform the technical personnel at Helsinki line station was placed on their notice board. Users were also requested to provide feedback on the performance of the stepladders to the initiator of the test use. The stepladders were experienced to be heavy and complex when operated. This is also likely to be the reason why the stepladder had been removed from vehicle S-44 and replaced with the Zarges stepladder. Difficulties experienced in connection with test use of the test stepladders were never reported according to the instructions in the Finnair Aircraft Maintenance Special Order (LEO). Based on the experience provided by the users, tools and equipment mechanic was to get the maintenance stepladders from the maintenance vehicles after approximately a week of commencement of the test use and forward them to the manufacturer for modification. At that time he noticed the stepladders without wheels had disappeared from vehicle S-44. The missing stepladder was being searched for in all company maintenance vehicles, but the stepladder was not being located. The location of the maintenance stepladders being test used remains unknown for a period of approximately 2 months. The stepladder has for certain been observed on the morning of October 17th 2000 at the Helsinki-Vantaa Airport aircraft stand number 25. According to ground personnel the stepladder was observed at the apron folded in an A-position underneath the end of the passenger bridge outside the safety rail. No one did remove the stepladder away from the location as it was assumed that the stepladder was intended for common use by ground personnel.

The Operations Control personnel, working on three shifts, at Helsinki-Vantaa Airport of the CAA, perform the allocation of the stand positions and passenger bridges 8-12 in advance for individual aircraft. On day of incident a change to the allocation plan was made at 18.09 Finnish time by the personnel at the operations control due to other traffic requirements. The Operations Control personnel kept a logbook of the actual parking

situation, and in addition the information was also fed into the electronic Flight Information Display System (FIDS) at the airport. Finnair maintains a comparable function for its own air traffic movements, Station Information Display (STIDI). At the time of occurrence the two information systems could not make use of each other's information automatically, but the Finnair operations control contact person working in addition at the CAA Operations Control updated the STIDI display system manually. Airport staff as well as various airline and other subcontractor employees participating in flight operations received information in a timely fashion on air traffic departure and arrival times, information on passengers and dead load as well as other relevant ground service information sufficiently through the various display systems at the airport.

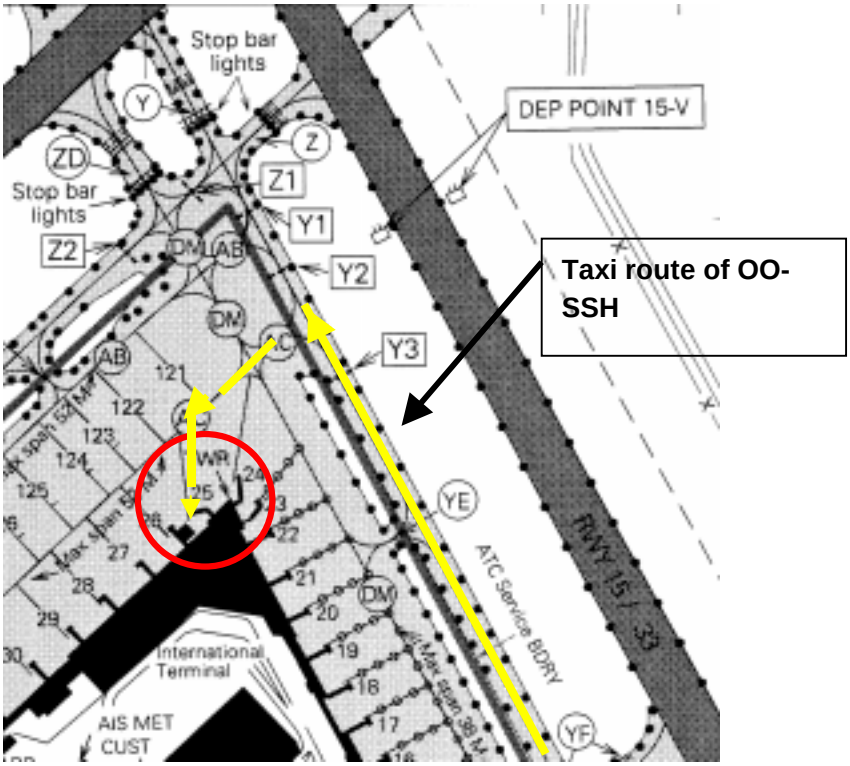
Aircraft stand number 25 had been used by four different aircraft on October 17th 2000. The last aircraft that had between 16.45-17.40 local time used the parking position was a British Airways B757-200. Finnair was responsible for the ground handling of the aircraft. The loading group (RAMP group) uses a RAMP vehicle that is not equipped with a stepladder. The RAMP group had used the technical departments aluminum test stepladder located at the parking position to attach and detach the external power source to the aircraft. The maintenance stepladder causing the engine damage was used on this aircraft when attaching and detaching the external power source. After detaching the external power source from the aircraft the RAMP foreman had removed the stepladder temporarily away from the aircraft positioning it next to the protective fence of the passenger bridge at the apron. After completing the push back procedures for the departing aircraft he forgot to remove the stepladder from the apron. Finnair Station Procedures Manual, SPM chapter 2.9 *Loading,* section 2.9.5.35 obligates the RAMP foreman to assure that all unnecessary ground service equipment that have been used during the unloading and loading phase of the aircraft is being removed away from aircraft. The same procedure is also stated in the Finnish issued manual under chapter 6.1 Skillful Service Manual, section 1. *Departing Flight*, subsection 1.2 *The Loading of an Aircraft:* "Any additional ground service equipment used by the loading group shall be removed away from the aircraft early enough" and in addition, that; "Assure that the push-back area is free of any ground service and other equipment". The company's Station Manual, STM and the unofficial training manuals used for ground personnel does not state the above mentioned job definitions.

1.1.2 The events in connection to the engine damage

Airbus A319 of Sabena Airline, with registration OO-SSH originating from Brussels landed Helsinki Airport October 17th 2000 on runway 15 at 18.19 local time. The aircraft was 11 minutes ahead of scheduled arrival time. This was the first flight leg for the crewmembers on the day of the incident. After stopover the aircraft was scheduled to fly back to Brussels via Geneva.

The cockpit crew was not at anytime during the flight in contact via radio with the company representative responsible for ground handling at Helsinki-Vantaa, and was therefore not advised in prior of the parking position. After landing the flight was cleared by the Ground Control (GND) of Helsinki-Vantaa Tower (TWR) to taxi to aircraft stand number 25. There was nothing abnormal in the phase of taxing. The parking position

number 25 is located immediately connected to the north corner of the Helsinki-Vantaa Airport building, and is equipped with a passenger bridge as well as with Aircraft Parking and Information System, APIS.



Picture 1. The Helsinki-Vantaa Airport general arrangements at the apron area and the taxing route of OO-SSH to aircraft stand number 25, where the engine incident occurred

As a result of the beginning darkness commander used taxi lights during the taxing. The weather conditions were good and taxing portion of the flight was characterized as routine and overall considered non-problematic for the cock pit crew. Due to the apron being lightened the commander turned off the taxi light arriving final approach line of the parking position and used there after the turn-off light. According to the commander observation of obstacles was complicated in artificial lighting on apron due to similar coloring (gray) effects and lighting shadows of the ramp equipment and the buildings. Neither obstacles nor buildings are equipped with distinctive painting or adhesive tape which improves the perceptivity.

Parking to aircraft stand was performed by following the docking guidance lights (Aircraft Parking and Information System, APIS) after the green traffic light at the end of the passenger bridge had been turned on for the aircraft. After noticing the green light commander assumed that the parking position is available, clean and free from obstacles for aircraft to park. Commander concentrated on APIS and followed the system as it started

displaying the distance in reference to the related stop position for the aircraft. According to the commander APIS system functioned properly, and none of the cockpit crew members did during the parking phase observe the aluminum maintenance stepladder. Taxi speed during parking was normal, and the system did not indicate the SLOW/DOWN command for cockpit crew. Commander decelerated the taxi speed with wheel brakes and by maintaining both engines at ground idle.

Commander stopped the aircraft as the APIS guidance light displayed the STOP command. Due to the commander's reactionary delay aircraft stopped approximately 85 cm after the systems indicating stop position and approximately 20 cm left of the centerline of the parking line. Even though the stopping was significantly delayed, the aircraft did not proceed to the area where guidance command TOO/FAR would have been displayed. Aircraft stopped within the acceptable parking area and aircraft door opened into the passenger bridge more or less normally, even though pushed against the cushioned front edge part of the bridge. The aircraft did not have to be repositioned with the assist of a pushback vehicle. Distance between the left engine and the passenger bridge and its safety rail was 170 cm. Distance between the fuselage and the front part of the passenger bridge was 155cm.

Simultaneously, when aircraft stopped by the passenger bridge, cockpit crew sensed an abnormally strong vibration and noise. Through the air conditioning system a strange smell was transmitted to cockpit. Crew recognized the vibration and noise originating from the left side of aircraft. Commander turned off the left engine 13 seconds after aircraft had come to a stop after which the loud noise and vibration ended. As indicated by eyewitnesses abnormal smoke was seen coming out from the damaged engine.

Finnair performed the ground handling for Sabena according to handling agreement between N.V Sabena S.A. and Finnair. Responsible RAMP group assigned for the meeting and the sending of aircraft, and unloading and loading activities was ordered to meet Sabena flight SN2337 at aircraft stand number 27. The RAMP group consisted of a RAMP foreman, three RAMP men and one special vehicle driver. They were prepared to use the technical departments maintenance stepladder in the loading activities, as stepladders is not a part of ordinary equipment in RAMP vehicles. Approximately 10 minutes before arrival of the aircraft operations control of Helsinki-Vantaa Airport changed the stand to number 25 due to other parking arrangements. Upon receiving information of changed position the RAMP group proceeded to stand number 25. There is no established minimum time frame for last minute changes of parking positions to assure that ground personnel have sufficient time to prepare for arrival of the aircraft (directives and procedures of the manager of Helsinki ground services, LAPOM 7/98 job description of parking planner, section 2. FIDS system updates).

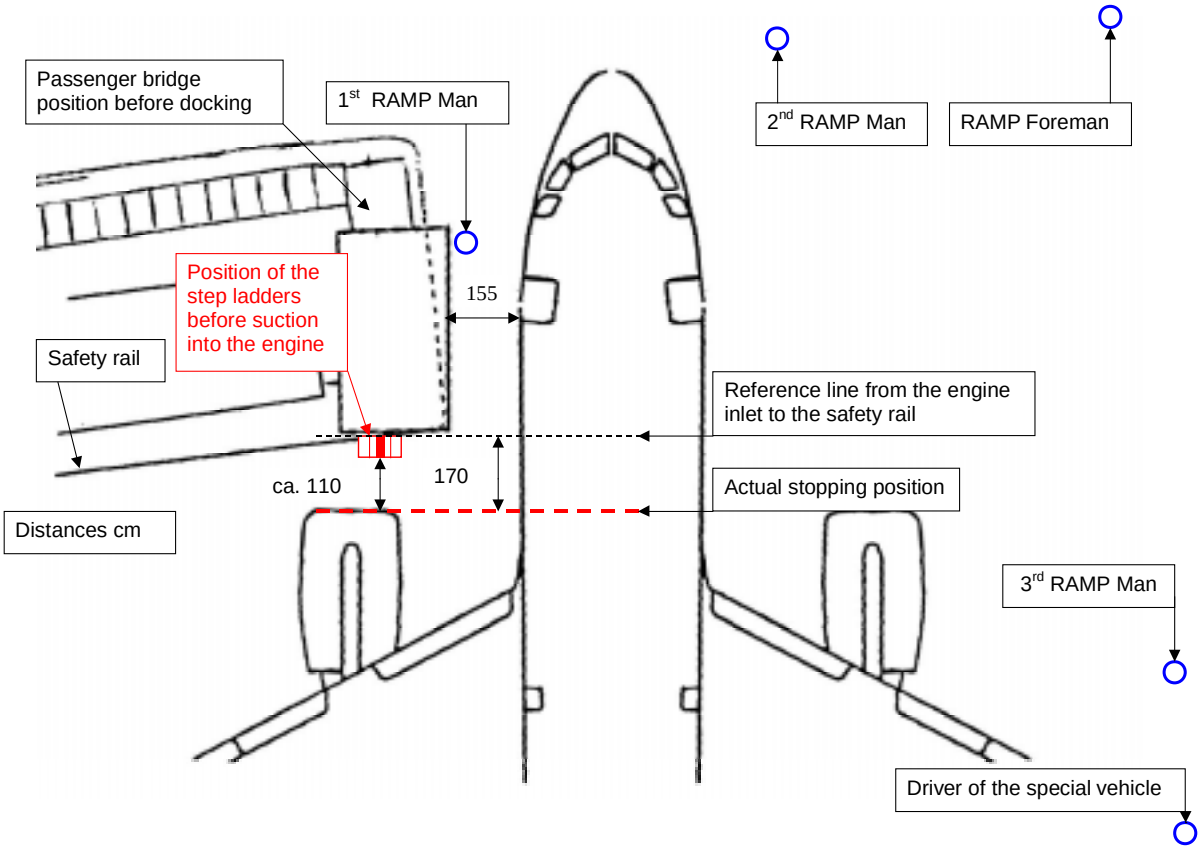
The information of stand change was not known by all members of the RAMP group assigned to meet aircraft at the time when aircraft already was taxing at taxiway Yankee (Y) towards stand number 25. Upon notification of stand change RAMP foreman brought part of his group by car to stand number 25 and returned to stand number 27 to get all necessary ground service equipment needed. The RAMP personnel were positioned at the apron when Sabena Airbus A319 taxied on its final approach line at stand number

25. According to the SPM of Finnair chapter 6.1 Skillful Service Manual, section 6.1.6.2 Loading, subsection 2. *Arriving aircraft*, subsection 2.1 *Preparation* RAMP foreman should have ensured that the RAMP group meeting the arriving aircraft should have been positioned and prepared at stand five minutes before Sabena flight SN2337 arrived. In addition it is required both in Finnair's STM and SPM that RAMP foreman shall examine that the apron area is free of ground service equipment and other obstacles prior arrival of the aircraft to the stand. In this case he did not inspect the apron area of the parking position at all. According to remaining members of the RAMP group the work tasks did not become more complicated due to change of aircraft stand and they had sufficient time to move to new location even though information of changed aircraft stand was received quite late.

First Ramp man in the group preparing for attaching external power unit positioned on the left hand side of aircraft arriving to the stand had approximately 1 minute in order to make observations of arrangements at the apron area. He observed wrongly positioned maintenance stepladder just before aircraft had come to a complete stop at the stand. Aircraft stand is equipped with an emergency stop switch in connection with the APIS system operated at apron, however first RAMP man had at that time no realistic possibility to prevent the engine damage to occur. He had not been instructed to operate the emergency stop switch.

Also second RAMP man positioned on the right hand side of aircraft preparing to install the wheel chocks observed the maintenance stepladder next to safety rail, but too late. He observed them in an upright position in front of left engine and could see the upper part leaning towards the engine and get sucked into it. Parts of the stepladder flew from the front part of the engine and sparkles and smoke appeared from the rear end.

RAMP foreman was according to his report at the time of incident in his vehicle on his way from stand number 27 somewhere by stand number 26 when he heard a noise and observed some loose obstacles flying underneath the body of the Sabena A319 and towards the wall of airport terminal. He was located on the other side of aircraft, from where there was no direct eye contact to the coverage area of left engine. Third RAMP man who was driving baggage carts was positioned for arrival of the aircraft at right hand side almost on level with the wing tip slightly in front of it, so he did not note anything additional at apron and not what took place at the time of occurrence. He only could observe the occurrence by hearing it, as he was not able to see to the left side of aircraft. Special vehicle's driver was at the time of occurrence positioned also on right hand side of the aircraft almost on level with the wing tip slightly behind the trailing edge and was not able to see the inlet danger area of left engine. Before aircraft arrived to the stand, the driver had an open view to apron, but according to his report he did not notice anything additional due to darkness. At the time of occurrence he only noticed the appearance of a sparking jet and smoke from the rear part of left engine. At same time there was some sort of a howl, after which the engine was shut down.



Picture 2. The parking of OO-SSH and the positions of RAMP group member's prior the maintenance stepladder is sucked into left engine of the aircraft

Finnair gate service person preparing for aircraft arrival to come to park adjusted the APIS system and set Airbus A319 information inside the passenger bridge accordingly and secured that maneuver part of the bridge was in correct position. After this she selected traffic signal to green located at the end of the bridge according to the given instructions. Confirmation of the apron area being free and clean of obstacles and communication with RAMP group is not part of the gate service person's duties. According to the gate service person it is not possible to view entire aircraft stand from the bridge so she did not know whether the RAMP group assigned to meet the aircraft was at the location or not. After a while she observed Sabena aircraft approaching the stand normally. She noticed, that the aircraft moved slightly after STOP command of APIS system was displayed. When aircraft had come to a stop she operated the passenger bridge out to its position by aircraft door. Simultaneously she heard loud noises from apron.

The weight and balance agent meeting arriving aircraft was at the time of incident outside the airport terminal on her way to the spiral stairs to the passenger bridge. The inlet danger area of the left engine of aircraft was not at her visual range, as she was still in a blind angle of the supporting structure of the passenger bridge. She had not seen the maintenance stepladder, but heard at the time of incident a loud abnormal noise and observed pieces of the stepladder flying towards airport terminal at the location she had been a moment before.

Picture 3. Simulated situation of the position of maintenance stepladder prior to damage

In connection with the engine damage staff working at the offices in the airport terminal could hear an abnormal loud noise from the direction of aircraft stand number 25 where Sabena A319 was parked. They observed the maintenance stepladder partly being sucked into the air intake of left engine. According to the opinion of most eyewitnesses in the office the maintenance stepladder was without impediment between safety rail and engine right next to the rail.

There were no extraordinary evacuation measures taken to disembark the passengers from the aircraft, they proceeded to airport terminal according to normal routines through the passenger bridge.

The damages occurred to the engine were significant. The engine had to be replaced in Helsinki prior commencing the ferry flight to Brussels.

1.2 Injuries to persons

No injuries.

1.3 Damage to aircraft

1.3.1 Aircraft

No damages.

1.3.2 Engines

Right engine

No damages.

Left engine

Ram air inlet case of the engine was damaged in various areas and sensor located in the ram air inlet which measures the temperature of air flow into the engine was destroyed. Fan blades and guide vanes of the bypass chamber had plenty of dents.

Sealing material by the compressor blades was damaged in several places, and the fan rotor did not rotate due to parts of the stepladder being in between blades and sealing material.

Picture 4. A general photo of the damaged engines air inlet and the parts of the maintenance stepladder in it

Engine change group dispatched by Sabena to Helsinki removed the damaged engine with the assist of Finnair Aircraft Maintenance after preliminary investigation. It was forwarded to the manufacturer (Commercial Fan Motor, CFMI) in France for a more detailed investigation.

Engine manufacturer CFMI performed a borescope inspection on the damaged engine S/N 779943 in France on December 7th 2000. Following findings were recorded:

Fan

Several fan blades were shingled and in addition 35 impacts, which were not within acceptable range. The fan is not serviceable.

Low Pressure Compressor, LPC

There were deposit in all five stages and one dent, but all blades are serviceable.

High Pressure Compressor, HPC

There were deposit in all nine stages. There are several dents in the blades of stages 1, 5, 6 and 7 but all blades are serviceable.

Combustion case

There were discoloration in the inner and outer shroud of the annular combustion case, but combustion case is serviceable.

High Pressure Turbine, HPT

The shroud, nozzle and blades are serviceable.

Low Pressure Turbine, LPT

The nozzle, rotor and stator were not damaged, but the blades had three dents.

Summary

The fan blade is not serviceable and the high pressure compressor had very important deposit.

The low and high pressure compressor, combustion case as well as the high and low pressure turbine are serviceable.

1.4 Other damage

The stepladder causing the engine damage was destroyed and unusable.

Picture 5. The destroyed stepladder in front of the damaged engine (the stepladder has been removed away from its original position where the damage occurred)

1.5 Personnel information

1.5.1 Cockpit crew

Commander of aircraft

Gender and age:	Male, 43 years	
License:	Airline transport pilot license number 114087, valid until March 24th 2001	
Ratings:	Instrument rating CAT III September 10th 2000	
Type qualifications:	B737-200 – 500	1980
	FA-22	1981-1982
	DC-10	1986-1990
	BA-46	1991
	A319-321	1999

Periodical training:	Line check December 27th 1999, valid for 1 year
	Operator proficiency test September 10th 2000, valid for 6 months
	Refresher ground September 10th 2000, valid for 6 months
	Difference training (A319), November 2nd 1999.

Commander of aircraft has obtained his basic education in Belgium year 1978. He commenced his employment with Sabena on March 31st 1980, when he was hired as first officer on the B737-aircraft type. Year 1986 he moved over to DC-10-aircraft type as first officer, where he remained until the year of 1990. He has been working as commander for Sabena as of year 1992 on B-737-300-aircraft and on Airbus A320-aircraft as of year 1999 in other words for approximately a year.

In addition to his duties on Sabena he also has flown as a flight officer and commander on FA-22 and BA-46 type of aircraft and as a commander the past four years for Sobelair, a subsidiary company of Sabena.

Flight Experience	*Last 24 hours*	*Last 30 days*	*Last 90 days*	*Total Experience*
All types	2 h 30min	24 h 50min	134 h 30min	12 537 h 55min
Type Concerned	2 h 30min	24 h 50min	134 h 30min	444 h 15min

The flight training for the commander of aircraft is in accordance with the given regulations and he is an experienced pilot.

First officer of aircraft

Gender and age:	Male, 27 years
License:	Airline transport pilot license number 116502, valid until June 10th 2001
Ratings:	Instrument rating CAT III, October 11th 2000
Type qualifications:	A319-321
Periodical training:	Line check September 17th 2000, valid for 1 year
	Operator proficiency test September 10th 2000, valid for 195 days
	Refresher ground September 10th 2000, valid for 6 months
	Difference Course (A319), November 2nd 1999.

Flight Experience	*Last 24 hours*	*Last 30 days*	*Last 90 days*	*Total Experience*
All types	2 h 30min	54 h 08min	136 h 34min	791 h 28min
Type Concerned	2 h 30min	54 h 08min	136 h 34min	512 h 52min

The flight training of first officer is in accordance with given regulations.

1.5.2 Ground personnel

Gate service person

Gender and age: Female, 25 years

Duty: Passenger bridge operation and other gate service duties

Training according to duties: Gate service initial training, December 8th 1998

Gate service initial training part B, April 12th 1999

Gate service recurrent training, January 1st 2000.

Training that the gate service person has received and which is required for the duty has been in accordance with the Finnair Training Operations Manual (TOM) as well as the Station Manual (STM) and is considered being sufficient. The performance of the gate service person has not had any impact on the damage.

The person in question has had training as well as the license provided by Finnair to operate on the passenger bridge. Training and liability for operating passenger bridges shifted from Finnair to Helsinki-Vantaa Airport year 1995. The airport intensified training year 2000 and requested to receive relevant training records of the gate service persons that Finnair has educated. Due to misunderstanding when transforming records, the training records of the person concerned were not transferred to the knowledge of the training organization of the airport. Consequently Helsinki-Vantaa Airport had not provided refresher training to the person concerned during year 2000 prior to damage. Therefore she has not undertaken the test as required by airport in order to have the license to operate the passenger bridges. The gate service person has undertaken and passed the test approvingly after incident.

Passenger bridge operation by the gate service person in connection with missing refresher training for operating it and lack of undertaking the test did not have an impact on the damage occurrence.

Load Control Officer

Gender and age:	Female, 33 years
Duty:	Weight and balance calculations
Training according to duties:	Load control initial training, March 22nd 1999
	Load control initial practice, March 22nd 1999
	Load control initial day of evaluations, April 26th 1999
	Load control difference training, November 25th 1999
	RAMP agent initial training, January 10th 2000.

Training is considered being according to Finnair TOM and STM and considered sufficient for the duty being performed. The person discharging her duties has had no influence on occurrence of the damage.

RAMP foreman of the RAMP group on the preceding flight prior the damage

Gender and age:	Male, 25 years
Duty:	RAMP foreman
Training according to duties:	RAMP handling initial training, March 1997
	RAMP foreman initial training, September 13th 1999
	RAMP foreman difference training, April 13th 2000
	RAMP handling difference training, March 5th 2000
	RAMP handling difference training, April 26th 2000
	Emergency initial training/RAMP foreman, June 7th 2000.

The RAMP group on incident flight SN2337

RAMP foreman

Gender and age:	Male, 54 years
Duty:	RAMP foreman
Training according to duties:	RAMP handling initial training, January 1971
	RAMP foreman initial training, January 1973
	RAMP foreman brush up training, February 24th 1997
	RAMP foremen training day, December 9th 1997
	RAMP foreman recurrent training, December 16th 1999

	Emergency initial training/RAMP foreman, June 2nd 2000
	RAMP foreman difference training, June 21st 2000
	RAMP foreman difference training, August 24th 2000.

Training received by the RAMP foremen is in accordance with the Finnair Training Manual TOM and Station Manual STM. The training records for RAMP handling initial training and the RAMP foremen initial training are lacking due completion dates.

First RAMP man

Gender and age:	Male, 34 years
Duty:	To attach the external ground power source after the aircraft has stopped and to assist the remaining RAMP group with other loading tasks
Training according to duties:	RAMP handling initial training, March 22nd 1999.

Second RAMP man

Gender and age :	Male, 32 years
Duty:	To install the wheel blocks after the aircraft has stopped and to assist the remaining RAMP group with other ramp tasks
Training according to duties:	RAMP man initial training, September 1989
	RAMP handling recurrent training, March 1st 1999.

Third RAMP man

Gender and age:	Male, 30 years
Duty:	To deliver the loading carts for passenger baggage to the aircraft when it has come to a complete stop and to assist the remaining RAMP group with other ramp tasks.
Training according to duties:	RAMP handling initial training, July 1993
	RAMP handling recurrent training, November 24th 1999.

Training given to the RAMP men has been in accordance with the Finnair training manual TOM and the Station Manual STM. Training records of RAMP handling initial training and RAMP man initial training are lacking due completion dates.

Special vehicle driver

Gender and age:	Male, 40 years
Duty:	To transfer the baggage conveyor belt to the aircraft after parking
Training according to duties:	Ground service equipment (GSE) recurrent training, October 12th 1998
	GSE initial training, December 12th 1998.

1.6 Aircraft information

1.6.1 The aircraft

Type and model:	A320 FAM, A319-112
Registration:	OO-SSH
Manufacturer:	Airbus Industries
Owner:	Kreditanstalt fur Wiederaufbau, KFW
Operator:	Sabena Airline
Maximum take-off weight:	68 000 kg
Serial number:	1184
Year of manufacture:	2000
Flying hours:	1520
Landings:	1157

1.6.2 The Engine

Type and model:	CFM56-5B6/P2 DAC
Manufacturer:	Commercial Fan Motor, CFM International
Owner:	Kreditanstalt fűr Wiederaufbau, KFW
Operator:	Sabena
Serial Number:	779943
Year of manufacture:	2000
Flying hours:	1528
Take-offs:	1157

1.7 Meteorological information

Weather conditions at Helsinki Airport (EFHK) on October 17th 2000 at 18.20 local time (UTC+3h) were: wind direction 120° and speed 8 knots (kt), visibility 10 km or more and no clouds below 1500 meters (CAVOK), temperature +10 °C and dew point +6 °C, barometric pressure (QNH) 1027 hPA, no significant weather change expected within two hours (NOSIG).

According to Finnish Aeronautical Information Publication (AIP) GEN 2.7, section 3. *The sun rise/sunset table,* the sun sets at Helsinki level at the time of incident approximately at 15.08 UTC. Complete darkness without artificial lightning in the evening in question has occurred at the time of approximately 15.51 UTC. Yearly deviations from the average year are within few minutes.

At the time of occurrence the apron of Helsinki-Vantaa Airport was lighted and lighting equipment was in order.

1.8 Aids to navigation

The aids to navigation had no impact on the progress of occurrence.

1.9 Communications

The investigation commission examined operational frequency 121,80 MHz recording of Ground Control (GND) of Helsinki-Vantaa Airport Tower (TWR) for radio communication pertaining the portion of the incident flight on October 17th 2000.

Sabena flight SN2337 was cleared by GND after landing at 18.19 local time for air craft stand number 25 according to normal procedures. Call sign of the flights was Sabena 42 L. TWR did not give any limitations to parking or any other operational part for the damaged aircraft.

The radio communication between TWR and aircraft was relatively speedy; but both air traffic controller and cockpit crew understood each other well.

According to commander of aircraft no radio communication was carried out with company representative at Helsinki-Vantaa.

Radio communication did not have any impact on the damage occurrence.

1.10 Aerodrome information

The ICAO code for Helsinki-Vantaa Airport is EFHK (Europe Finland Helsinki).

The airport is located according to Aerodrome Reference Point (ARP) at N60° 19’ 02” and E024° 57’ 48” . The average altitude from sea level is 51 m/167 FT.

Aircraft landed on runway 15, which is 2901 m long, 60 m wide and covered with asphalt. The average altitude from the sea level is 59 m (163 FT).

Aircraft stand number 25 is located by the airport terminal according to picture 1. and is equipped with a passenger bridge as well as APIS system. There was no surveillance camera system at the stand at the time of occurrence.

Most important information and arrangements of the airport is published for pilots thru the Aeronautical Information Publication (AIP) and in addition foreign pilots receive comparable information in for instance the Jeppesen Route Manual. The Aeronautical Information Services of Air Navigation Services Department of FCAA informs changes in Finnish AIP to foreign route manual editors.

Helsinki-Vantaa airport has a 24-hour per day operative Flight Information Display System (FIDS), which supports the managing of flights and information in reference to their movements, directs and maintains the passenger display system and transmits information to the airports internal and external systems. With the assist of this system for instance airline and ground service companies attains vital information in reference to air traffic schedules, the flow and possible irregularities. Station services unit of the airport updates information into the system.

The surveillance and reporting system of passenger bridges is being enhanced by FCAA by installing a computer based movement control system (Timecon) into bridges. In addition FCAA develops the surveillance of aircraft stands by installing a camera systems to passenger bridges and open out stands.

1.11 Flight recorders

Flight data recorder (FDR)

Aircraft was equipped with a digital flight data recorder (DFDR) manufactured by Allied Signal.

Type:	SSFDR (Solid State Flight Data Recorder).
Serial number:	980-4700-003.

Investigation commission requested on October 18th 2000 Finnair Aircraft Maintenance to decode the data in DFDR. The data recorded in the device was decoded without removing it from the aircraft. Due to DFDR software of avionics office of technical group of the company, the data was transferred into a readable format and was forwarded for use by investigation commission.

Cockpit voice recorder (CVR)

The aircraft was equipped with a cockpit voice recorder manufactured by Allied Signal.

Type: SSCVR (Solid State Cockpit Voice Recorder).

Serial number: 980-6022-001.

Investigation commission did not exploit the recorded information from the device immediately after the damage had occurred. Sabena was requested to produce the recordings to the Committee for investigation 21 days after occurrence on November 7th 2000. However they did not do so, as Sabena Flight Operation had assumed the recording being non-significant for the investigation. The recording had not been preserved.

OM-A of Sabena chapter 2.1 *Supervision by the Operator,* section 2.1.5.5 *Flight Recorder Records* obligates, that following an incident that requires mandatory reporting or whenever Authority so directs, the company shall preserve relevant original recordings of the flight recorder for the period of 60 days or for the time as directed by the Authority. In the Note section the company is obligated to produce to the Authority within a reasonable time after request any recording made by flight recorder which is available or has been preserved. The use of flight recorders in the company is based on JAR-OPS 1 chapter 1.160 *Prevention, Production and Use of Flight Recorder Records.* The company has not operated according to its operations manual.

OM-A chapter 11.6 *Guidelines for Crew in case of Accident or Serious Incident* states, "Remember to stop the cockpit voice recorder immediately after landing, in event of an accident/incident, to avoid automatic erasure that would otherwise occur". In addition the section states, “Do NOT stop the CVR in flight. Do not erase the CVR after a noticeable accident/incident.”

Even though commander of aircraft logged the incident occurrence in the logbook of aircraft and also filed out an internal company report, Technical Flight Incident Report (TFIR), Sabena organization did not preserve the records for investigation. The company directives requires to do so.

1.12 Wreckage and impact information

The damage occurred at aircraft stand number 25 by safety rail of the fixed passenger bridge at airside of the airport. The area, where the aluminum stepladder was left behind, is classified as a engine inlet danger area of this aircraft type when engines are operating at ground idle. The A319 engines inlet danger area is 2.2 m according to Airbus type manual. This stand does not have an acceptable place of storage or rack for the maintenance stepladder, like the stands number 27 to 33 have. The storage rack for the wheel chocks is a loose rack placed on safety rail, which was mounted outside the rail right within the inlet danger area of the damaged engine. It is also possible to mount the rack inside the rail. The airport operator has not instructed before the incident, where the maintenance and loading material for aircraft should be stored. According to infor-

mation that the investigation commission has received it is common to store often on the stands the stepladders that are used for attaching and detaching the external ground power for wide body aircraft. Also safety cones to be used to show extreme extensions of the aircraft and push-pull rods for moving the aircraft are stored in stand vicinity.

Biggest parts of the stepladder ejected out forward from intake opening towards the terminal. Some parts had also ejected under the aircraft body. Biggest part of the stepladder ejected weighted approximately 1.7 kg. Small metallic parts had ejected behind the engine through the fan duct spreading around to a distance of approximately 40-50 m as far as to the maintenance lane at apron.

The measurements were performed at site of the incident concerning the aircraft's actual parking position as well as preliminary estimates of damage before moving the aircraft. The position of the aircraft on the stand was approximately 20 cm left to the guidance line on the ground parallel with the fuselage, and approximately 85 cm past the STOP sign given by the APIS signal. However the aircraft did not reach TOO/FAR area of the APIS system. The distance from inlet leading edge of left engine to safety rail of the passenger bridge and the side wall of passenger bridge was 170 cm. The distance between fuselage and front edge of the passenger bridge was 155 cm.

Parts of the metallic stepladder ejecting forwards from engine did not cause damage or injuries towards the surrounding buildings, aircraft body or humans on the stand.

1.13 Medical and pathological information

The Airport Police unit performed immediately after occurrence an alcometer test on commander and first officer of the aircraft as well as on the gate service person who operated the passenger bridge. None of the tested persons were at the time of occurrence under the influence of alcohol.

No other medical examinations were performed.

1.14 Fire

There was no fire on the site.

According to an eyewitness's observation abnormal smoke appeared out of the engine when the stepladder was sucked into engine. When noticing that the person in question prepared for the use of fire extinguisher.

1.15 Survival aspects

Forward passenger door of aircraft could be opened up inside the passenger bridge nearly as normal, even though commander of aircraft did not stop the aircraft immediately after the APIS-command STOP-sign had illuminated. Disembarkation of passengers from aircraft was carried out normally through the forward passenger door.

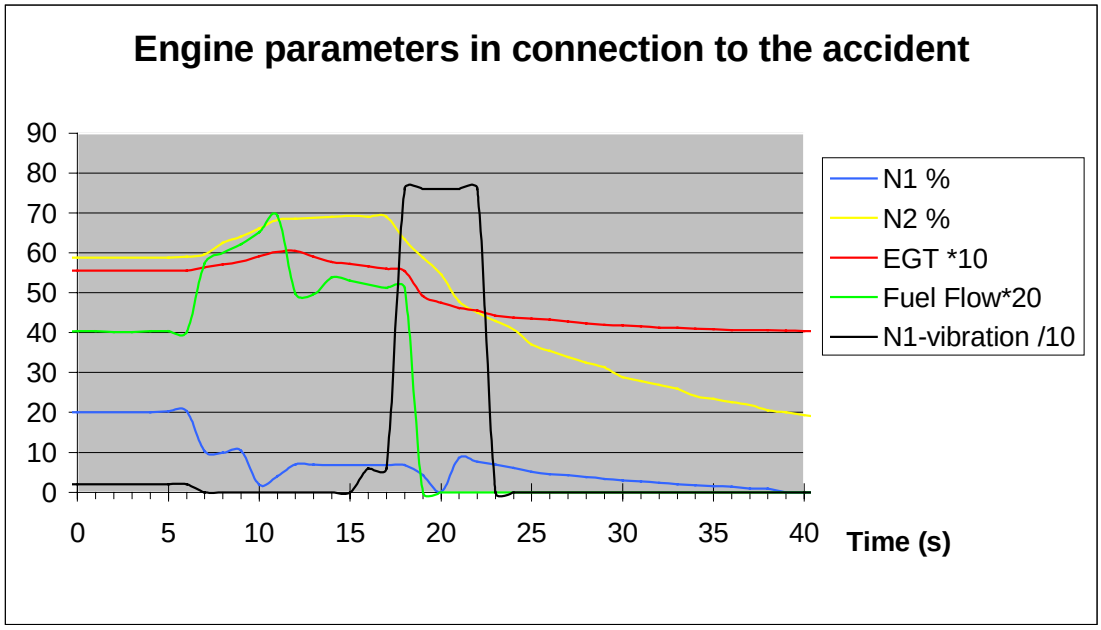
No rescue or evacuation procedures were required.

1.16 Test and research

1.16.1 Operation of the engine

The diagram enclosed contains relevant engine parameters recorded into the DFDR starting from final portion of the taxing approximately five seconds prior initiation of the damage. The power setting of engines was at minimum ground idle. When the stepladder was sucked against fan blades mechanical friction reduced N_1 revolutions (blue graph), where at the engine's automatic power governor increased fuel flow (green graph) to maintain selected N_1 power setting. Simultaneously N_2 revolutions (yellow graph) and the exhaust gas temperature (EGT, red graph) increased.

The thrust of engine is created mainly by the fan. Therefore the power increased in the engine core did probably not add the forward directed thrust. There is no definite explanation to the high vibration value of N_1 rotor presented in diagram (black dotted graph).

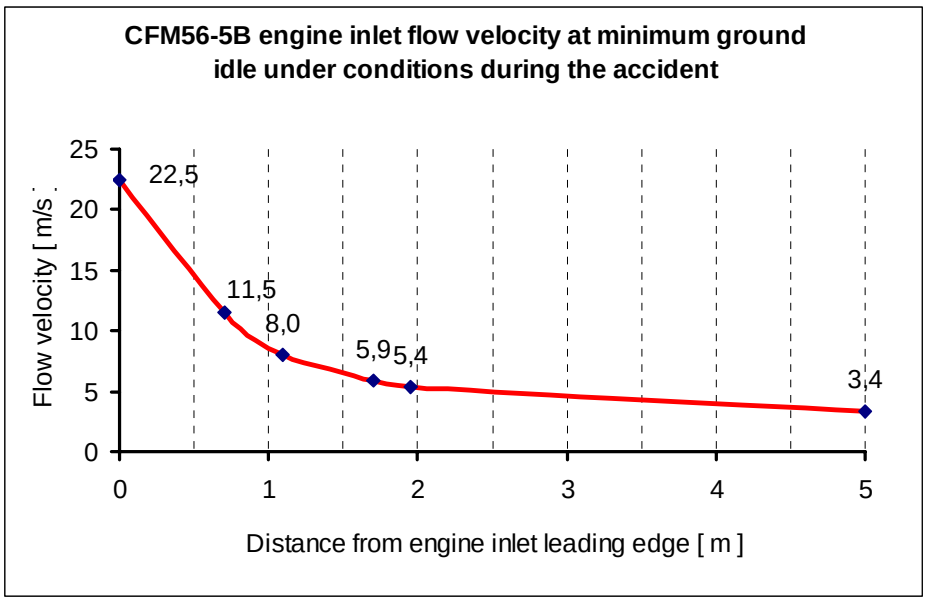


Picture 6. The flight recorder data of relevant engine parameters at time of occurrence

CFMI has defined a semicircular area in front of engine as a inlet danger area at ground idle. The diameter is 2.2 m.

The speed of airflow accelerates in this area significantly when distance reduces. The speed of airflow just in front of the leading edge of inlet opening is approximately 22.5 m/s (81 km/h) and at the edges of the area at a distance of 2.2 m approximately 5 m/s (18km/h).

The enclosed table based on information provided by the engine manufacturer shows the speed of airflow at various distances from leading edge of the engine inlet opening.



Picture 7. The speed of air flow of engine CFM56-5B

1.16.2 Operation of the Aircraft Parking and Information System (APIS)

Sabena A319 was parked on the aircraft stand by means of Aircraft Parking and Information System (APIS). Aviation regulation AGA M3-5 (Airport area planning) issued by Flight Safety Authority of Civil Aviation Administration regulates that minimum clearance between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects for the size of A319 type is 4.5 meters. Despite that the Aircraft Parking and Information System allows aircraft to park clearly closer in a manner demonstrated below.

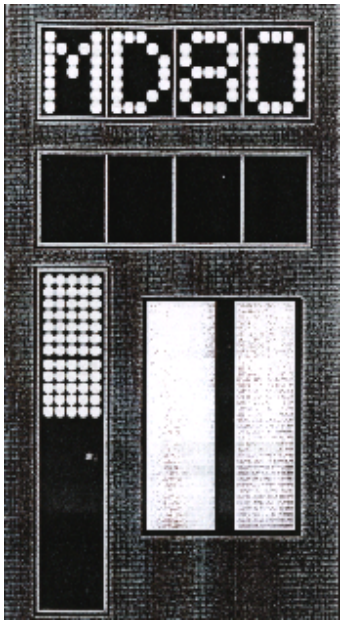
APIS system is designed to give the commander fast, simple and reliable guidance to park aircraft next to passenger bridge. The system consists of the guidance display positioned in front of aircraft, measuring unit and manually used operating panel located inside passenger bridge. The measuring unit operates through a laser beam, which is harmless for humans. The beam is aligned horizontally parallel with the approach line just above the windshield of an aircraft towards the centerline of the body considering all different aircraft types. The accuracy of the measuring unit for the distance portion within the area of parking position is ±10 cm and sideways 0,15-0,3°. The system can measure the distance and the side angle of aircraft from a distance of 5-100 m from measuring unit. The measuring unit can define the position of approaching aircraft in proportion to centerline and distance from the stop position. The guidance display, which provides the

commander with all relevant information for parking, is located in the front of aircraft close to measuring unit, normally attached to the airport terminal.

Gate service person meeting the aircraft activates the system through the operation panel inside the passenger bridge after she/he has assured bridge being completely inside position. After activation the system completes a approximately 30 seconds self test, at which time the guidance display illuminates STOP/TEST display.

After approved testing and passenger bridge being driven completely inside position the top line of the display shows the chosen aircraft type as a flashing display. When aircraft is in a distance of 21 meters from STOP position the display indicating the aircraft type changes to a solid display. It is also possible to choose the passenger bridge number on the display, which however disappears from display, when the measuring unit has sensed the aircraft at a distance of 32 meters from the STOP position.

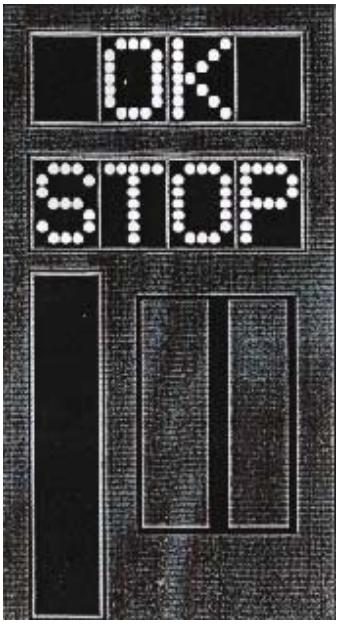
If taxing speed of aircraft approaching the parking position exceeds 3 m/s at a distance of 21 m from stop position, APIS display will alternate with a SLOW/DOWN display. In this investigated case the aircraft approached parking position within the permitted speed.



Picture 8. APIS display, when aircraft type MD80 selected into the system is on the parking centerline within a distance of 6.61-7.19 meters from the stop position

Vertical line on the display shows the position of aircraft in proportion to the approach line. If aircraft deviates from the centerline, the guiding line changes to a arrow shaped double line indicating which direction (left or right) the aircraft should be steered to regain the approach line.

The thermometer on left side of the display indicates the distance of aircraft in proportion to parking position. At a distance of 16.2 m from the STOP position the thermometer starts to decrease from bottom upwards so that every horizontal row represents 60 cm of distance towards the approach line. At end of the taxing, when only one horizontal row is displayed, the distance to STOP position is between 59 cm and one cm. When last block has disappeared from the display the STOP command will appear. When aircraft has been stopped within the approved area, an OK display will illuminate above the STOP command.



Picture 9. APIS display, when aircraft is within the correct parking area according to the system

If taxing continues beyond the approved area, STOP sign will be altered with TOO/FAR display. There is a possibility of not being able to operate the passenger bridge, until aircraft has been pushed back with a pushback vehicle. At this kind of circumstances the engines of narrow-body aircraft equipped with wing engines come dangerously close to fixed structures, for example the distance of A319 is at the most approximately 70 cm.

The system consist also of two emergency stop switches, where one is located inside the passenger bridge in connection with the operation panel and the other being located outside to be used on the ground.

It is possible to show on the display many additional warnings or other flight related information, such as arrival and departure times.

Investigation commission examined immediately after the damage October 17th 2000 the function of the APIS system and measured comparable distances concerning STOP

command. Distances in parking performed on Airbus A319 compared to the passenger bridge and its protective rail varied a little in the measurements on October 24th-25th and on December 2nd 2000. Range of change was from 238 to 255 cm. Deviation of the distances depends among other things of the approach speed as well as the reaction rate of cockpit crew when braking as STOP command is illuminated. Cockpit crew is striving to stop the aircraft as softly as possible, in order to prevent passengers that possibly already are standing up in the cabin from falling or getting injured.

Electrical engineering of Civil Aviation Administration performed an inspection on the APIS system on October 18th 2000 by completing an equipment and walk test according to instructions of the manufacturer. Based on the results the system operated flawlessly. APIS system at aircraft stand number 25 has had only two malfunctions. The emergency stop switch on ground had been stuck on January 8th 2000 and on May 30th 2000 the system had illuminated constantly STOP/ERRX. For this reason the system was out of order for some time. Both malfunctions were fixed soon after discovering them.

1.17 Organizational and management information

1.17.1 Sabena

The operation of N.V. Sabena S.A's subsidiary Sabena Airline is directed by Belgian Civil Aviation Authorities (BCAA) approved accountable manager, who has directly as subordinates the post holders of ground operations, flight operations and technical operations. The company has a quality system according to JAR-OPS 1. Information mentioned in this investigation report in reference to the company is mainly based on June 15th 2000 revised Operational Manual (OM-A) of Sabena.

Flight Department

Director of flight operations (DFO) approved by Belgian Civil Aviation Authority directs and is responsible for Sabena flight operations. Flight co-ordination department reports directly to DFO, where flight support manager is among other things responsible for analyzing airports.

Sabena OM-A's chapter 8.1.2 *Criteria for Determining the Usability of Airports* defines, that fleet managers shall evaluate together with flight department the airport infrastructure and the usability by aircraft type considering the operating conditions. One criteria for ground services is, whether the airport has passenger bridge parking or not. Final approval on the usability of a certain airport will be given by DFO. According to OM-A of Sabena the airport is adequate as stated above and in addition among other things, if there is published information of the airport in the Jeppesen route manual and if there is appropriate handling and passenger facilities available.

Jeppesen route manual presents limitations of airport information concerning Helsinki-Vantaa Airport of taxing procedures at the parallel taxiways in map number 10-9B. The map number 10-9E presents instructions how to use visual docking guidance system. The information in the manual is based on the information presented in AIP. AIP does

not include information, that stands equipped with passenger bridges at Helsinki-Vantaa Airport do not fulfil the clearance distance according to aviation regulations of FCAA and that APIS system guides the parking narrow-bodied wing engine aircraft too close to fixed structures on aircraft stands equipped with passenger bridges. Sabena has decided to use Helsinki-Vantaa Airport according to information available.

Ground Operations Department

Ground operations manager approved by Belgian Civil Aviation Authority directs ground operations department of Sabena. When making ground handling agreements his/her duty is primarily focus on flight safety aspects.

The duty of the station manager is to act as a representative for the company at line stations and he/she shall assure safety of the aircraft and punctuality of flights on his/her behalf. Furthermore it is his/her duty to take all necessary measures, in case of operation anomalies or incidents, in order to minimize consequences of such events, both operation and economics. In addition he/she shall monitor the quality of the ground handling agent and if deemed necessary complain to handling company and report the matter to company headquarters. It is also the duty of station manager to visit airport authorities on a regular basis.

N.V Sabena S.A. and Finnair Inc. have agreed, that Finnair is responsible for both loading and gate services of Sabena in Finland. The agreement is based on the Standard Ground Handling Agreement (SGHA) instructed by the International Air Transport Association (IATA). The agreement is divided into main agreement as well as appendixes A and B. Validity of the agreement was from April 1st 1997 to March 31st 2000, but it was also valid at time of occurrence, as none of the parties had given a notice of termination on the agreement. According to information the investigation commission received by Finnair renewal of the agreement has been under preparation after the occurrence.

Qualiflyer Group Nordic Finland (QFGN Finland) operates for Sabena amongst other as a quality controller and caretaker considering the performance of Finnair. The duty of QFGN Finland is to acknowledge and assure that also quality standards of safety and ground service activities are fulfilled. QFGN also monitors, that employees of the ground handling subcontractors are properly trained. In addition the duty of QFGN Finland is to assure close contact with ground handling company, airport management as well as relevant authorities and act in co-operation on behalf of airlines represented.

In the opinion of investigation commission ground handling services within responsibility of Sabena in Helsinki has been handled adequately according to valid agreements and regulations.

1.17.2 Finnair

Ground Operations Department

Finnair station services reports to commercial director of the company, who reports directly to chief executive officer of Finnair. The commercial director is the Post Holder Ground Operations approved by Civil Aviation Authority. More accurately station services report to ground service sector directed by Ground Operations Manager. The ground service sector is divided into six units, whereas one is Helsinki Airport. Station manager assisted by a deputy and a system support and development manager, directs Helsinki Airport operations. Customer service manager, ground service manager and resource control manager reports to station manager. Airport gate service persons and ramp personnel belong in this unit.

Planning and service managers report to customer service manager and are responsible for gate, check-in and aircraft handling activities. Direct managers for gate service persons are gate service managers.

Planning managers and supervisors responsible for baggage hall, loading and ground equipment activities report to station manager. Ramp foremen report directly to the supervisors of loading activities.

Ramp operations instructions

Operations Manual-Part A, OM-A

FCAA approved in English issued Finnair Operations Manual–Part A, OM-A chapter 8.2 *Ground Handling Instructions* section 8.2.2.23 *Positioning of ground support equipment (GSE)* states, that all staff operating GSE and persons supervising its handling are responsible for following: " At arrival of an aircraft it must be assured that all GSE is positioned behind the marked safety line prior to the aircraft arriving at the parking position."

Chapter 2. *Operational Control and Supervision* in the manual emphasizes, that OM-A is an FCAA approved highest priority manual and that instructions in the manual overrules instructions in all other manuals. JAR-OPS 1 post holders approved by FCAA such as manager technical operations and manager ground operations are hereby obligated to follow up that manuals within their branch are up to date.

According to the Joint Aviation Regulations, JAR-OPS 1 of European Joint Aviation Administration (JAA) concerning commercial air transportation, subpart B *General,* section 1.025 *Common language* states, that operator must ensure that all operations personnel are able to understand the language in OM-A which pertain their duties and responsibilities are written. In the same aviation regulation subpart P *Manuals, logs and records* article 1.1040 *General rules for Operations Manuals* states, that unless otherwise approved by the Authority, or prescribed by national law, an operator must prepare the operations manual in English. In addition, an operator may translate and use the manual or parts thereof into another language.

OM-A chapter 5. *Qualification Requirements for Other Operations Personnel* states for the part of language proficiency the requirement for ground service personnel, that the person shall have sufficient knowledge of English language as relevant to his duties. However it is commonly known, that the knowledge of language of all personnel in the branch does not necessary meet the level of current requirement.

In the opinion of investigation commission personnel participating in ground handling operations should have access to their own job descriptions and responsibilities in the Finnish language at least for parts that cover flight safety. This thought is supported by the discussions with personnel participating in Finnair ground handling operations and training of the branch.

Station Manual (STM)

The purpose of the Station Manual is to ensure safe and smooth handling of Finnair aircraft and passengers at all stations operated by Finnair.

The manual provides general guidelines and functions as source of information for procedures, practices and company policies covering the entire personnel engaged in aircraft and passengers handling. The manual is issued entirely in English.

This manual contains procedures, regulations and information for aircraft and passenger handling of Finnair. The contents is based on Finnair policies, national and international aviation regulations as well as IATA and ICAO standards and recommendations. In the opinion of investigation commission this manual establishes the framework for the airlines' ground service operations.

According to the manual chapter 2.3 *Ground Handling Agreements* section 2.3.9.11.2 *Loading and Unloading* RAMP-foreman of the ground handling group preparing for the meeting of an arriving aircraft to park must ensure that apron is free of obstructions and that all equipment is cleared of the aircraft's path. The manual does not specify a minimum time in advance for the group to be at aircraft stand prepared to meet the arriving aircraft. Also it does not obligate RAMP foreman of departing flight to ensure cleanliness of the stand. This task is defined as a responsibility of RAMP foreman in SPM.

Station Procedures Manual (SPM)

Station Procedures Manual consists of eight chapters, where chapter 2 provides procedures for station services. The manual encloses guidelines for functions in Finnish or in English without significant consistency. In the opinion of investigation commission the manual should be written in English and in Finnish in order to ensure understanding of procedures.

Gate Operation

Chapter 2.4 *Gate Operation* is written comprehensively in English. The manual defines the parties, responsibilities and other aspects belonging to gate operations starting of

when the gate service person checks work roster in the beginning of shift ending when the assigned flight of the person has been completed, the gate prepared for next flight and all paperwork completed.

There are good and relatively detailed guidelines for general duties of the gate service person, but flight safety duties for the gate service person concerning operation of passenger bridge and ground operation aspects are not defined.

In the case currently being investigated the function of the gate service person has been according to valid procedures.

Ramp Operation

Ramp operation is handled comprehensively in chapters 2.6-2.10 concerning arriving and departing baggage handling as well as loading and unloading. Chapter 2.9 *Loading*, section 2.9.5.33 states, when loading is completed, RAMP-foreman shall sign the loading instruction/report and forward this to the Ramp Agent. In addition section 2.9.5.35 states, that RAMP-foreman shall ensure that all unnecessary equipment is removed away from aircraft before departure.

Chapter 2.10 *Unloading* section 2.10.5.9 states, that RAMP-foreman shall ensure before an aircraft arrives to parking that stand is clean of all GSE and other equipment. In addition the section states that, if the technician is not present, it is the duty of RAMP foreman also to direct/guide aircraft to its parking box. This job description is missing in the company's uncontrolled training manual. Section 2.10.5.20 states that in the final stage of ramp operation it is the duty of RAMP-foreman to ensure that all unnecessary equipment is removed away from the aircraft.

Training manuals for RAMP man and RAMP foreman

The manuals are planned for training use only and are published in spring 2000. Secondarily they are meant to be used as checklists for loading personnel during RAMP operation. According to information obtained by investigation commission manual were originally used at Finnair line stations, but nowadays also at the hub, Helsinki-Vantaa Airport.

Manuals are written in Finnish and they consist of basic loading procedures and requirements as stated in the company's STM and SPM. They are completely unofficial manuals for ground handling operations. They are not included in the revision service as a part of the quality assurance of the company. Manuals are divided into five chapters: A. *General,* B. *The Finnish translation of the Station Manual*, C. *Aircraft*, D. *Tags and labels* and E. *Dangerous goods.* In the opinion of investigation commission the manuals are very good and functional, however they do not emphasize enough on safety matters related to ground service operations. In addition they should be included in the revision service.

Since ground service personnel operates with significant flight safety duties as stressed by Flight Safety Authority, manuals should still be written in Finnish to avoid confusion.

It is stated in the training manual of RAMP man that he should follow the arrival and departure times of the aircraft in the monitors. Monitors referring to Finnair's own STIDI-display as well as the FIDS-display of Civil Aviation Authorities. In addition it is their duty to dock the aircraft and use the ramp support equipment as well as assist with dispatching the aircraft. The duty of docking has not been specified nor has the inspection of apron being clean and free of obstacles been assigned as a duty to the entire RAMP group. It is not mentioned in the training manual that RAMP men should know the company's own and FCAA instructions related to operation at the apron.

Job description of a RAMP man include various ground service duties, where the closest flight safety related duties are for example placing the wheel chocks and attach the ground power on arriving aircraft. This section does not include any information about procedures when using supporting equipment. It is not mentioned in the job description that they should take in consideration all orders and regulations in their work performance. Co-operation procedures with other occupational groups such as maintenance and station service personnel for interrupting an aircraft parking in a emergency situation using the APIS-system or hand signals are missing.

Training manual for RAMP foreman being responsible for loading states that RAMP foreman should clarify himself the stand for the aircraft as well as take care and be responsible for that the group is with necessary equipment at stand on time. In addition he should attend to that all excessive equipment is removed away from the stand of arriving aircraft and that working routines are correct. It is not defined in the job description how much earlier the group should arrive and be prepared at aircraft stand. The manual determines, as stated in SPM, the assigned duty of directing/guiding aircraft into park, if technician is not at location.

It is the duty of RAMP foreman to perform an aircraft departure check and dispatch the aircraft using either interphone or hand signals. In connection with this duty flight safety duty related to check the apron is not defined for him, even though this is documented in other manuals (STM/SPM).

Technical Operation

Finnair maintenance organization and its procedures, which are based on the maintenance organizations license, authorization for the planning organization and air operator certificate acknowledged by FCAA, are defined in Finnair Technical Procedures Manual (TPM). The manual is written both in Finnish and in English. Director of Technical Division of Finnair is responsible for technical operations. He reports directly to Chief Executive Officer of Finnair. The duty of technical division is to maintain aircraft and their spare parts together with other technical services for Finnair as well as to external customers.

Technical Support of Operation is a direct subordinate to Technical director. He is responsible among other things that there are plans for future needs concerning utilization of personnel, facilities and maintenance equipment, and that the approved plan is executed. Manager of Technical Support of Operations is assisted by Aircraft maintenance and its manager. Maintenance engineer of planning is his subordinate and it is his duty to be responsible for the development of maintenance equipment. Tools and equipment coordinator reports directly to him. The coordinator is responsible for that tools of the department have the required maintenance instructions and user's manuals as well as that damaged tools are forwarded for repair. Additionally it is the duty of tools and equipment coordinator to arrange the acquirement of tools to the department.

In connection with use of the equipment in maintenance vehicles maintenance mechanics are responsible for that equipment removed of vehicles to be used during maintenance operation is replaced in the maintenance vehicle after completion. It is the duty of department superintendent of line stations to ensure that workspace, equipment, work procedures and materials are according to regulations and that they are used according to given instructions. It is the duty of supervisors of line stations to be responsible for the condition of maintenance equipment, tools and vehicles. The maintenance of equipment is the responsibility of maintenance foreman, who is also responsible for the condition of maintenance equipment, tools and maintenance vehicles. Vehicles used for maintenance operations are variously equipped with maintenance equipment and tools. At the time of occurrence there was no detailed equipment list in the vehicles.

According to TPM chapter 3.8 section 3.8.6 *General job description* personnel on duty for Technical group of Finnair are obligated to:

- perform the task to his/her best ability
- comply with given instructions and procedures
- report to his/her foreman of discovered malfunctions and errors in procedures, aircraft, equipment or spare parts (in this case the stepladder was removed from the maintenance vehicle as they were impractical)
- report errors and faults that occur in line with his/her own duties
- safeguard the tools, equipment and other materials possessed by the employee and deliver them for repair if needed.

According to TPM chapter 2.4 *Tools and equipment* simple tools such as maintenance stepladders do not require a individual control. Therefore they may be taken for test use according to the discretion of the department without heavy procedures as mentioned in the section in question. In this investigated case the associated maintenance stepladder was introduced for test use according to this paragraph.

Finnair has collected for the aircraft maintenance operation, in addition to the TPM, Aircraft Maintenance Special Instructions (LEO) as well as a Forms manual (LKK). LEO and LKK are written in Finnish. LEO completes the procedures in TPM. The procedures stated in LEO may not mitigate minimum procedures as defined in TPM. LEO defines

the procedures, when the equipment user realizes the equipment being defective. In this investigated case the appeared unserviceable of the test equipment may be considered as in the manual stated equipment defect. In a case like this the user of the equipment is required to file a report and by this procedure advice the organization of the situation.

LKK states the general instructions how to use the forms. Manual section *Maintenance equipment Defect/Loan Report (F 1263 B)* states, that by using the procedure it can be ensured to have the maintenance equipment quickly and appropriately for repair or to returned to its correct storage or operation. Investigation commission finds the instructions sufficient. The person removing the stepladder away from maintenance vehicle number 44 has not operated according to instructions given by Finnair.

Quality Assurance

Vice president quality assurance is responsible for Finnair quality management. Quality assurance is based on safety, punctuality and qualitative customer service. The aim of quality assurance is to guarantee that all activities are conducted in accordance with the regulating directives. The quality assurance consists of quality audits, quality inspections and management evaluations.

Division quality managers are responsible for coordination and improvement of the division quality system in accordance of the company policy and division quality goals. Achievement of goals requires strict fulfillment of requirements and instructions related to flight safety, customer service and constant development. Vice president quality assurance is JAR-OPS 1 referred quality manager. His duty is to ensure that the quality system works beyond the barrier layers of different divisions. Quality manager is responsible for the implementation of company quality audits according the program approved by him and to decide if deemed so if additional audits and quality inspections are needed. It is his responsibility to ensure that the corrective actions required for nonconformities discovered during the audits and quality inspections are carried out. In addition he is a member of the flight safety group of Finnair.

The quality system comprises all procedures that are defined for flight department in Operations Manual parts A to D, for technical department in TPM and for ground department in STM according to requirements and procedures of international, Finnish CAA and Finnair.

According to the information that investigation commission has Finnair quality audits have not been directed towards ground handling services or airport infrastructure referring to this investigation.

1.17.3 Finnish Civil Aviation Administration

General

The duty of Finnish Civil Aviation Administration (FCAA) is to deliver airport and air navigation services for the needs of civil as well as military aviation. The duties, assem-

bly and appointment of the board of FCAA is given thru more accurate enactment by the decree of law.

The duty of FCAA is to take care of general flight safety and issue regulations and instructions associated to aviation, process aviation operators certificates and licenses as well as aircraft operations, airworthiness, registration and mortgage related issues and also otherwise enhance aviation, attend to aviation development and control as well as other authority duties related to civil aviation.

In addition the goal of FCAA is to take care of appropriate offering of the services provided, enhancing them according to the business activities considering needs of the customers as well as regional needs of the entire society and other general needs. FCAA has to care for international agreements of civil aviation and international cooperation for those parts that do not belong to the power of other authorities.

At the time of occurrence the FCAA agenda dated May 23rd 1991 was valid and also agenda dated October 17th 2000 for those part mentioned in this report. FCAA is a state-owned combine enterprise which fundamental organization is formed by the company's combine administration (Head Office), separate Authority unit responsible for flight safety (Flight Safety Authority), profit centers (Airports, Air Navigation Services Centers and Avia College) as well as the internal service profit units of FCAA. In addition the combine enterprise has affiliated subsidiaries. The establishment of them is decided by the board of the company. The Head office consists of a Director General, Secretariat, Administrative department, Finance department, Airports department and Air navigation services department as well as an office for international issues.

Safety and quality operation related issues are managed and followed-up on within the safety and quality commission at FCAA, where members are in addition to the Chief executive officer also the directors of Airport and Air navigation services department and as secretaries the quality managers of different departments. The commission meets monthly to process safety and quality reports and other reports of the safety and quality committees of different departments. The commission will decide on possible required actions to be taken. The commission also directs and coordinates on administration level the development and the maintaining of quality and safety systems and monitors operation of air navigation and traffic services concerning safety. According to agenda, the departments of head office will audit and monitor the safety and quality operation of their own branch and will report to chief executive officer in the safety and quality commission.

The comprehension that the investigation commission has, the safety and quality commission has not treated items appeared in station services of airports concerning structural, instructional or operational flight safety items related to this investigated occurrence.

Airports department

Airports department of FCAA is responsible for planning, construction as well as development of maintaining the airports and aerodromes of FCAA. In addition it responsible for strategic planning, centralized management of the property items and also coordination of safety and preparedness items. The Airports department is accountable for passenger services, ground traffic services, station services as well as traffic services.

The Airports department has Headquarters, Master planning unit, Airport operations division and Electrical engineering, which is led and developed by the director of airports department. The Master planning unit is responsible for general planning and mapping out of the airports.

An internal service unit, Airport engineering of Civil Aviation Authorities reports to the director of Airports department. Airport engineering produces airport and facility planning and construction services. According to the agenda of Airports department, the unit or department of FCAA that orders and assigns to Airport engineering, is responsible for the project.

Airports department has a safety and quality committee function. The department is responsible for that discovered safety and quality issues of the profit centers are noticed and corrective actions are planned, educated and implemented. According to information received by the Committee quality activities of the department has not been focused on problems appeared in structures, procedures or operations of the station services now being investigated.

Airports department has been responsible for the planning, acquiring and installation of passenger bridges at Helsinki-Vantaa Airport. Design planning of the first phase of the middle terminal portion was initiated on April 7th 1992, general planning on June 9th 1993 and implementation planning on October 20th 1993. The delivery contract for passenger bridges number 20-25 was signed on May 19th 1995. Passenger bridge number 25 that is now associated in this investigation, was introduced on October 7th 1996. The planning and construction of passenger bridges has been knowingly performed against recommendations of ICAO ANNEX 14.

Flight Safety Authority

The director of Flight Safety Authority or the person appointed by him departing from what is regulated in the law concerning state-owned enterprises regarding the power of the board as well as the chief executive officer, determines particularly the stipulation of rules and instruction connected to flight safety as well as items related to monitoring of civil aviation, licenses, aircraft operation, airworthiness, registration and mortgage.

The duty of Flight Safety Authority is to attend to general flight safety and also to issue regulations and instructions to ensure flight safety, process certificates and licenses related to aviation as well as issues related to aircraft operation, airworthiness, registration and mortgage. In addition it is the duty of Flight Safety Authority to monitor the safety of

aviation operations. It shall also attend to authority monitoring and approval of air navigation services and airport operations.

A safety target of the annual reduction of airline accidents and the amount of deceased in airline accidents regardless of expansion in air traffic has been set amongst other targets for Flight Safety Authority. In order to achieve this target Flight Safety Authority shall attend to that the joint European requirements are implemented in Finland according to jointly approved schedules and procedures.

Flight Safety Authority is divided in Flight operations and licensing division, Technical division, Administrative services as well as Airport and air navigation regulations division. Airport and air navigation regulations division is divided into Airport, Air traffic control and Flight calibration sections.

According to the operation and quality manual of Flight Safety Authority the duty of airport section is to:

- follow up, prepare and adapt the operational standards and recommendations belonging to the section
- prepare and adapt the aviation regulations aeronautical information related to airfields, their operation and equipment as well as approval procedures and monitor that they are complied with
- monitor the flight safety items of aerodrome planning, building, maintenance and operation based on ANNEX 14, as well as security control of the airport area and the related procedures and training
- carry out operational and equipment inauguration inspections of the aerodromes and also audits of airport safety management
- process and prepare the licenses of the aerodromes concerning construction, holding and others and
- arrange flight safety training concerning aerodromes as well as training of aerodrome related aviation regulations.

In the opinion of investigation commission Flight Safety Authority has not purposefully enough demanded corrective actions and supervised the implementation of the actions when it was noticed that safety distances at Helsinki-Vantaa Airport related to the investigated occurrence had been broken. Even though the passenger bridges are built prior the first effective date of AGA M3-5 on January 23rd 1997, exceptional permit procedure should have been implemented according to aviation regulation already before November 1st 1997.

Airport Helsinki-Vantaa and the Station Services

Helsinki-Vantaa, the main airport in Finland is responsible for results of its operation as well as quality and safety of the products following general strategies and guidelines set by FCAA and aiming for the set goal. Its duty as a profit center of the enterprise is to

produce passenger, station , traffic area, air navigation and other services related to commercial services of airport activities.

Airport is profit responsible of the upholding and administration of related service bearings of the airport operation. In addition it assists the Flight Safety Authority in regional and local duties.

Airport director is profit responsible for the managing of his unit as well as for the achievement of the set goals. He reports directly to Director General at Civil Aviation Administration. The Director General decides yet of the main organizational policies of Helsinki-Vantaa Airport. Airport director is assisted in managing by assistant director and headquarters, which consists of financial administration, personnel administration and security unit. Operationally Helsinki-Vantaa airport is divided into Terminal, Operations and Technical services. Apron manager reports to General manager operations and is responsible for station services.

According to operations manual of airport the Operations is responsible for air navigation services including rescue services, traffic planning and environmental protection issues. According to same manual Technical services branch is responsible for construction and maintenance at the airport. However in practice construction projects demanding large investments and financing is the responsibility of head office at Civil Aviation Authority.

According to Helsinki-Vantaa Airport Operation Manual Chapter A.6 *Aviation Operation* section A.6.1 duties of station services is to care for apron control, direct the traffic movements on ground and assign parking stands for the aircraft as well as coordinate parking and repositioning of aircraft. In addition its duty is monitoring of the condition of equipment at apron and guidance of aircraft.

Helsinki-Vantaa Airport has a safety and quality committee. The airport is as an profit center responsible for its own safety operation. APRON 2000 quality group has been operating at airport since summer 1999 as a joint action group between the airport and the ground handling companies. The group had only an informative status towards separate parties. The chairman of meetings have been the apron services representative at the airport. The representative of FCAA has reminded the ground handling representatives during the September 23rd 1999 held meeting of the FOD instruction concerning apron cleanliness at the airport. The instruction defines obligation to clean loose obstacles and debris immediately upon detection or after littering. In addition during meetings on October 7th 1999 and on October 26th it was stated, that passenger bridge number 23 is not suitable for use of Airbus A319 aircraft. On November 9th 1999 held meeting it was mentioned, that Finnair A319 operation is initiated on November 8th 1999 and that suitable aircraft stands for the aircraft type are only stands from number 26 to 33. The apron control being responsible for airport parking has not however had any instructions about the item discussed at the meeting. Many RAMP safety issues have been discussed during the meetings, but for example the aviation regulation AGA M 3-5 about clearance distances have not been discussed. Recently in order to improve the

solving of airport operational problems ground handling company representatives with decision-making authority have been invited to the meetings.

On proposal made the apron manager of Helsinki-Vantaa Airport year 1994 the traffic light system at aircraft stands have been improved. In the statement the proposed duty for gate service persons of inspecting the cleanliness of aircraft stand and stand being free of obstacles has not been carried out.

Training of operating Helsinki-Vantaa Airport passenger bridges was transferred to airport apron services year 1995 being prior a responsibility of Finnair. Passenger bridge training is mandatory for all persons operating passenger bridges. RAMP personnel is not counted for in this group.

Instructions for apron operation of the airports

Aprons

According to ICAO ANNEX 14, Aerodromes chapter 3.12 *Aprons* section *Clearance Distances on Aircraft Stands* recommendation 3.12.6 an aircraft stand should be located so, that minimum clearance distance between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects should be concerning the aircraft with code letter C (Airbus A319) 4.5 meters. Code letter C refers to aircraft which wingspan is above 24 m, but below 36 m and the outer main gear wheel span above 6 m, but below 9 m.

Flight Safety Authority of FCAA has based on the prior mentioned ICAO ANNEX 14 completed and published the aviation regulation AGA M-5, Aerodrome Planning. Section 13 *Aprons* subsection *Distances between aircraft stands* of the regulation stipulates the minimum safety distances. According to this the aircraft stand shall be located so that the safety distance between an aircraft using the stand, an adjacent building, aircraft on another stand or other objects shall be referring to code letter C -size aircraft at least 4.5 meters. Aviation regulation issues strict requirements for building of different parts of the airport. According to information the investigation commission has received it is uncertain for airports whether the regulation applies for constructed and existing airports and if the constructor or the airport is responsible for the arrangements that are against the regulation. The name of aviation regulation is misleading.

Operation manual of Helsinki-Vantaa Airport section A.6.2 *Aircraft parking at apron* does not state that Helsinki-Vantaa aircraft stands equipped with passenger bridges do not fulfill either the ICAO ANNEX 14 recommendation mentioned above stated or the aviation regulation AGA M3-5 of FCAA. However aviation regulation AGA M3-5 is referred to in this section as reference material.

FCAA has published information about Finnish airports in Aeronautical Information Publication (AIP) Part 2. Information referring to Helsinki-Vantaa Airport does not reveal that stands equipped with passenger bridges do not fulfill safety distances stipulated in AGA

M3-5. Since exceptions are not mentioned in AIP, naturally it is not written in Jeppesen manual used by airlines or in route manuals of other publishers.

Helsinki-Vantaa Airport operation manual section A.6.5 *Safety distances near aircraft* states that safety distances have been presented in Ground traffic instructions of the airport. Safety distances as defined in the Ground traffic instructions means in practice occupational safety related distances by the engines intake and exhaust danger areas and not distances regulated in AGA M3-5. Section 3.3 *Parking* of instruction states that " Storing of carts as well as other transportation beds and equipment is permitted only at their assigned location". The parking prohibited area, waiting area as well as parking area adjacent to the aircraft stand are defined in instructions. There is no specified instruction for storage of equipment required at aircraft stand in ground handling and technical maintenance operations.

Concerning aircraft loading and catering activities it is stated in the operation manual in section 6.7.3 that operator is responsible for loading and that the performer of service shall make necessary agreements with airport. Related to the investigated occurrence Finnair, being responsible for Sabena ground handling, has not made the agreement with the airport.

Operating instruction for passenger bridges (unofficial airport instruction) requires the gate service person to only verify the aircraft type arriving to stand before turning the green traffic light on. The instruction does not mention anything about verification of aircraft stand being clean and free of obstacles.

Operation control of Helsinki-Vantaa Airport has used aircraft parking related unofficial directive instructions prepared by Airports department of FCAA concerning the use of different size of aircraft at all stands at airport. The instruction is prepared according to received information based on only wing span and length of fuselage for various aircraft types and not according to safety related minimum clearance distances at aircraft stand.

2 ANALYSIS

2.1 Operation and procedures for Finnair Technical department

Helsinki line station unit of Finnair Aircraft maintenance attends to the daily used maintenance equipment at apron which includes also the aluminum maintenance stepladder stored in maintenance vehicles. Maintenance vehicles are used at apron by Finnair aircraft technicians in maintenance and repair activities.

Since the existing stepladders manufactured by Zarges were ran out of in the depot and the condition of stepladders in the maintenance vehicles were found to be poor, the Purchasing department of Finnair Technical department ordered two slightly differently equipped stepladders from Suomi Tikas Inc. for test use.

Helsinki line station tools and equipment mechanic placed the stepladders in maintenance vehicles S-55 and S-44. Stepladder without wheels was placed in vehicle S-44, those that were damaged. Tools and equipment mechanic removed the old stepladder away from the vehicle and moved them to storage to be used as a spare stepladder. Notification of the issue and feedback on test use was communicated on the information board in the pause room, which was considered sufficient.

Shortly after initiation of test use of the stepladders users gave feedback to the tools and equipment mechanic. According to the feedback the stepladders were too heavy and complicated when used. Approximately after a week when the tools and equipment mechanic intended to have done additional changes to the stepladders, he noticed, that the stepladder from vehicle S-44 had disappeared and was replaced with the former Zarges made stepladder. Tools and equipment office had searched for the stepladder in maintenance vehicles. Aircraft stands were not inspected so they were not found. Therefore the location of the stepladder or users cannot be defined approximately for a period of two months. However it is very likely, that the stepladder has been positioned at stand number 25 since its disappearance. Cause of removal of the stepladder from the vehicle is not surely known, however based on received feedback technicians of Finnair experienced the stepladder being complicated and heavy. If the person who removed the stepladder would have acted according to given Finnair instructions (LEO) and notified his foreman pertinently, it may be possible, that the damage would not have happened. This spontaneous action or negligence may in any case be considered as action, which initiated the chain of events and made the engine damage possible after several coincidences.

Based on previous the surveillance of tools and equipment of Finnair maintenance depot has also had defects. Somebody belonging to Finnair technical personnel must have obtained the old stepladder from the depot replacing the new ones.

At time of occurrence all Finnair maintenance vehicles did not have a maintenance equipment book describing what equipment is stored in vehicles, but according to Finnair tools and equipment office the procedure for this is being developed. According to

information learned by investigation commission maintenance equipment books should be available in all maintenance vehicles in near future. After this the management of tools and equipment available in vehicles will improve.

It is not required to mark test stepladders or stepladders used in maintenance and ground service operations with a serial number. In the opinion of the investigation commission stepladders can be considered equal with tools used in maintenance activities, so therefore they should be marked with a serial number. Marking equipment and signing procedure when loaning equipment would make equipment control significantly easier and reduce the risk that it would disappear uncontrolled.

The Defect/Loan Report form used by Finnair Technical department is unnumbered, so control and monitoring of performed loaning and filed defect reports is difficult. Missing unnumbered and filed reports are hard to trace. If the form would be numbered, it also would make it significantly easier to monitor the amount and condition of stored equipment in addition what is mentioned above.

2.2 Finnair station operations

2.2.1 RAMP activities on the flight preceding the damage occurrence

Use of the stepladder prior the damage occurred at approximately 17.40 in connection with the dispatching preparations of Boeing 757-200. The RAMP foreman who used the stepladder for detaching the ground power unit moved the stepladder thereafter outside the safety rail to the position from where it 40 minutes later was absorbed into the engine of arriving Sabena aircraft. The stepladder was left there opened in an upright position. It was standing in relation with the aircraft so that the airflow caused by too near to the rail incoming engine could be able to make them to fall down (to the unsteady direction). There was plenty of space between the departing engines of the wide bodied aircraft and the safety rail (approximately 8 m), so it did not notably remind of the possibility of an upcoming danger factor caused by narrow bodied aircraft with wing engines.

When finished with the dispatch preparations of the Boeing RAMP foreman assisted the push-back driver with the reversing of the aircraft. After this duty he should have, following instructions, ensured that all unnecessary equipment used in connection with the loading and ground service operation, even the maintenance stepladder are removed away from the aircraft. As he sees it, when returning back to the apron he forgot to remove the stepladder from the aircraft stand. According to the valid Finnair procedure the RAMP-foreman should have had to ensure the cleanliness and the absence of loose obstacles on apron prior the arrival of next aircraft.

2.2.2 RAMP activities during the damaged flight

As the Operation control at Helsinki-Vantaa Airport changed the stand for Sabena flight SN2337 from stand number 27 to stand number 25 relatively late, all members in the RAMP group meeting the aircraft were not aware of actual stand position, when the air-

craft taxied towards aircraft stand number 25. When the last members arrived to their positions at the apron the aircraft was already taxing on parking line to stand. According to Finnair SPM the RAMP group should have been at aircraft stand meeting the aircraft five minutes prior its arrival.

The RAMP man, who was preparing to attach the external power unit to the aircraft was the closest by the damage occurrence, recognized the stepladder too late. He had no time or possibility for his own safety to remove the stepladder in front of A319 left engine. Also the RAMP man on the right hand side of the aircraft noticed the stepladders in front of the left engine, but due to his observation position he could not prevent the occurrence. If the RAMP group would have had more time to prepare the arrival of the aircraft, it is possible that they would have discovered the incorrectly positioned maintenance stepladder at apron in time and had been able to prevent the damage to occur. Even though the stand is equipped with the emergency stop button of APIS-system, the closest RAMP man was not aware of the button. Furthermore he was not trained on how to operate it. Incidentally a few Finnair RAMP persons do know how to operate the switch in question, but a systematic operation training is missing completely.

In the opinion of investigation commission the short time to prepare the arrival of the aircraft has influenced the decision-making of the RAMP foreman to ensure as in line with Finnair procedures that the apron area is clean of all ground service equipment and other equipment. In this case he did not observe the incorrectly positioned maintenance stepladder. He was positioned at time of occurrence on the opposite side of the aircraft from where he did not have direct eye contact to the target area of left engine. According to members of the RAMP group duties did not become more complicated and they were not in a hurry, when they were notified of the stand change. In the opinion of the investigation commission the engine damage could have possibly been prevented, if the RAMP group would have been at the aircraft stand five minutes prior the arrival of Sabena flight.

2.2.3 Finnair RAMP operation, procedures and training

Finnair has defined the procedures of its ground service operation in the company's Station Manual (STM) and Station Procedure Manual (SPM). In addition RAMP personnel use unofficial, only for training purposes intended RAMP man and RAMP foreman manuals, which are not included in official revision service of the company.

In the opinion of investigation commission the company has defined ground service procedures well, even though SPM and STM differ slightly for the parts related to loading and unloading. Since STM defines the operations policy for the procedures of SPM, the duty of the RAMP foreman to assure the absence of loose obstacles and cleanliness of apron after aircraft departure should be added in STM. Investigation commission finds even a better solution in that the concern of absence of loose obstacles and cleanliness of the apron area is defined as a duty to every member in the RAMP group however thus that the responsibility of implementing the duty still remains with the RAMP foreman.

Gate operation related procedures in the SPM should be more specified. Duty of gate service persons in connection with the operation of passenger bridges should include to ensure in cooperation with technical and ground handling personnel that before the red traffic light of the parking stand may be switched to green, the aircraft stand is safe for aircraft parking. Coordination of procedures with many different occupational groups may be difficult, but from the flight safety point of view the issue is worth developing.

Investigation commission is in favor of developing and using the training manuals of RAMP man and RAMP foreman concerning the RAMP operations. Training manuals should be included in the revision service of the company and flight safety items of the manuals should be more specified. One of the most critical phases in loading operation is docking of the aircraft. The task definition *Docking* should be formulated in Manuals so that RAMP group is aware of all operational phases and understands their own responsibilities and possibilities for example the part of interrupting the docking.

Finnair has not equipped RAMP vehicles with a stepladder needed in ground operation by the RAMP-group like the aircraft maintenance vehicles are. The RAMP group has used Finnair Technical departments' stepladders at the stand for its own operation. If the loading equipment needed in RAMP handling operations by the group, such as a stepladder, would be placed in RAMP vehicles and vehicles would be provided with equipment books like the maintenance vehicles, similar occurrences would be prevented in the future. In the opinion of investigation commission no other maintenance or ground handling equipment should be stored at the aircraft stands except for the aircraft's wheel chocks, push-pull rods and safety cones.

In the opinion of investigation commission the training of RAMP personnel has not emphasized enough the apron and aircraft parking related flight safety aspects, as the above presented concerning the changes for the manuals. The training of visual docking guidance system (APIS) is not included in the training programs.

2.3 The operation of the cockpit crew

Crew of the aircraft had performed flight preparations according to the company procedures. They had no information about reduced safety distances between an aircraft on another stand and any adjacent building and other objects at Helsinki-Vantaa Airport aircraft stand number 25, as there was no specific mentioning about that in Jeppesen route manual used by Sabena.

Cockpit crew was cleared to taxi according to completely normal procedures by Helsinki-Vantaa Ground Control (GND). GND cleared OO-SSH to aircraft stand number 25. The crew was not told previously, that the parking stand would have been number 27. This last minute stand change committed by Helsinki-Vantaa Operation control did not cause the cockpit crew any problems.

The commander of aircraft used the taxi light during the taxing according to company procedures and switched it off when turning to the final approach line of the aircraft stand. He had confirmed the traffic light at rear of the passenger bridge being green and

verified stand being available for parking. Before turning he had switched on the turn-off light to lighten the apron also on the left hand side of the aircraft. Even though this sector was lightened, the commander of the aircraft did not observe the maintenance stepladder at aircraft stand right by the safety rail of the passenger bridge. This is partly due lightning circumstances caused by the starting darkness. The artificial lightning at apron created shadows of the buildings at the stand. It is possible, that the maintenance stepladder were in the blind spot created by the shadows. Cockpit crew checked the aircraft stand area before parking for the parts they could observe out of cockpit. They were confident that airport operator and ground handling agent had ensured the arrangements at apron and confirmed it being safe. In the opinion of the investigation commission the observation of buildings and obstacles at apron will enhance, if their contrasts would be emphasized with attention coloring or contrasting bands.

When commander parked the aircraft at stand the aircraft stopped due to commanders' reaction time approximately 85 cm after STOP command given by the visual docking guidance system (APIS). If commander would have stopped the aircraft immediately after STOP command, it is possible, that the maintenance stepladder would have slipped outside the air inlet opening when falling and not been absorbed into the engine of the aircraft. Investigation commission finds however the parking operation of the commander committed according to procedures, as parking was performed within the allowed parking area as indicated by the APIS-system. From the cockpit crew point of view parking arrangements must be safe, even though the aircraft would reach the APIS system's indicating TOO/FAR command. Too far command means that, the forward cabin door cannot be opened inside of the passenger bridge, nor can passengers consequently be disembarked from aircraft into airport building before the aircraft has been moved to an allowed parking area.

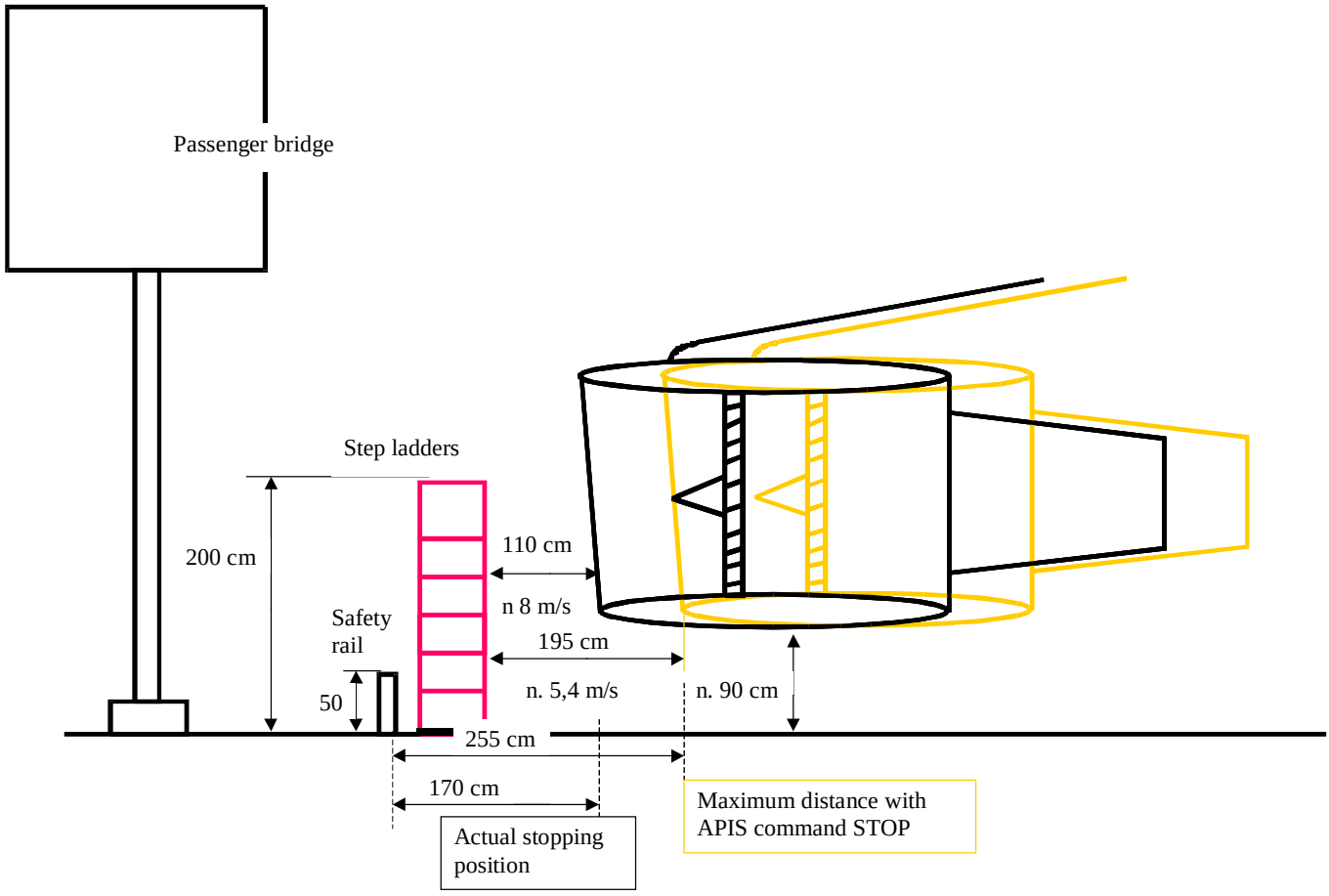
It took relatively long time (approximately 13 s) before commander of the aircraft turned off the engines of the aircraft. According to commander the cockpit crew had at first thought that the abnormal sound from left side of the aircraft was caused by deployment of underneath of the cabin door located evacuation slide. In the opinion of investigation commission shutting down engines faster would not have significantly reduced the damages.

The damage occurred after sunset in artificial lightning as the visibility was otherwise good. Commander initiated the approach to passenger bridge with ground speed of 8 kt both engines at ground idle. Speed was decelerated normally by using the wheel brakes. The damage occurred at the same time as the aircraft had come to a complete stop and both engines were at idle. Outside the safety rail forgotten maintenance stepladder in an upright position, fell down as a consequence of the engine inlet. The top of the stepladder went into the inlet opening of engine and was pressed against the rotating fan blades decelerating rotation speed of the N_1 rotor.

The distance from leading edge of the inlet opening of the engine to the stepladder facing the aircraft was approximately 110 cm. If commander of the aircraft had stopped aircraft immediately after illumination of the STOP command of the APIS system, parking distance would have been approximately 195 cm. In this case it would have been possi-

ble, that 205cm high stepladder could have hit the outer edge of the inlet opening when falling and slipped from there outside without ending up into the engine. Even though the speed of engines airflow changes significantly in relation to distance, suction of the engine would not likely have been able to lift on the ground located, 14.5 kg weighing stepladder into the engine. Velocity of the air flow by the leading edge of the engine is approximately 22.5 m/s, at a distance of 1.1 m approximately 8,0 m/s and at a distance of 1,95 m approximately 5,4 m/s.

The enclosed picture illustrates the position of the engine and the stepladder as well as the distances between them and the structures at the damage occurrence. The black drawing of the engine presents actual parking position of aircraft and yellow lineation the distance of the situation, if the aircraft would have stopped immediately after the STOP command indicated by the APIS system. In addition velocity of the inlet flow into engine is presented in the picture indicating the distances significant from the damage occurrence point of view.



Picture 10. Drawing presenting changes of the inlet airflow into the engine at damage occurrence

2.4 Civil Aviation Authority and Helsinki-Vantaa Airport ground service operation

The planning phase of passenger bridges of the middle terminal phase one at Helsinki-Vantaa Airport was commenced on April 7th 1992 and passenger bridge number 25 was taken into use on October 7th 1996. The Flight Safety Authority had not by that time issued the aviation regulation in reference to safety distances at aircraft stands.

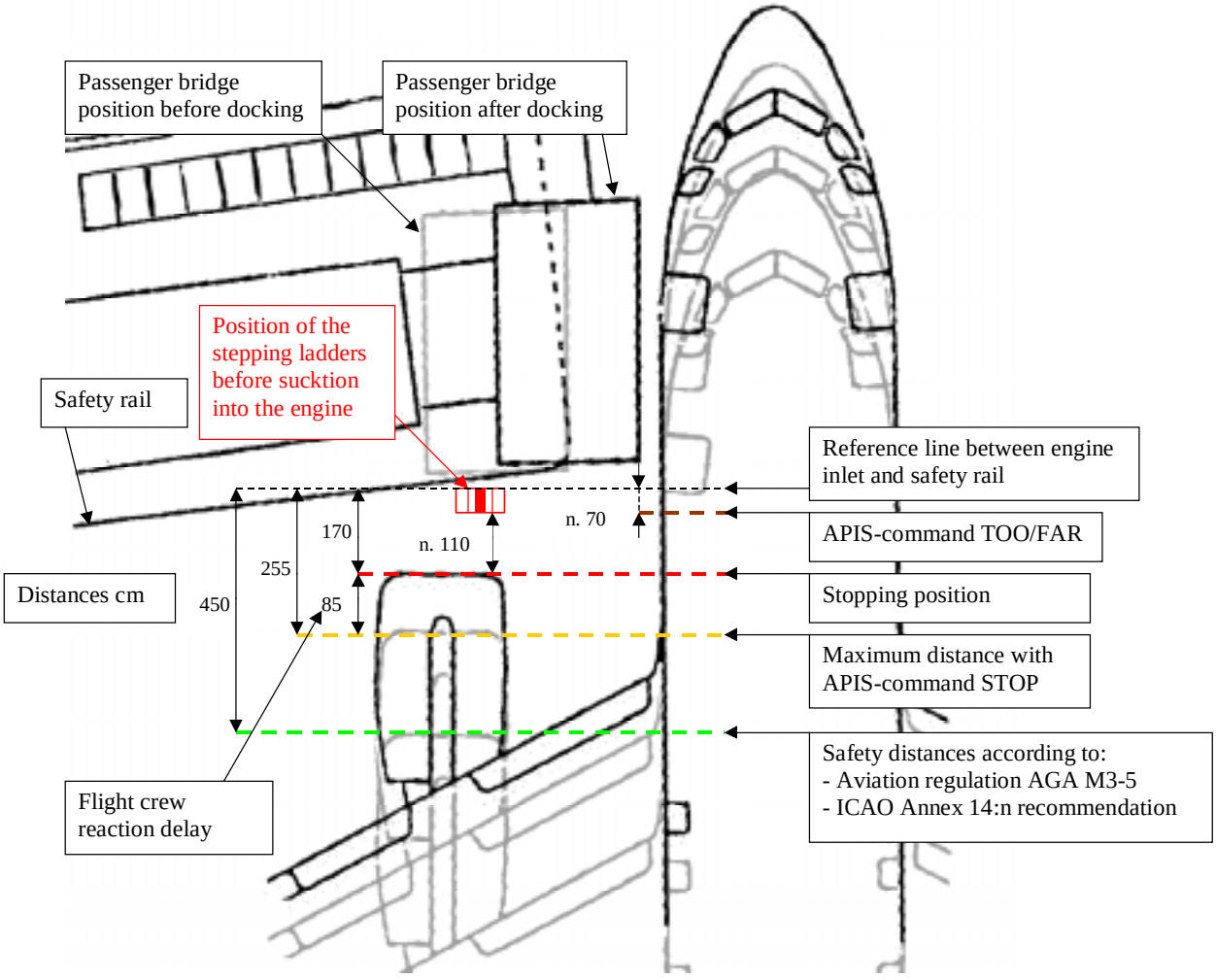
Aviation regulation AGA M3-5, Aerodrome planning, which is based on ICAO ANNEX 14, came into effect the first time on January 23rd 1997. It was required In the regulation under section 13 *Aprons*, that the aircraft stand shall be located so, that the distance from aircraft using the stand between the adjacent building, an aircraft on another stand and other objects shall be referring for a A319 size aircraft at least 4,5 meters. In the aviation regulation change effective May 31st 2000 the clearance of large size aircraft (code letter F) was defined. Airport operator should have requested for an exception permission for the deviation that were not corrected for to reflect the regulation by November 1st 1997 according to the regulation effective on January 23rd 1997. However Helsinki-Vantaa Airport did not comply with this. Flight Safety Authority has an exception permission for Finnish airports on April 3rd 2001 according to which as of September 6th 2001 A319 size aircraft with wing engines could not any longer, at least by taxing, use Helsinki-Vantaa Airport aircraft stand number 25 without specific measures. According to the measurement performed by investigation commission maximum clearance to the passenger bridge and safety rail considering accurately parked A319 was 255cm. If the parking point of stand defined by APIS is moved slightly further back, the clearance (2,7 m) as stipulated in the exception permission could possibly be obeyed.

As it is not fully clear to airports whether AGA M3-5 applies for already constructed and existing airports and whether the constructor or airport is responsible for arrangements that are against the regulation, Flight Safety Authority of FCAA could consider renaming the regulation in question according to ANNEX 14 (Aerodromes, Design and operations).

In picture 11 there is the presentation of three stages related to the occurrence of Sabena A319 engine damage. Green dotted line demonstrates the minimum distance of 4.5 m regulated by aviation regulation AGA M3-5 which was valid at time of occurrence. If the aircraft could have been parked according to this regulation, it may be assumed, that this engine damage would not have occurred. Even if falling down from this minimum distance 4,5 m the step ladders would have stayed out side the suction danger area stipulated by the engine manufacturer. According to the exception permission issued by Flight Safety Authority of FCAA, starting on September 6th 2001 Helsinki-Vantaa and other Finnish airports shall comply with new clearance distances concerning aircraft size with code letters C to E. Clearances are lengthwise 2,7 m and sideways 1,25 m. During the investigation performed measurement of the minimum distance of A319 aircraft results varied lengthwise 238 – 255 cm. For this reason the above mentioned clearance requirement in lengthwise does not make it possible for narrow bodied aircraft equipped with wing engines (as A319) to park by taxiing at Helsinki-Vantaa Airport aircraft stand number 25. New clearance distance is fulfilled only by adjusting the parking point defined by APIS further back. New clearance distance for sideways is

clearly fulfilled at aircraft stand number 25, though investigation commission finds the clearance in question relatively short on apron slipped by moisture or snow and ice.

Yellow dotted line indicates the APIS-systems STOP-command for the greatest safety distance of 255 cm from the passenger bridge and its safety rail, when aircraft is stopped immediately when STOP-command is lightened at parking stand number 25.



Picture 11. Safety distances according to instructions and regulations and the damage occurrences situational-distances at the Helsinki-Vantaa Airport aircraft stand number 25

Operations manual of Helsinki-Vantaa Airport section A.6.5 *Safety distances near aircraft* states that safety distances are presented in airport Ground traffic instructions. The safety distances in question are however not the clearance distances as defined in AGA M3-5, but they intend to explain the occupational safety related distances considering

the engines inlet suction and exhaust danger areas. The procedure should be clarified to avoid misunderstandings. In addition the Ground traffic instruction is regarded in airlines and other companies only as a concern of the occupational groups, which has to use some type of a ground vehicle when moving on apron. The Ground traffic instruction section 3.3 *Parking* states that "Storing of the carts as well as other transportation beds and equipment is permitted only at their assigned location". Investigation commission did not find an airport procedure defining this location. Concerning aircraft stands the parking prohibited area, waiting area as well as parking area adjacent to the aircraft stand are presented in this instruction. There is no specified instruction for storage of equipment required at aircraft stand in ground handling and technical maintenance operations. It is obvious that supportive equipment are needed in aircraft ground handling and technical maintenance operations, but according to the commission's point of view there is no need to store supportive equipment at aircraft stand other than wheel chocks, safety cones and possibly also push-pull rods. Other equipment needed should be brought out to the stand in vehicle of the responsible group not until the group arrives there.

At the moment the operational instructions of Helsinki-Vantaa Airport especially concerning aircraft stands equipped with passenger bridges are not sufficient. After the damage on November 30th 2000 airport has issued a regulation for storing equipment on apron. The regulation prohibits storage of equipment on apron but on the other hand however it states that for long-term storage the permission will be given by apron manager. Temporary storage of equipment requires always a separate agreement with apron management of the airport. The regulation obligates ground service personnel (technical, loading and users of passenger bridge personnel) jointly assure, that no loose obstacles are near the parking stand. The technical fulfillment of the regulation requires in the opinion of investigation commission however cooperation between airport as well as airline and ground handling companies. In the opinion of investigation commission the airport should define the equipment that may be stored at aircraft stand such as wheel chocks, push-pull rods and safety cones and order an isolated storage to be built at the safest location on terminal side of the stand. The Commission finds however the given regulation directed correctly.

In the opinion of investigation commission Helsinki-Vantaa Airport the traffic light system at aircraft stands equipped with passenger bridges is good, but it should be further developed. The red light located in the rear of the bridge should not be possible to switch to green until personnel at the stand have verified the cleanliness of stand and area being free of obstacles and thus pushed "AREA CLEAN" sign for information for the gate service person inside the passenger bridge. Gate service person could this way be certain of stand arrangements and switch the traffic light to green for the aircraft arriving to park. These arrangements requires naturally a reserve procedure in case of technical malfunctions.

It became evident In the investigation that structures on apron in the range of artificial lighting causes shadows to stands adjacent the terminal. Therefore it is extremely difficult to observe structures and obstacles on the apron in darkness and during poor weather conditions. For this reason the investigation commission recommends the un-

der-side structure of passenger bridges and safety rails at airports would be attention colored or safety marked with contrasting bands.

3 CONCLUSIONS

3.1 Findings

1. Cockpit crew of the aircraft had required and valid licenses as well as qualifications for their duties.
2. The registration and airworthiness certificates of aircraft were valid.
3. Aircraft had no technical malfunctions prior to the damage.
4. Sabena did not preserve the cockpit voice recorder recording for investigation of this serious incident.
5. Aircraft Parking and Information System (APIS) was technically in condition at time of occurrence.
6. Aviation regulation AGA M3-5 issued by Flight Safety Authority of FCAA and the recommendation of ICAO Annex 14 defines clearance distances between aircraft using parking stand and fixed structures as well as other obstacles for A319-size aircraft (code letter C) 4,5 m.
7. Helsinki-Vantaa Airport aircraft stand number 25 does not fulfill the aviation regulation AGA M3-5 nor the recommendation by ICAO Annex 14 for example for parts covering the clearance distances.
8. Concerning apron arrangements at Helsinki-Vantaa Airport that do not apply to aviation regulation AGA M3-5 requirements the exception permission was not applied for according to the regulation prior the damage.
9. Helsinki-Vantaa airport has after the damage occurrence on November 29th 2000 requested the Airports department of FCAA to compose an application for exception permission for broken clearance distances according to the regulation.
10. Flight Safety Authority has granted on April 3rd 2001 a exception permission among others to Helsinki-Vantaa Airport for apron arrangements that do not fulfill the regulation. AGA M3-5 section 13.6 new minimum distance for C up to E size aircraft has been defined valid as of September 6th 2001 as 2.7 m lengthwise and 1.25 m sideways from the aircraft. The exception permission applies for aircraft stands equipped with Aircraft Parking and Information System (APIS).
11. The new above mentioned clearance distances do not enable narrow-bodied aircraft equipped with wing engines (as A319) parking by taxing to aircraft stand number 25 at Helsinki-Vantaa airport without moving the stopping point of APIS system.
12. The above mentioned exception permission stipulates, concerning airports, where passenger bridges are used, that information has to be published in Finnish Aeronautical Information Publication (AIP) about minimum clearance distances deviating from recommendations of ANNEX 14. With this procedure the route manual publishers will receive up to date information of the airports.

13. Helsinki-Vantaa Airport had not instructed prior the damage occurrence procedures for ground handling companies to verify aircraft stand being free of obstacles and clean in connection with aircraft parking.
14. Finnair has stipulated the verification of aircraft stand being free of obstacles and clean in the Station Procedure Manual (SPM) as a duty of the foremen dispatching and meeting the aircraft.
15. Helsinki-Vantaa Airport has after the damage occurrence on November 30th 2000 issued a regulation *Storage of articles at the airport,* which stipulates the verification responsibilities to verify aircraft stand being free of obstacles and clean.
16. Aircraft stand for Sabena flight SN2337 was changed from number 27 to number 25 approximately 10 min prior the aircraft landed Helsinki-Vantaa Airport.
17. The instruction or regulation (LAPOM 7/98, Duties of the parking planner) of Helsinki-Vantaa apron manager does not specify a time frame for last minute changes of aircraft stands.
18. The schedule and changes for using passenger bridges are done by Helsinki-Vantaa Airport Operation Control. The information is displayed in the airport's Flight Information Display System (FIDS). Finnair uses Station Information Display (STIDI) for its own operations.
19. All members in the RAMP group were not aware of the change of the passenger bridge, when aircraft was taxing towards the stand number 25.
20. According to information recorded in the digital flight data recorder (DFDR) commander of aircraft performed the approach to stand with the speed area accepted by APIS system.
21. The aircraft stopped at aircraft stand approximately 85 cm after the stopping point defined in APIS system and approximately 20 cm left to the center of parking line.
22. The distance between damaged engine and passenger bridge as well as the safety rail was 170 cm and the distance between fuselage and front edge of the passenger bridge was 155 cm. Crew did not get APIS command TOO/FAR in stopping.
23. Accuracy of the distance measuring of APIS systems is ± 10 cm, but one block row displayed by the thermometer is 60 cm.
24. The maintenance stepladder causing the damage has for certain been seen on October 17th 2000 at aircraft stand number 25 unfolded in an upright position underneath the end of the passenger bridge and outside the safety rail of the bridge.
25. The stepladder causing the damage was used at stand number 25 for detaching the ground power unit on the Boeing 757-200 being on stand prior the damage. After this RAMP-foreman forgot the stepladder outside the safety rail at the inlet danger area of the A319 aircraft engine.
26. RAMP foreman meeting Sabena flight SN2337 did not inspect the parking stand for being free of obstacles and clean according to Finnair instructions (STM and SPM) before the aircraft parked.

27. Commander of the aircraft did not observe the maintenance stepladder at the stand.
28. When commander parked the aircraft at stand the maintenance stepladder was absorbed into left engine of the aircraft from the position where it was left from previously been used.
29. If an A319 type of an aircraft is parked normally after STOP command of APIS system the distance between the inlet opening of left engine and passenger bridge as well as safety rail is as an average 238-255 cm. When aircraft is in the center of parking line the distance between fuselage and front edge of the passenger bridge is 175 cm.
30. On APIS command TOO/FAR the distance of the A319 engine is approximately 70 cm from passenger bridge and safety rail.
31. The structure of the passenger bridge and approximately 50 cm high safety rail are gray in color. They are hard to be observed in dusk and dark against the background structures. The passenger bridge creates shadows on apron due to lightning at stand thus discovering possible obstacles at stand is hard from cockpit.
32. There is no approved storage place or rack for the stepladder at aircraft stand number 25. The storage rack for the wheel chocks is a loose rack placed on the safety rail. Helsinki-Vantaa Airport has not instructed which equipment can be stored at the stand and where.
33. During simulation of the damage occurrence performed by investigation commission the stepladder was relatively distinctive against the structures of the passenger bridge at daylight. In similar conditions as the damage occurred the performed test indicated that observing the stepladder from cockpit was very difficult.
34. As recommended by the apron manager at Helsinki-Vantaa Airport, the traffic light system on apron has been enhanced year 1994. The improvement propositions related to apron safety were however not completely fulfilled.
35. RAMP personnel have not been trained in operating the APIS system nor on how to interrupt aircraft parking by using the emergency stop button of the system.
36. Commander shut down the left engine normally approximately 13 seconds after the initiation of damage.
37. The maintenance stepladder causing the damage had for an unknown reason disappeared from vehicle S-44 and was missing for approximately two months. It was not found before the damage due to insufficient search.
38. The maintenance stepladder that was being test used has most likely been at aircraft stand number 25 ever since its disappearance.
39. Helsinki-Vantaa Airport has developed the control of how the passenger bridges are used and reporting by installing a computer based security control system in them.
40. Helsinki-Vantaa Airport has developed the control of the aircraft stands by installing a surveillance camera system both in the passenger bridges and on open stands.

3.2 Cause of the engine damage

The cause of the engine damage was a lapse of memory of the RAMP foreman when leaving the aluminum maintenance stepladder at wrong location at Helsinki-Vantaa Airport aircraft stand number 25 after dispatching British Airways Boeing 757.

Contributing factors were:

- Finnair RAMP foreman did not comply with the company manuals for assuring aircraft stand being clean and free of obstacles prior the arrival of Sabena A319 to the stand number 25.
- Test used stepladder was removed from maintenance vehicle S-44 and were left probably already then on stand number 25. Control for the maintenance equipment done by Finnair Technical branch has been inadequate. Search for the stepladder failed, as it was discovered missing.
- Aircraft stand number 25 at Helsinki-Vantaa Airport does not fulfill the recommendation of ICAO ANNEX 14 nor the requirement of aviation regulation AGA M3-5 concerning clearance distances from the aircraft using the stand between the adjacent building, an aircraft on other stand and other objects. If the safety distance would have according tot the requirement of the aviation regulation, the step ladders would not have been sucked in to the engine.
- Instructions of Station operations at Helsinki-Vantaa Airport concerning ensuring the aircraft stand being free of obstacles and clean is inadequate.
- Cockpit crew did not observe in evening lighting poorly visible maintenance stepladder which was left within the engine inlet danger area.

4 RECOMMENDATIONS

1. Finnair shall develop the instructions for ground handling personnel working at the apron so, that the training manuals for RAMP man and RAMP foreman are issued officially and they shall be included in the revision service of the company. The manuals should emphasize on apron related flight safety issues more than currently.
2. Finnair shall develop and enhance the training programs for the RAMP personnel by including in the training of the operation of APIS system as well as procedures on how to interrupt an aircraft parking process with the assist of the system. Changes of the instructions shall also be acknowledged in the manuals.
3. Finnair shall develop the monitoring and management of the ground service and maintenance equipment by marking the stepladders and equivalent equipment with a serial number as well as numbering the Defect/Loan Report form used by the company.
4. Helsinki-Vantaa Airport shall develop the traffic light system at aircraft stands so that the red light at the end of the passenger bridge is not possible to switch on to green, until the ground handling or the technical personnel on the apron have ensured the area being clean and free of obstacles and given a signal to the gate service person inside the passenger bridge, that the stand is useable.
5. Finnish Civil Aviation Administration shall consider the coloring or safety marking (reflex bands) of Helsinki-Vantaa Airport passenger bridges and safety rails to enhance the observation of the equipment that does not belong there.
6. Helsinki-Vantaa Airport shall prepare an instruction which material can be stored at the aircraft stands and where. Current Airport Regulation shall be specified in cooperation with ground handling companies also for the parts covering the assurance of stand being free of obstacles and clean. After this the regulation shall be included in the Operation manual of the airport.
7. Helsinki-Vantaa Airport shall provide operation training for all ground handling companie's RAMP personnel who are involved in aircraft docking procedures on how to use the visual docking guidance system (APIS).

Helsinki October 25th, 2001

Heikki Tenhovuori

Vesa Palm

ENCLOSURES

1. Statement of the recommendations by the Finnish Civil Aviation Administration, Flight Safety Authority on September 20th 2001
2. Statement of Belgian Civil Aviation Administration on August 24th 2001

SOURCE MATERIAL

Following source material is retained at the Accident Investigation Board of Finland:

1. Flight safety report of commander of OO-SSH
2. Deviation and finding report of Helsinki-Vantaa Ground Control
3. Nomination letter of Accident Investigation Board on October 18th 2000
4. Decision of the investigation B 3/2000 L of the Accident Investigation Board of Finland on October 20th 2000
5. Training records of the crew
6. Training records of the ground personnel
7. Interviewing records of the interested parties
8. Telefax copy of the report from the damage investigation conducted by CFMI engine manufacturer
9. Interim information letter of the investigation of the occurrence to the interested authorities and airline parties
10. Recordings of digital flight data recorder of aircraft OO-SSH
11. Picture material
12. Hearing records of the Airport Police Unit
13. Extract of the log book of aircraft OO-SSH
14. Statement of Finnair Inc. on October 20th 2001

ENCLOSURE 1

September 20, 2001 16/02/00

Accident Investigation Board, Finland
Yrjönkatu 36
00100 Helsinki

Your request for comments dated August 3, 2001

COMMENTS OF THE FLIGHT SAFETY AUTHORITY ON THE FINAL DRAFT INVESTIGATION REPORT B 3/2000L

Please find attached the comments received from the Airports and Air Navigation Services Division. The Flight Safety Authority has no comments on the safety recommendations given.

Any necessary actions will be decided on separately.

Yours sincerely,

Director, Flight Safety Authority

Kim Salonen

ENCLOSURE 2

MINISTRY OF COMMUNICATIONS AND INFRASTRUCTURE

Air Accidents and Incidents Investigation Unit BELGIUM

FAX

Number of page(s), including this one : 1 Date :24 August, 2001

To : Mr. Heikki TENHOVUORI
Investigator-in-charge
AIB FINLAND
Fax n° :00.358.9.1825 7811
From : R. TAVERNIERS
Chief Inspector of Accidents
☎ : (32)2.206.32.70

Concern: Engine damage at Helsinki-Vantaa Airport on 17th Oct 2000.

Dear Sir,

I thank you for the sending of the final draft regarding the above mentioned accident.

This is an excellent report and I have no remarks. Thank you for your collaboration.

My very best regards,

R. TAVERNIERS
Chief Inspector of Accidents

Center Communication North - 4th floor - Rue du Progrès 80, P.O. Box 5, B - 1030 Brussels
☎ : (32)2.206.32.11 - Fax : (32)2.206.32.88 – e-mail : ccn.aa.biv@vici.fgov.be
internet : www.vici.fgov.be