Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2007:23e

Aircraft accident to YK-AHB at Stockholm/ Arlanda airport, AB county, Sweden, on 11 December 2006

Case L-30/06

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

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Statens haverikommission (SHK) Swedish Accident Investigation Board

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Statens haverikommission
Swedish Accident Investigation Board

2007-12-19 L-30/06

The Swedish Civil Aviation Authority

SE-601 73 NORRKÖPING, Sweden

Report RL 2007:23e

The Swedish Accident Investigation Board has investigated an accident that occurred on 11 December 2006 at Stockholm/Arlanda airport, AB county, involving an aircraft with registration YK-AHB.

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

The Board will be grateful to receive, by 20 June 2008 at the latest, particulars of how the recommendations included in this report are being followed up.

Göran Rosvall Stefan Christensen

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Contents

Report RL 2007:23e

L-30/06
Report finalised 19 December 2007

Aircraft; registration and type	YK-AHB, Boeing 747 SP
Class/airworthiness	Normal / Valid Certificate of Airworthiness
Registered owner/Operator	Syrian Arab Airlines, Damascus International Airport, Damascus, Syria
Time of occurrence	11 December 2006, at 06:01 hours, in darkness *Note:* All times are given in Swedish standard time (UTC + 1 hour)
Place	Stockholm/Arlanda airport, AB county
Type of flight	Commercial air transport
Weather	According to the SMHI (Swedish Meteorological and Hydrological Institute) METAR at 06:20: Wind 190°/18 knots, visibility more than 10 km, scattered clouds with base at 2300 feet, broken clouds with base at 8000 feet, temp./dewpoint +04/+03°C, QNH 1005 hPa
Persons on board:	
crew members	13
Passengers	103
Injuries to persons	None
Damage to aircraft	Substantially damaged
Other damage	Damage to airbridge
Captain:	
Sex, age, licence	Male, 52 years, ATPL
Total flying time	18000 hours
Flying hours previous 90 days	70 hours, all on type
Number of landings previous 90 days	14
Co-pilot:	
Sex, age, licence	Male, 32 years, CPL+IRME
Total flying time	3500 hours
Flying hours previous 90 days	60 hours, all on type
Number of landings previous 90 days	12
The system operator	
Sex, age	Male, 58 years.
Total flying time	18000 hours
Flying hours previous 90 days	65 hours, all on type
Number of landings previous 90 days	12
Cabin crew members	10

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The Swedish Accident Investigation Board (SHK) was notified on 11 December 2006 that an aircraft with registration YK-AHB had an accident at 06:01 hours on that day at Arlanda airport, AB county.

The accident has been investigated by SHK represented by Göran Rosvall, Chairperson, Stefan Christensen, investigator in charge and operational investigator, and Henrik Elinder, technical investigator.

The investigation was followed by Max Danielsson, representing the Swedish Civil Aviation Authority.

Summary

The aircraft, a Boeing 747 SP, had landed at Stockholm/Arlanda Airport after a scheduled flight from Damascus. When taxiing in to the gate the pilots were guided regarding distance and lateral deviations from a display board on the terminal building. The display was programmed by an operator from a handling company. She had received information about the arriving aircraft type from the data system at the airport, where the type code 74L was stated. She was not familiar with this specific code, but presumed it was a standard Boeing 747, which her colleagues also assumed.

At the operators panel in the airbridge housing she programmed B 747 after have deleted the first version alternative which was B 747 SP. The reason why 747 was first choice in the versions list, was that there had been accidents earlier at the airport when wrong version had been entered at the displays. A standard B 747 is longer than a SP-version, implying that parking is considerably closer to the terminal building. The computer system laser scans the front profile of the parking aircraft to confirm that the correct type is programmed. Some gates at Arlanda have versions of this system that can separate different versions of the same aircraft type (B747 – B 747 SP). This modification was not implemented at the actual gate.

When the aircraft was taxiing in towards the gate the display indicated the type version B 747, according to the computer log in the system. During the interview the Commander stated that he earlier had experienced that docking systems had displayed B 747, and yet had been correct for a B 747 SP. The operator supervised the intaxiing and when she realized that the aircraft came alarmingly close to the airbridge housing, she activated the emergency stop button. This was however already activated by the ground staff at the ramp. The top of the left wing struck the under side of the airbridge at the same time as the display indicated “STOP” and a large hole was torn up at the upper side of the wing.

Recommendations

The Swedish Civil Aviation Authority is recommended to:

- Via the airport work for that proficiency in different versions of aircraft types is introduced into the training curriculum for gate operators *(RL 2007:23e R1)*.

- Ensure that a relevant safety and quality control system for airbridge operators and guidance systems for docking aircraft is present. *(RL 2007:23e R2)*.

- Ensure that the gates concerned at Arlanda airport are equipped with updated docking systems that can distinguish between different versions of the same aircraft type *(RL 2007:23e R3)*.

- Work for that all docking terminals at Arlanda airport are designed in a way that information regarding aircraft types and type versions not can be misinterpreted. *(RL 2007:23e R4)*.

Note.

CAA: Swedish Civil Aviation Authority (Luftfartsstyrelsen)

LFV: Swedish state enterprise running airports and providing Air Navigation Services (Luftfartsverket)

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 The accident

On 11 December at 05:56 Syrianair flight RB 447 landed at Stockholm/Arlanda airport after a scheduled flight from Damascus. Syrianair's traffic at Arlanda is mainly carried out by Airbus 320 aircraft, but due to a large number of passenger bookings, a Boeing 747 SP[1] was used for this flight.

The landing and the first part of taxiing in took place completely normally, and the pilots were advised to park at gate 18. During the final part of taxiing, towards the final parking position at the gate, the pilots were guided by a high intensity LED display on the wall of the terminal building forming part of the automated docking system and providing information concerning azimuth position and the distance to run to the stop position at the airbridge. As the aircraft taxied in towards the gate, the airbridge operator was located at the operator's panel on the inner side of the airbridge housing and had her attention focused on the LED display.

As the aircraft approached the airbridge the operator became nervous, thinking it was coming rather close, and crossed over to the outer side of the airbridge in order to get a better view. When she realised that the aircraft wing was too close, and a collision was unavoidable, she ran back to the panel and pressed the emergency stop button. The apron staff on the ground below the airbridge housing also realised that there was about to be a collision and therefore activated the emergency stop on the panel that is located at ground level.

At the same moment that "STOP" appeared on the LED display the aircraft collided with the airbridge. The top of the aircraft left wing struck the underside of the airbridge housing and continued a little further, to become wedged in place. A large hole was made in the structure of the top of the aircraft wing. The airbridge also suffered damage. When the engines had been shut down the cabin services manager went into the cockpit and said that the aircraft had run into the airbridge, and that there was a hole in the top of the left wing. No-one was injured, and all the passengers could leave the aircraft in a normal manner.

1.1.2 The handling agent

Before parking, the handling agent's operator at the gate had received information via the airport computer system that the aircraft that would park would be a 74L, which is the international IATA[2] code for the B 747 SP. She was not familiar with the 74L nomenclature and so asked her supervisor and colleagues for advice. The supervisor did not know either, but the colleagues thought it was a "normal" Boeing 747 and that "DOOR 2", the rearmost of the two front doors, would be used.

When preparing the display program to guide the aircraft into its final parking position, she therefore first tried to enter "DOOR 2" into the program after selecting B 747 as the aircraft type. However the system was programmed so that B747 SP is pre-selected when selecting B 747 due to an earlier accident that occurred at Arlanda (see 1.18.3). The B 747 SP only has "DOOR 1" and so "DOOR 2" could not be selected, because the system would not accept this combination.

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[1] B 747 SP (Special Performance) is a shorter version of the B 747
[2] IATA = International Air Transport Association

She therefore entered the code that was equivalent to B 747, upon which the LED display, according to the system's internal log showed: "B 747" – "2 DOOR". This message, where "B 747" and "2 DOOR" flash alternately on the LED display, is intended for normal versions of the aircraft, which, due to the longer distance from the nose to the wing, park about 6 metres further forward than the shorter SP version.

The gate operator told SHK that she had not received any training and/or information concerning different versions of the same type, nor had she been informed about the situations that can arise when entering the incorrect version of certain aircraft types into the panel.

1.1.3 Commander

When interviewed, the commander stated that he had only noticed the text "B 747" on the LED display while taxying towards gate 18. He did not think this was strange, since when docking at a number of other airports he had seen that the docking system showed B 747 although it was set for the 747 SP. He followed the instructions on the display as usual, with small azimuth adjustments, and at the same instant the display showed "STOP" the crew felt a shock run through the aircraft.

1.1.4 Overview of the event

The following overview is based on extracts from the data memory units the airbridge housing panel and the panel on the apron at ground level. If the emergency stop button down on the apron is pressed, this is logged in the system unit memory. If the emergency stop button on the operator's panel is pressed, this is logged in both the operator unit's memory and in the apron unit's memory. At the time of the accident only emergency stop activation was recorded in the event log of the apron controls.

05:52:23	Stand 18 active B747 SP – LOCAL.	Selection of type. In this case B747 SP is pre-selected. DOOR 1.	747SP
05:52:25	Stand 18 Door blocked (AC 22-B747SP)	Computer does not accept the operator's selection of DOOR 2 for B 747 SP.	Error 9
05:52:33	Stand 18 ready	The system returns to its normal state. No a/c type selected.	-
05:53:00	Stand 18 active B747 - LOCAL	Operator selects B 747. DOOR 2 is pre-selected.	Alternating: B747 / DOOR 2
06:00:27	Stand 18 docking B747 - LOCAL	System identifies a/c.	Alternating: B747 / DOOR 2
06:01:41	Stand 18 emergency stop B747	Emergency stop button pressed.	STOP
06:01:56	Stand 18 ready	The system returns to its normal state. No a/c type selected.	-

The accident occurred at position N59º 39.1' E017º 55.6', 42 metres above sea level, in darkness.

1.2 Injuries to persons

	Crew members	*Passengers*	*Others*	*Total*
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	13	103	–	116
Total	13	103	–	116

1.3 Damage to aircraft

Substantially damaged.

1.4 Other damage

Damage to the airbridge. No known environmental effects.

1.5 Personnel information

1.5.1 Commander

The commander, male, was 52 years old at the time and had a valid Airline Transport Pilot Licence.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	6	70	18000
This type	6	70	No information

Number of landings this type previous 90 days: 14.

1.5.2 Co-pilot

The co-pilot, male, was 32 years old at the time and had a valid CPL Licence.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	6	60	3500
This type	6	60	No information

Number of landings this type previous 90 days: 12.

1.5.3 The system operator

The system operator, male, was 58 years old at the time.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	6	65	18000
This type	6	65	No information

1.5.4 Cabin crew members

Ten cabin crew members were on duty on that particular flight.

1.5.5 The crew members' duty schedule

That particular flight was number two in the past week for all three of the cockpit crew.

1.6 The aircraft

1.6.1 General

The aircraft	
Manufacturer	Boeing
Type	747 SP
Serial number	21175
Year of manufacture	1976
Flight mass	Max. authorised take-off/landing mass 243 775/203 243 kg, actual not known
Centre of mass	CG 17.05
Total flying time	52122 hours
Number of cycles	21645
Flying time since latest inspection	24.5 hours
Fuel loaded before event	84,400 kg

ENGINES				
Manufacture	Pratt and Whitney			
Model	JT9D-7A			
Number of engines	4			
Engines	*No. 1*	*No. 2*	*No. 3*	*No. 4*
Total operating time, hrs	41440	33909	34866	35167
Operating time since overhaul	8565	6097	7270	7502
Cycles since overhaul	3150	2265	2697	2717

The aircraft had a valid Certificate of Airworthiness.

1.6.2 Location of doors on this type of aircraft

The usual, and most commonly seen versions of this aircraft at Arlanda, are the B 747 – 100, -200 and -400. These versions have two doors ahead of the wings and all have the name B 747 on the airbridge operator's panel. At Arlanda the airbridge is normally aligned with the rearmost of the two doors, "DOOR 2 ".

The B 747 SP has a shorter fuselage than the B 747, and has only one door, "DOOR 1", ahead of the wings, which is used for embarking and disembarking passengers. The other door is located over the wing and is only intended for emergency evacuation. The differing locations of the doors on these aircraft versions means that the B 747 SP must be parked further away from the terminal building to prevent the wing from colliding with the airbridge.

1.7 Meteorological information

According to the SMHI (Swedish Meteorological and Hydrological Institute) METAR at 06:20:
Wind 190°/18 knots, visibility more than 10 km, scattered clouds with base at 2300 feet, broken clouds with base at 8000 feet, temp./dewpoint +04/+03°C, QNH 1005 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome information

The airport status was in accordance with AIP[3] Sweden.

The taxiways and parking surfaces were damp, but braking action was stated to be good at the time of the accident.

1.11 Flight recorders

1.11.1 Flight Data Recorder (FDR)

Honeywell P/N 981-6009-011.

1.11.2 Cockpit Voice Recorder (CVR)

Collins P/N 522-4057-010.

1.11.3 Readings from the recorders

After the accident the aircraft's CVR (Cockpit Voice Recorder) was removed for reading and analysis under SHK supervision. The examination showed however that there was no data recorded on the tape.

It was also agreed with the operator that the aircraft's FDR (Flight Data Recorder) could be removed after the ferry flight to the company's home base, when the damage would be repaired. The procedure with the FDR was carried out in conjunction with a representative of the Syrian CAA who also supervised transport and further handling of the recorder.

Complete FDR data could not however be obtained, as the normal authorities used for analysis declined, for political reasons.

[3] AIP – Aeronautical Information Publication

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

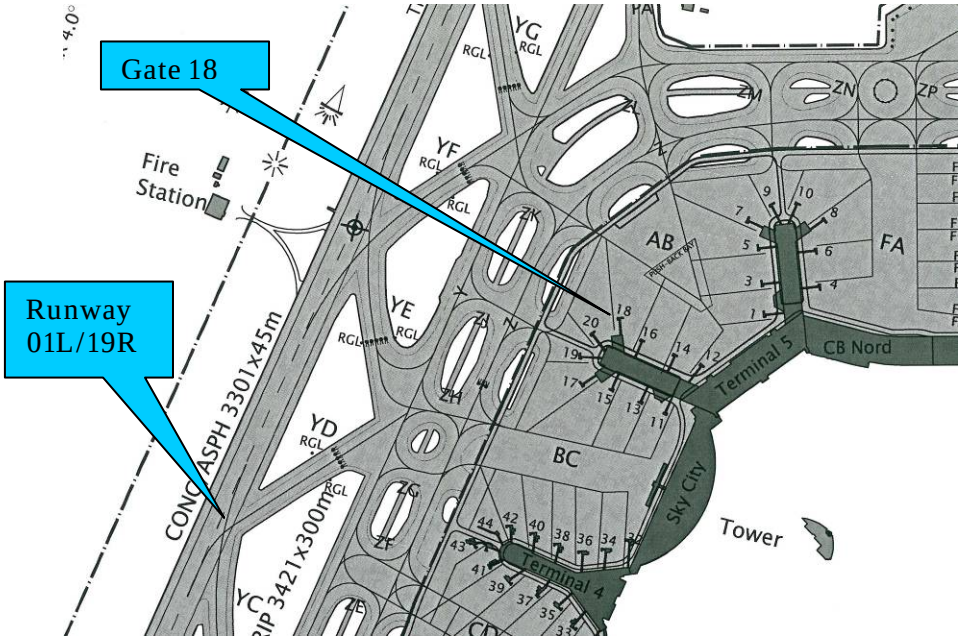

Fig. 1. Part of Stockholm/Arlanda airport

Taxying towards gate 18 took place in accordance with normal procedures. In the company's earlier operations with B 747 SP aircraft at Arlanda, it was preferable that gates 17 and 18 were used for parking their aircraft.

1.12.2 The aircraft

Fig. 2. The aircraft being repaired after the accident

1.13 Medical information

Nothing was discovered to indicate that the psychological or physical condition of the pilots was degraded before or during the flight.

1.14 Fire

There was no fire. It can however be noted that the damaged wing contained integral fuel tanks. These were however not damaged by the accident.

1.15 Survival aspects

1.15.1 General

The Emergency Locator Transmitter (ELT) of type Thales ELT 406 was not activated.

1.15.2 Actions by the rescue services

Not applicable.

1.16 Tests and research

1.16.1 Airbridge

The airbridge is a link between the terminal building and the aircraft embarkation door. On the airbridge there are among other things a control for manoeuvring the airbridge in height and azimuth, and a panel for programming and entering data into the Docking Guidance System, ”Safedock”. The airbridge is managed by an operator who, after entering the correct values, also has the task of monitoring the last of the aircraft parking movements. When the aircraft has stopped, the ground staff place chocks on the nosewheel and then operate a switch that indicates to the airbridge operator that the aircraft has parked and is chocked.

The operator then manually drives the airbridge forward to the aircraft, if necessary lowering a protective canopy. When the aircraft door has been opened by the cabin crew, in some cases a gangway is lowered to cover the gap between the airbridge and the aircraft door. There is an emergency stop function that can be activated both from the operator’s position and down on the apron.

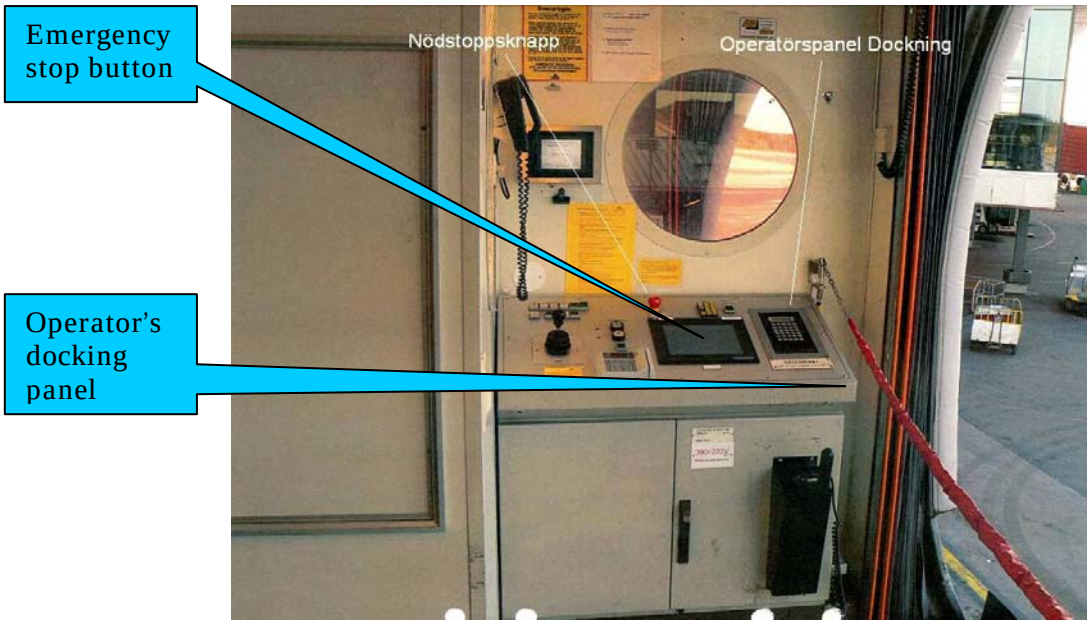

Fig. 3. Airbridge

1.16.2 Docking Guidance (DGS) ”Safedock”

DGS is an optical aid with the task of guiding the pilots along the last section in to the aircraft’s final parking position at the airbridge. The system is computerised and uses, among other things, a laser scanner to verify that the correct aircraft has been entered into the program, and to continuously detect the precise location of the aircraft as it approaches the airbridge. Distance and azimuth deviation information are provided to the pilots by means of a high intensity LED display located on the terminal building in front of the aircraft next to the airbridge.

Before each docking, the system is set up by the operator with information regarding the type of aircraft. Data entry is via a control panel on the airbridge. Apart from function buttons, the panel includes an information display for the operator. The panel has 20 function buttons which can be used for entering the most common aircraft types. A sub-menu is available for programming in other aircraft types and type versions. The program in the system is arranged so that when B 747 is selected, the B 747 SP is shown first as the type version. In order to select other versions, the sub-menu for the type must be selected (see 1.18.3).

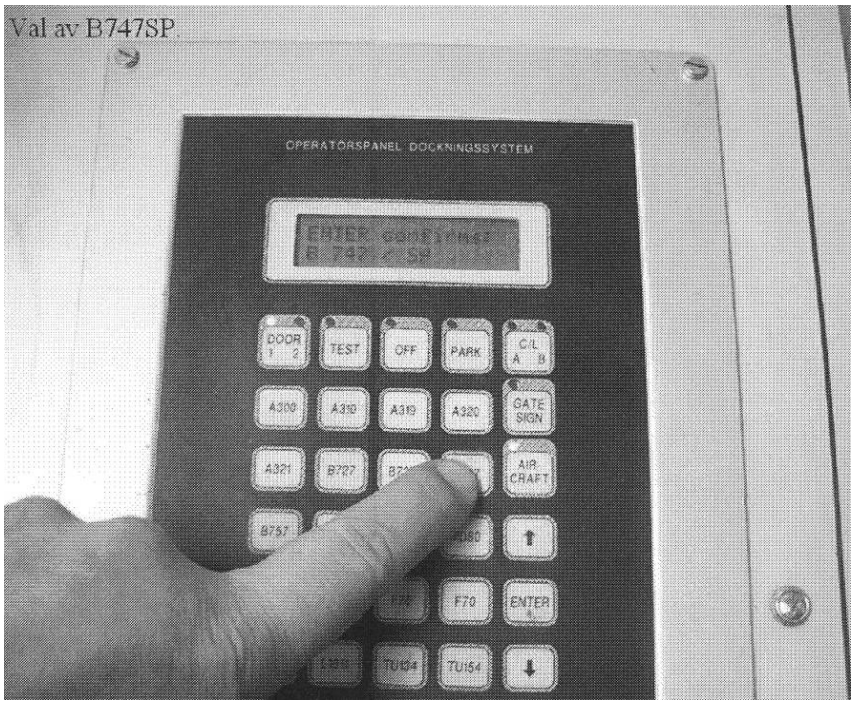

Fig. 4. Operator’s panel on the airbridge. (Selection of B747SP)

In the configuration that was applicable at the time of the accident, the system’s laser scanner could not distinguish between different versions of the same aircraft type, because it could only detect the frontal contour of the aircraft, without taking varying fuselage lengths into account. At certain gates at Arlanda there is an updated version of Safedock, where the system can distinguish between different versions.

In the newer versions laser scanning is complemented by a function that detects the distance between the aircraft nose and the nearest of its engines (information from LFV). This can prevent accidents like the present one, where the distance between the aircraft nose and the nearest of its engines varies between different versions of the same aircraft type. The difference in distance between the aircraft nose and the front edge of the wing, between

the B 747 and the B 747 SP is about 6 metres. The Safedock system at gate 18 had not been upgraded to the latest version.

The system has various automatic safety systems that warn the operator and pilot if a fault occurs. Among other things a warning is given if the aircraft type identified by the system does not agree with that selected in the program. The emergency stop on the panel can also be activated manually by the airbridge operator or the apron staff at ground level. Doing this stops any possible movement of the airbridge, while at the same time activating the DGS system's stop function so that "STOP" is shown on the LED information display.

There is no indication that there was anything wrong with the docking system. Fig. 5 shows the information that is shown on the pilot's LED display and the operator's panel display during a normal docking. The illustrated examples are extracts from the Safegate user's manual and show a docking with a Boeing 757 type aircraft.

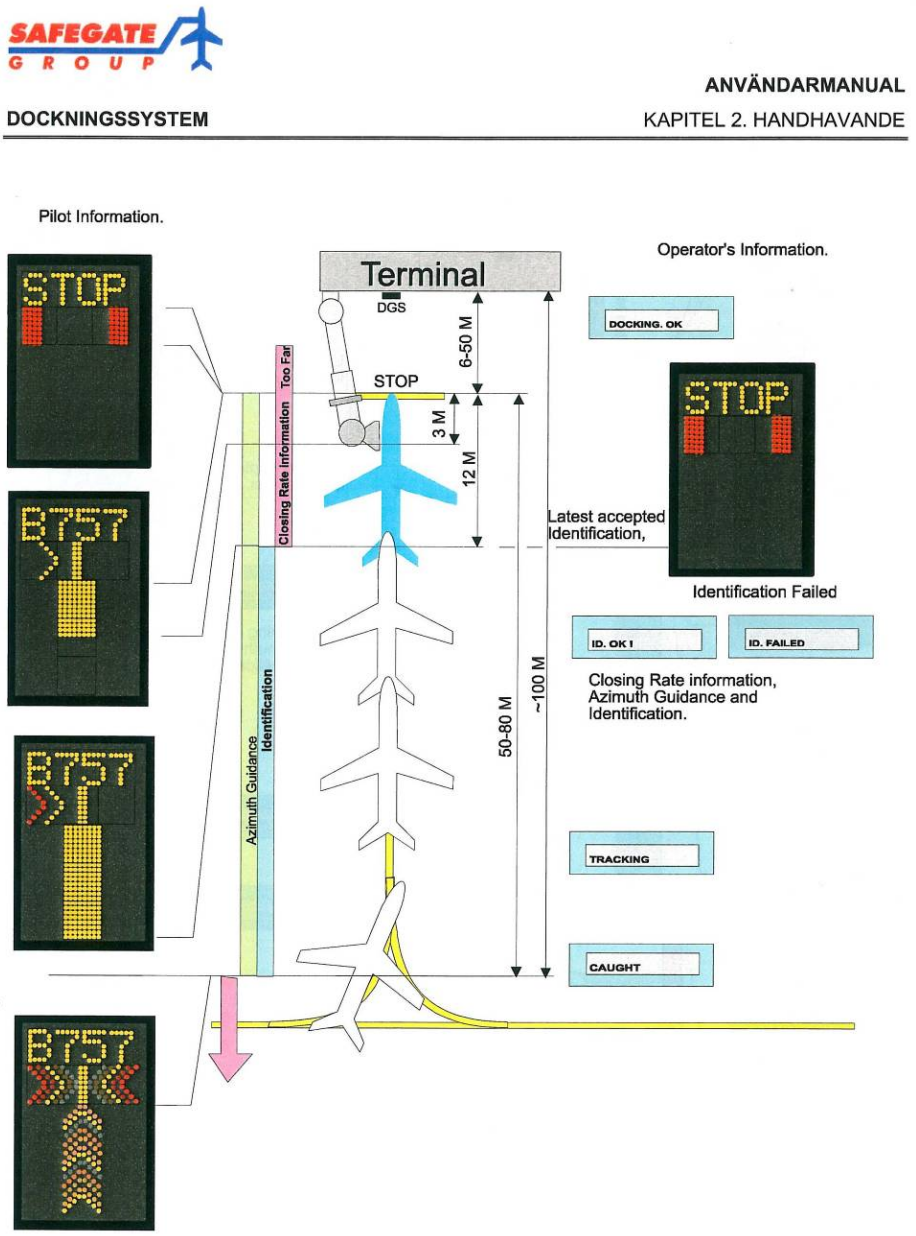

Fig. 5. Docking procedure

Once the aircraft type has been selected, the system's laser scanning unit is activated and goes over to an active mode to search for an approaching aircraft. If visibility is very poor, the text "DOWNGRADE" appears, and the floating arrows are switched off. This is also a message to tell the pilots to taxy in with extra care. The graphical distance meter LEDs light up when the aircraft is caught by the laser, usually about 30 metres from the stop position, and the arrows showing lateral deviation from the centreline and distance indication are activated. This is indicated on the operator's panel by the message "TRACKING" being shown on the display. When the system has identified the approaching aircraft and verified that it is the selected type, "IDENTIFIED" is shown on the operator's display. If verification of the correct aircraft type has not been achieved before there is 12 metres remaining to the stop position, the LED display shows "WAIT", and if a second attempt at verification fails, the message "STOP" is shown. The laser scanning system at gate 18 at Arlanda cannot detect the difference between a B 747 and a B 747 SP.

The DGS system at the gates is not linked to the airport internal information system, in which the type of aircraft is stored.

1.16.3 F pier data transfer

At the most recently constructed terminal at Arlanda airport, called the F pier, the way the docking system handles aircraft types has a different solution. When the operator logs in to the airbridge operator's panel the IATA code for the actual aircraft that is to dock comes up on the operator's display. The operator only confirms the selection of the type and/or its version, by pressing a button.

The system at the F pier has been made possible by the airbridge manufacturer designing the docking installation so that the local computer unit on the airbridge fetches information concerning arriving aircraft types directly from the airport data communications system. A similar modification to the manually operated docking system at terminal 5 is, according to an interview that SHK had with the manufacturer, fully feasible.

1.16.4 Ground equipment

Located on a services building underneath the airbridge there is a panel with a red emergency stop button and a black button. By pressing the black button the ground staff can inform the system that chocks have been placed against the wheels, whereupon the LED display shows: "CHOCK ON". The red emergency stop button has the same function as the emergency stop up on the airbridge control panel.

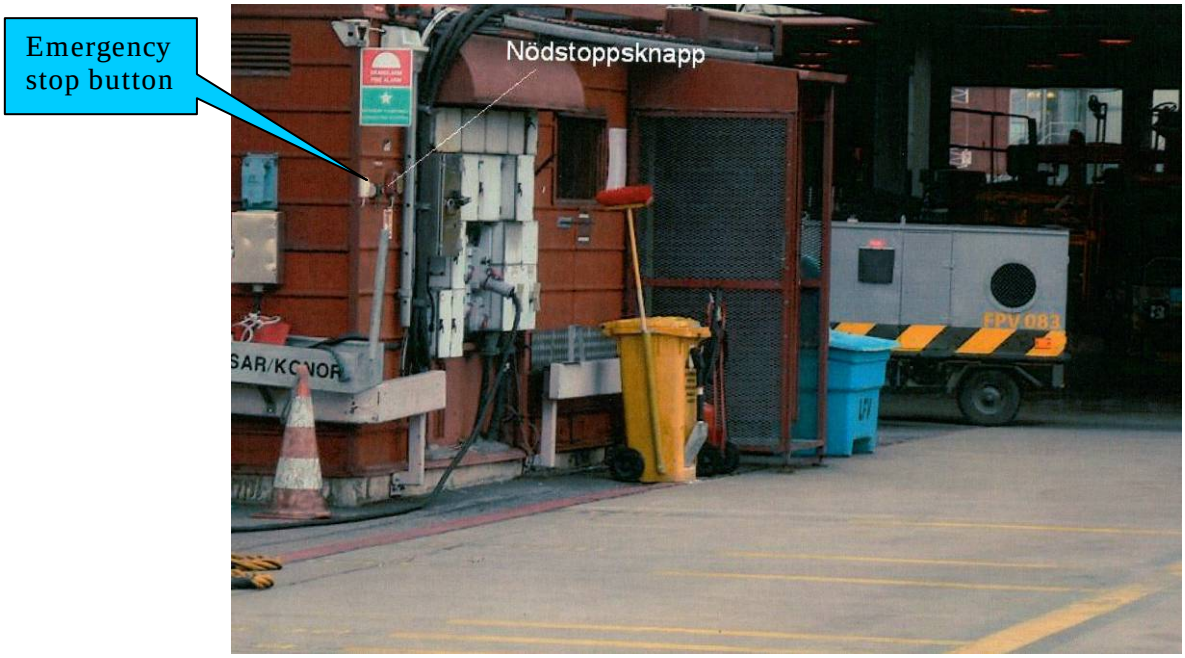

Fig. 6. Airbridge at ground level

1.16.5 Markings

There is a line painted on the ground that the aircraft nosewheel must follow when taxiing into the gate. This line is aligned with the light signals on the LED information display, and guides the pilots in azimuth in to the gate. At the airbridge there are also painted transverse lines to act as stop markings for the nosewheels of different types of aircraft. The line that indicates the stop position for the B 747 SP is located further out from the terminal building than the equivalent marking for the B 747.

1.17 Organisation and management

1.17.1 The airline

The company, which is state-owned, has its main base in Damascus, where the operation and technical headquarters are also located. The operations consist of scheduled flights which are mainly between destinations in North Africa, the Middle East and Europe.

1.17.2 Arlanda airport

LFV is the owner of the terminal buildings and associated gates with their airbridges. Business at the airport is run so that the operative airlines contract individual handling agents at the airport to carry out such tasks as apron services, passenger services and technical services. In this particular case the same handling agent was contracted by the airline to manage both apron and passenger services. This included among other things operating the airbridges and controlling the flow of passengers after disembarkation.

The handling company has the use of the required equipment supplied by LFV to be able to perform the services for the airline, in accordance with a ground services agreement (marktjänstavtal) with Arlanda airport. Further frameworks and requirements for the training of airbridge operators are stated in BCL[4]-F 3.5, item 12.4, Airport Regulations A-12-2000 and Airport Information AI-066-2006. Training and certification for

[4] BCL – Bestämmelser för Civil Luftfart (Civil Aviation Regulations)

separate parts of these duties are managed and followed up in accordance with an agreement between the handling company and LFV.

1.17.3 Training - LFV

LFV trains and certifies "Super Users"[5] in the handling companies, who in turn train their colleagues. As operators become certified, they are reported to the licensing department, to be entered into the card reader system which enables them to operate the airbridges. The certificates issued by LFV are valid for 18 months at a time, and are renewed on application from the handling company. Re-certification and basic training of Super Users is managed by LFV.

If a certified person has not operated an airbridge for a certain period of time, a short refresher course must be completed, which among other things includes three docking manoeuvres. If a handling company does not apply for a person whose licence is about to expire to be re-certified, this person is automatically excluded from the system when the licence has expired. Handling companies themselves are responsible for the training and continuation training of their own staff, with LFV-certified Super Users as instructors. The procedures for certification of airbridge operators were introduced at Arlanda in 2006. The operator at the time of the accident had a valid licence.

In the documentation that SHK has obtained, no training was mentioned in respect of different versions of the same aircraft type.

1.17.4 Training – the handling company

The internal training of airbridge operators in the handling company is based on the operator's manuals and checklist obtained from LFV. The handling company has thereafter itself prepared simplified training material, including a written test.
Before their final graduation within the company, student operators pair up with an instructor or other certified staff. This usually takes place simultaneously with ramp agent training, i.e. gaining authorisation to perform mass and balance calculations for departing aircraft.

In its internal training the handling company concerned does not specifically teach operators the handling of different versions of aircraft types. The written test used for training and certification does not include any questions concerning the use of the airbridge operator's panel. In respect of quality checks of the aircraft docking procedures, the handling company refers to the operator's manual issued by LFV.

1.17.5 The handling company's working procedures

According to the Airport Regulations the handling company is responsible for:

"Ensuring that the correct aircraft type, and where applicable the correct version, is activated in the docking installation" (Airport Regulations A 12-2000).

The handling company applies the following procedure for obtaining information about arriving aircraft:

[5] Super User: A specially trained person who can serve as an instructor

- The first step is that the operator who is to meet the aircraft finds out him/herself which aircraft type is involved from the airport information system, called the NDS.

- The second step is, where necessary, to confirm the aircraft type with the aid of internal TV from ATC[6] where the air traffic control flight progress strips[7] for incoming aircraft are shown.

- The third step is that the operator confirms visually at the airbridge that the correct aircraft type has been entered.

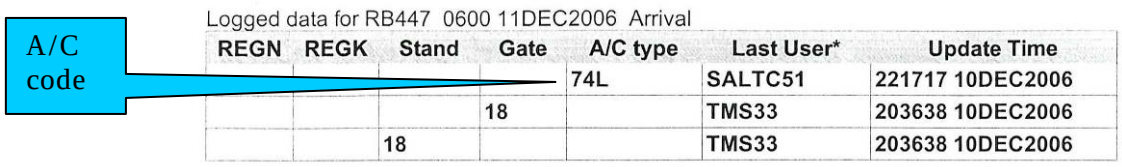

Fig 7. Information from the airport data system

On that particular morning the operator obtained the information "74L" from the airport's internal data system. She did not recognise the name, which is the IATA code for the type version B 747 SP. The coding is internationally ratified and covers all the appropriate aircraft types with their associated versions and variants.

According to the interview with the operator she had not been advised or trained in the differences between types and/or special procedures in the case of different versions of an aircraft type. There was no decoding table available to translate the IATA codes into the names that were used in the docking system.

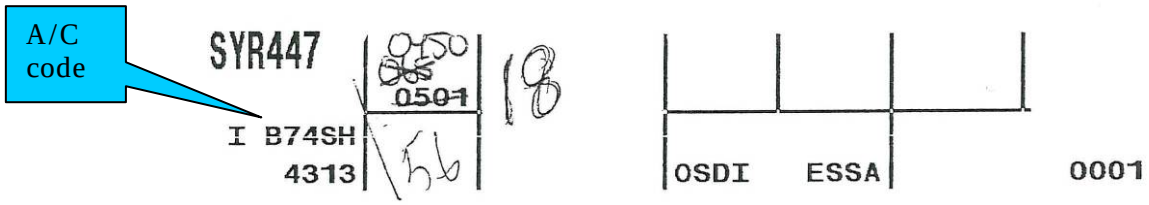

Fig 8. Information shown on the air traffic control flight progress strip

After having consulted colleagues, the operator was advised that this was a B 747, and should in that case use "DOOR 2". She looked at the strip on the internal TV system and could see that the name there was "B747SH". That code is the ICAO[8] name for the B 747 SP, where the original code B74S is complemented by the letter "H" which signifies the "heavy" turbulence category of the aircraft. She was not familiar with that code, either.

Out at the gate the operator only saw the aircraft briefly, but was convinced that it was a B 747. There are only very small differences between the front profile of a B 747 SP compared with a B 747. It was dark at the time the aircraft arrived.

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[6] ATC- Air Traffic Control
[7] Flight progress strips – Paper strips on movable plastic holders on which are noted and updated the data needed by air traffic control in connection with arriving and departing aircraft
[8] ICAO – International Civil Aviation Organization

DGS	ICAO	IATA	ATC
B747SP	B74S	74L	B74SH

Fig 9. Compilation of the different codes used

As can be seen in fig. 9 above, on that morning there were four different codes being used to denote the Boeing 747 SP aircraft type. SHK is not aware of any further coding of this type being used in other contexts. In the checklists that are published by LFV and the handling company respectively in respect of airbridge operation, there are the following instructions concerning entering the aircraft type on the panel:

LFV: *"Activate the docking system and select the type of aircraft."*

The handling company: *"Activate the docking system."*

These instructions do not contain any information or guidance in respect of different versions of the same aircraft type.

1.18 Additional information

1.18.1 Equal opportunities aspects

This event has also been examined from the point of view of equal opportunities, i.e. against the background that there are circumstances to indicate that the actual event or its effects were caused by or influenced by the women and men concerned not having the same possibilities, rights or obligations in various respects. Such circumstances were however not found.

1.18.2 Environmental aspects

There were no known environmental effects.

1.18.3 Previous events:

On two previous occasions B 747 SP aircraft have collided with airbridges at Arlanda airport. In both cases the B 747 and B 747 SP were confused, so that the wrong version was entered into the program. No personal injury was caused by these accidents, but there was extensive damage to the aircraft and the ground equipment. (See SHK Report C 1997:20, accident to Air China B 747 SP on 14 June 1996, http://www.havkom.se/virtupload/reports/C1997_20e.pdf).

After the previous accidents the operator's panel program was modified so that B 747 SP was the version of the aircraft type that would be shown first on the panel when the ramp agent selected B 747. The reason for this change was that it was desired to have the "safer" outer parking position as a basis for preventing a repetition of the earlier accidents. In order to pass beyond the basic setting of B 747 SP one must actively go into the system to select a different version of the B 747.

In connection with the most recent docking accident at Arlanda with a B 747 SP (Air China) in 1996, SHK issued the following recommendations concerning the modification to the docking system at Arlanda airport:

- *"The Swedish Civil Aviation Authority is recommended to ensure that all personnel concerned have full knowledge of the risks in connection with docking, of the function of the systems and of adequate actions to be taken in abnormal situations."*

- *"The Swedish Civil Aviation Authority is recommended to supplement the docking system so that it will be able to distinguish between different versions of the same aircraft type."*

1.18.4 Measures taken

Centrally, by the Swedish Civil Aviation Authority as a result of the SHK recommendations:

In March 1998 (just under two years after the accident) a memo (L 98/62) was written by the CAA stating:

"*This particular event is covered by requirements that already exist concerning staff competence*" and that

"*On installation of new equipment, requirements can be set so that this functionality shall always be included.*"

The issue was not considered to be of "*immediate flight safety importance*" whereupon the case rested until December 2001 (over five years after the accident), when a first conclusion was made on the case as follows:

"*The recommendations have to some extent been taken in hand: The local training by LFV Handling, later known as Novia, ensures that the operators are familiar with the system and are aware of the risks.*

The docking system has not been complemented so that it can distinguish between different versions of the same aircraft type. This capability will be possible when it is replaced by new material."

The case was then deferred for several more years until October 2004 (eight years after the accident), when a further conclusion to the recommendations was decided by the CAA as follows:

"*It is the responsibility of the service provider to permit staff to only operate equipment for which they have received relevant training. If they consider that licensing is necessary, such licensing can be introduced. Lda (the appropriate department within CAA) has not specifically requested this in that particular context.*"

Locally via LFV at Arlanda airport
At Arlanda airport LFV has, among other things, taken the following action in respect of the airport's docking installations:

- The introduction of licensing for airbridge operators.
- Modifications to the docking equipment at certain gates in
- terminal 5.
- Integration of the computer system in the new construction of the terminal (pier F).

2 ANALYSIS

2.1 The Accident

2.1.1 The commander

From the safety viewpoint the accident that occurred must be categorised as very serious, given the fact that the wing contains fuel and a comprehensive electrical system.

Since the aircraft CVR did not hold any useable data, the actions and observations of the pilots while taxying in could not be reconstructed with certainty.

The commander stated that while taxiing towards the gate he only noticed that “B747” was shown on the LED display. The operator at the gate said that she saw the alternating information “B747/2 DOOR” flashing on the LED display while the aircraft was taxiing in. This was later confirmed by the printout from the DGS data memory. On the basis of the available facts, it must be considered completely certain that the display in the DGS system was showing “B747/2 DOOR” as the aircraft taxied in.

SHK has however no explanation for the commander declaring that he only saw “B747” on the display. The fact that the commander continued to taxi in, even though the displayed name was not completely correct can possibly be explained by his earlier experience of problem-free dockings at other airports with B 747 SP where the DGS display indicated B 747.

There is also reason to believe that the commander trusted that the indication was correct, and that the laser scanner would work and indicate “STOP” if the setting did not agree with the docking aircraft type or version. He was however aware that DOOR 2 could not be used when docking a B 747 SP.

The alternation of the texts on the LED display itself draws attention that is difficult to ignore, especially as the display in question is the principal aid for the pilots while taxiing to the gate.
SHK considers it probable that the commander did see the full text, “B 747/2 DOOR” on the display but assumed that it was an unusual but normal local code for the B 747 SP. The fact that the commander completed the taxiing manoeuvre however leads SHK to point out that the company’s training and operating procedures could probably be improved in this area.

2.1.2 The handling operator

Once the operator had made her decision that the arriving aircraft was a “B747” all that remained was the practical work of entering this data into the airbridge housing docking panel. As mentioned in 1.18.1, LFV, after the earlier accidents had occurred, changed the program for the operator’s panel functions in respect of selecting the aircraft type. When selecting B 747, B 747 SP would come up as the first choice. This “barrier” was however revealed as being completely worthless when the operator, as in this case, was totally convinced that she should enter B 747 and had not been trained or informed about the B 747 SP type version.

Since the computer panel in the airbridge housing where the aircraft type is selected is not linked to the rest of the airport’s computer system, there was nothing left to prevent the operator from entering B747. Based on the information available to the operator, SHK finds it probable that she believed that she had correctly prepared for the docking.

When the aircraft during the later stage of taxiing approached the airbridge housing alarmingly quickly, the operator stated that she ran over to the panel and pressed the stop button. The data logger showed however that the stop had already been activated by the ground staff on the apron.

2.2 Training and procedures

2.2.1 LFV

LFV uses a training policy embodying “Super Users”, in which the basic idea is to train instructors so that they can later carry out the direct training of the operators. SHK appreciates that this is a common training model, with obvious advantages, but at the same time considers that the operators’ job involves areas with both risks and responsibilities, where basic training and follow-up should form a natural foundation. Managing a guidance system for heavy commercial aircraft is definitely a part of the job that requires a commensurate training and quality control system.

The training model that LFV has been using cannot be said to meet the requirement for thorough training in respect of the management and risk assessment when working with the control and programming of guidance systems at airbridges.

The earlier accidents at Arlanda when docking B 747 SP aircraft exemplify, on the one hand the dangers of incorrect handling, and on the other the need to tailor the training and advice from LFV to the users, i.e. the handling company’s staff. The deficiencies in training and advice that are pointed out in this report indicate that the problems are not fully appreciated and that the risks associated with incorrect operation are not being taken seriously.

2.2.2 The handling company

The theoretical internal training of operators carried out within the handling company has been brief and relatively limited, mainly based on information and training material supplied by LFV. The practical part of the training has been combined with training to become a ramp agent.

The handling company has in its training of operators not called attention to the risks that can arise when incorrectly entering the aircraft versions and has as a result not included any theoretical or practical steps with respect to this in its internal courses. No training was provided in respect of decoding or identifying the various names of aircraft types.

According to the Airport Regulations (see 1.17.4) the handling company is responsible for the correct aircraft type, or where applicable the correct version, being entered into the docking system computer. In the opinion of SHK such a delegation of responsibility on the part of LFV must be based on thorough training of the affected staff at the same time as providing relevant job documentation, itself based on safety analyses of all the tasks involved, to the users.

2.2.3 Working procedures

According to the routines practised by the handling company (see 1.17.4), the operators themselves must, via a certain system, find out themselves which type of aircraft and/or version is involved.

- The first step, via the airport’s computerised information system, was of little use, since the operator was unfamiliar with the code “74L” and no conversion table for the different aircraft codes was available.

- The second step, to check the incoming aircraft's name via the tower's internal TV, was not useful to the operator either, since she was not familiar with the code "B74SH".

- The third step, to visually confirm from the airbridge housing that the correct aircraft type had been entered, was in this case worthless, since in the dark and viewed directly from the front, it is virtually impossible to distinguish a B 747 from a B 747 SP.

SHK is able to say that the safety barriers that the handling company used were both undersized and inadequate. The operator was obliged to base her selection of aircraft type on good advice from her colleagues and what she herself thought was correct. The pre-selection of B 747 SP that had been inserted as a barrier in the docking panel computer system only acted as an easily overcome obstacle in the process of entering the B 747 type definition that the operator had decided upon.

The safety system that the operator had to rely on in order to perform her work must be regarded as inadequate.

2.3 Arlanda airport

2.3.1 Computer system

The computer system that forms the principal source of information for most participants in the operational side of Arlanda's functions uses IATA coding in respect of aircraft types. This coding system is very detailed and requires knowledge or conversion tables in order to be used correctly and safely.

The docking system in the airbridge housing has its own database and does not use the airport computer system. The type nomenclature for the B 747 SP is for example not the same in both systems. SHK concludes that the built-in weakness resulting from not having the systems integrated has not been identified by either the owner or the operators. An integrated system whereby the docking installation's computer unit fetches the type of aircraft – or where necessary the version – from the airport's central data information system, would probably raise the level of safety considerably, both for ground staff and their airborne colleagues. SHK considers it unfortunate that different aircraft version nomenclature appears in an operational context.

2.3.2 Safety system at the gate

The laser scanning system at gate 18 reads off the front profile of the aircraft that is taxiing in, with the purpose of ensuring that the correct type has been entered. However the system cannot distinguish between different versions where the principal difference is the length of the fuselage.

When SHK issued its previous recommendations, no modifications were available. It can be said, however, that since then updating has come about that is equivalent to the requirements in the SHK safety recommendations for the docking system, in which the laser also detects the distance from the aircraft nose to the foremost engine. According to LFV this update has been installed at certain gates at Arlanda, although not where B 747 SP aircraft are normally docked.

In the case of the newly constructed F pier the docking system computer is integrated into the airport data communications system, which ensures that both the correct aircraft type and its correct version are always used. This system thinking, which cannot be affected to such a degree by human

error, should in SHK's opinion form the basis for a decision to immediately upgrade all the gates concerned at Arlanda Airport.

2.4 General

The recommendations from SHK are directed to the current inspection authority for measures to be taken. In the current case, the recommendations made earlier by SHK were not dealt with in an acceptable manner, which contributed to a Boeing 747 SP for the third time colliding with terminal structures at Arlanda airport. This must be seen as remarkable.

The recommendations presented in this report are to some extent a reiteration of those which were issued earlier by SHK in connection with the previous accidents.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) An updated laser scanning system was not present at the gate concerned.
d) The incorrect version of the aircraft type was entered into the docking system program.
e) Proficiency in the different type versions was not included in the operator's training.
f) The operator did not know the IATA code 74L.
f) A conversion table between the different type codes was not available.
g) There were four different codes for the same type version.
h) The aircraft type part of the computer system at the gate was not linked to the airport information system.
i) Recommendations which had been issued earlier by SHK had not been acted upon.

3.2 Causes

The accident was caused by an inadequate training programme and deficient safety guidance in respect of the gate operator's handling of the docking system. A contributory factor was that safety shortcomings that had been pointed out earlier had not been rectified.

4 RECOMMENDATIONS

The Swedish Civil Aviation Authority is recommended to:

- Via the airport work for that proficiency in different versions of aircraft types is introduced into the training syllabus for gate operators *(RL 2007:23e R1)*.

- Ensure that a relevant safety and quality control system for airbridge operators and guidance systems for docking aircraft is present. *(RL 2007:23e R2)*.

- Ensure that the gates concerned at Arlanda airport are equipped with updated docking systems that can distinguish between different versions of the same aircraft type *(RL 2007:23e R3)*.

- Work for that all docking terminals at Arlanda airport are designed in a way that information regarding aircraft types and type versions not can be misinterpreted. *(RL 2007:23e R4)*.