Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2010:05e

Incident involving aircraft D-ACPE and OH-SAK at Göteborg/Landvetter airport, Västra Götalands county, on 7 December 2007.

Case L-32/07

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

2010-05-06 L-32/07

The Swedish Civil Aviation Authority

SE-601 73 NORRKÖPING, Sweden

Report RL 2010:05e

The Swedish Accident Investigation Board (Statens haverikommission, SHK) has investigated an aircraft incident that occurred on 7 December 2007 at Gothenburg/Landvetter airport, (Västra Götalands county), involving two aircraft with registrations D-ACPE and OH-SAK.

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

The Swedish Accident Investigation Board will be grateful to receive, by 10 November 2010 at the latest, particulars of how the recommendations included in this report are being followed up.

Göran Rosvall Stefan Christensen

Report RL 2010:05e

L-32/07
Report finalised 6 May 2010

Aircraft 1; registration and type	D-ACPE, Bombardier CLRJ700
Class, airworthiness	Normal, valid ARC
Registered owner/Operator	Lufthansa Leasing GmbH & Co. Fox-Uniform OHG/Lufthansa CityLine GmbH
Aircraft 2; registration and type	OH-SAK, BAE AVRO 146 RJ85
Class, airworthiness	Normal, valid ARC
Registered owner/Operator	Steven Limited/Blue1
Time of occurrence	07.12.07, time 07:57:00 in darkness Note: All times are given in Swedish standard time (UTC + 1 hour)
Place	Göteborg/Landvetter Airport, O län (Västra Götalands county), (posn. N 57 39.6', E 012° 17.5', 153 m above sea level)
Type of flight	Commercial air transport
Weather	According to ATIS 07:50: wind 180°/10 knots, visibility 10 km in light rain, broken clouds at 400 feet, temperature/dew point 7/7°C, QNH 979 hPa
Persons on board:	D-ACPE:
crew members	4
passengers	53
Persons on board:	OH-SAK:
crew members	4
passengers	58
Injuries to persons	None
Damage to aircraft	None
Other damage	None

<u>D-ACPE</u>

Commander:	
Sex, age, licence	43 years, ATPL
Total flying time	8320 hours, of which 7608 hours on type
Flying hours previous 90 days	144 hours, all on type
Number of landings previous 90 days	92
First officer	
Sex, age, licence	35 years, CPL
Total flying time	3176 hours, all on type
Flying hours previous 90 days	170 hours, all on type
Number of landings previous 90 days	132
Cabin crew members	2 persons

<u>OH-SAK</u>

Commander:	
Sex, age, licence	38 years, FI
Total flying time	5940 hours
Flying hours previous 90 days	208 hours, all on type
Number of landings previous 90 days	147

First officer:	
Sex, age, licence	46 years, FI
Total flying time	7600 hours
Flying hours previous 90 days	104 hours, all on type
Number of landings previous 90 days	74
Cabin crew members	2 persons

The Swedish Accident Investigation Board (SHK) was notified on 7 December 2007 of an incident involving two aircraft with registrations D-ACPE and OH-SAK occurring that day at 07:57 at Göteborg/Landvetter airfield, O län (Västra Götaland county).

The accident was investigated by SHK represented by Göran Rosvall, Chairperson, Stefan Christensen, Investigator in Charge and Lars Alvestål, operations investigator aviation.

The investigation was followed by Nicklas Svensson, Swedish Transport Agency.

Summary

On the morning of 7 December 2007 Lufthansa CityLine, RJ 700, (LH) intended to take-off from Landvetter with destination Munich. At the same time Blue 1, RJ 85, (B1) was approaching the airport after a flight from Helsinki. LH requested permission to taxi out and received on the GND [1]-frequency clearance to taxi to the holding position runway 21. An SAS aircraft had taxied out for take-off before LH, but aborted the take-off due to a technical fault and therefore began to taxi in again.

On two occasions LH received clearance to the holding position at runway 21, both of which were acknowledged correctly by the crew apart from omitting the words “holding point”. The crew were instructed to change to another radio frequency, which was also acknowledged correctly by the first officer. However the frequency change did not take place, and LH continued to taxi beyond the holding position and lined up on runway 21.

The air traffic controller saw on the ground radar what had happened and ordered B1 to go around. At that time B1 was at a distance of about 2000 metres from the runway threshold.

After analysis of the air traffic control audio tape it was established that the crew used phrases in their radio communications that were not in accordance with the international standard phraseology. It also became apparent that the air traffic controller did not request readback of the clearances that had not been fully acknowledged by the LH crew.

International studies carried out by Eurocontrol have shown that “non-standard phraseology” is a problem area within radio communication. Runway incursions belong to the area that has seen a negative trend within the work of European flight safety.

The incident was caused by deficiencies in the self-inspection system in the respect of the application of standard phraseology by both the operator and air traffic control.

[1] GND: (Ground) Radio frequency for the guidance of traffic into and out of terminal ramps or remote parking areas.

Recommendations

It is recommended that the Swedish Transport Agency should:

- Explore possibilities for the clearance of aircraft taxiing to take-off position to exclude runway name *(RL 2010:05 R1)*.

- In its international flight safety work to ensure that the document "*European Action Plan for The Prevention of Runway Incursions", EAPPRI,* is suitably distributed to the relevant participants within European aviation *(RL 2010:05 R2)*.

1 FACTUAL INFORMATION

1.1 History of events

1.1.1 The air traffic situation

On the morning of 7 December 2007 Lufthansa CityLine, RJ 700, (LH) intended to take-off from Landvetter with destination Munich. At the same time Blue 1, RJ 85, (B1) was on the approach to the airport after a flight from Helsinki. LH requested permission to taxi out and received clearance to taxi to the holding position at runway 21.

An SAS aircraft had taxied out for take-off before LH, but was forced to abort its take-off due to a technical fault and therefore began to taxi back to the terminal. The LH crew felt disturbed by the lights of the SAS aircraft that was taxiing in, and therefore paused their reading of the checklist, in order to evaluate the situation.

The air traffic controller intended to organise the traffic so that LH would have to wait to take-off until B1 had landed. As LH approached the holding position for runway 21, B1 was on finals and had received landing clearance.

The air traffic controller however noticed on the ground radar that LH had lined up on the runway without receiving clearance for this. The air traffic controller then instructed B1 to go around. B1 initiated the climb and passed over the end of the runway, where LH was positioned, at an altitude of about 1300 feet above the threshold. When B1 received the instruction to go around, the distance to the runway threshold was about 2000 metres and the altitude was about 400 feet above the runway threshold level.

1.1.2 Sequence of events - Lufthansa CityLine (LH)

The engine start and the first part of the taxi out were in accordance with normal procedures. The air traffic controller on the GND frequency gave LH clearance to taxi to the runway 21 holding position. This was acknowledged correctly by LH, except that the words “holding point” were omitted. The crew experienced the lights from the SAS aircraft that was taxiing in as disturbing, and since the aircraft were not on the same frequency, the LH crew were unaware of the earlier events or the air traffic control intentions. The commander therefore ordered the first officer to wait with the checklist until the situation with the SAS aircraft was clear.

The illustration at Figure 1 shows the positions of the aircraft, where LH is taxiing on taxiway Z and the SAS aircraft is about to taxi in via taxiway Y. The illustration also shows the holding position, to which the air traffic controller had given LH clearance. At the time the aircraft were at the positions shown in the illustration, LH was instructed to contact the control tower on a new frequency, which was acknowledged correctly by the first officer, who was managing the radio communication during taxiing.

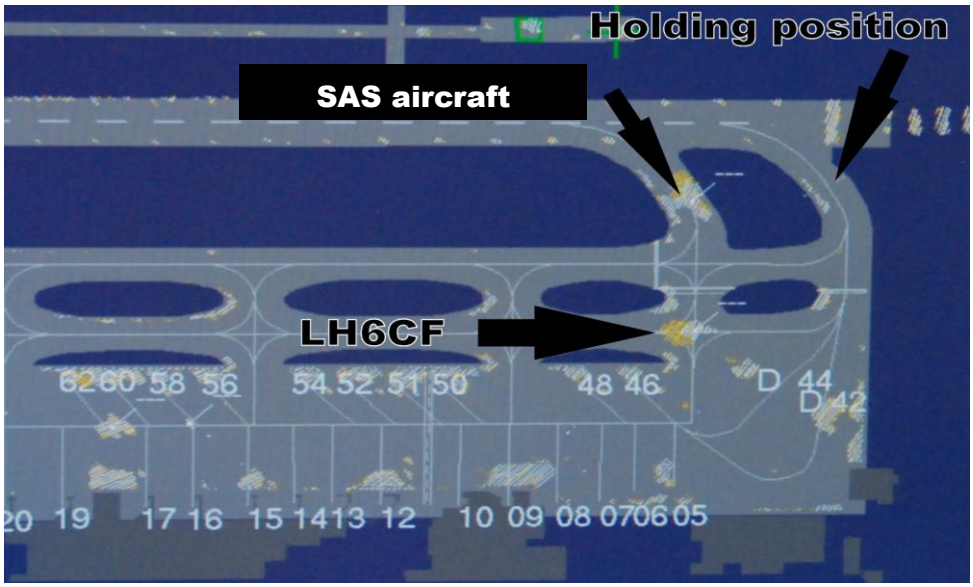

Fig.1. Ground surveillance radar image showing the positions of the aircraft.

The LH crew did however not contact the control tower on the new frequency, but continued to taxi past the holding position for runway 21 and lined up on the runway. At the time it was dark and visibility was reduced due to light rain that had begun to fall.

1.1.3 Sequence of events - Blue 1(B1)

The aircraft was in an instrument approach to runway 21. Since the weather was largely cloudy with a cloud base of about 400 feet, the crew of B1 had no visual contact with the airport at any point during the approach. Radio communication had previously taken place with approach control and the aircraft was not handed over to tower control until the later part of the approach.

The crew was not aware of the air traffic situation at the airport. At the first contact with control tower they only received instructions to continue the approach. At an altitude of about 950 feet MSL[2] the tower ordered B1 to go around. The aircraft descended a further 40 feet before a climb was initiated.

After the go around, B1 was vectored by radar to a new approach to runway 21. On checking the data from this approach it could be calculated that the time from a point during the approach path at 400 feet above threshold level – where the approach was terminated – to the runway threshold itself was 39 seconds.

1.1.4 Overview of the events

The following overview is based on extracts from the tape recordings of communication with air traffic control and data from the aircraft´s Flight Data Recorder, FDR. All timing referred to below is in respect of 7 a.m., Swedish standard time.

Normal text in **bold** indicates transmissions on the ground frequency (GND), i.e. the radio frequency used to guide traffic into or out of the terminal parking ramp or remote parking ramp at the airport.

Italic text indicates transmissions on the control tower frequency (TWR), which was the frequency used to advise airborne traffic in the vicinity of the airport.

[2] MSL: Mean Sea Level

Time	Communication	Event
55:02	**LH6F request taxi please**	LH request clearance to taxi on the GND frequency.
55:06	**LH6F taxi via Hotel and Zulu to holding point runway 21**	Clearance obtained.
55:11	**Hotel Zulu runway 21, LH6F**	LH acknowledgement of the clearance.
55:22	*I don't believe it but we have to revert again*	SK1813 (SAS), aborting for the second time an attempted take-off on runway 21 due to a technical fault and requests to taxi back in again.
55:30	*1813 Roger, same procedure as last time, on the runway and left on Foxtrot again*	Clearance from TWR in respect of SAS taxiing back to the terminal.
56:31	*Established, Bluefin 471, ILS 21*	BLF471 (B1) reporting on the tower frequency and advising they are on finals for runway 21.
56:36	**LH6F continue to holding point for full length**	Instruction to LH to avoid meeting the SAS aircraft which is taxiing in.
56:39	*Continue approach, Bluefin 471*	B1 receiving instructions to continue approach.
56:42	*SK1813 contact GND 121.9*	SAS receiving instructions to make contact on the GND frequency.
56:51	**Wilco, 6CF**	LH acknowledgement. ("Wilco" is an abbreviation for the expression "will comply").
57:06	**LH6F contact TWR 118.6, tschüs**	LH receiving instructions to make contact on the TWR frequency.
57:10	**118.6 to TWR, 6CF, bye, bye**	LH acknowledgement of the instructions.
57:10-58:18		LH continues to taxi without changing frequency to TWR and at 58:18 lines up on runway 21 without clearence.
58:19	*Bluefin 471 make a go around*	The air traffic controller notices on the ground radar that LH has lined up on the runway, and instructs B1 to go around.
58:30	*LH6CF are you here?*	The air traffic controller asks LH if they are on frequency.
59:01	*Did we mix up something with the line up clearance?*	LH asks if there has been some confusion in connection with the clearance to line up on the runway.

In the overview it can be inferred that the LH crew did not hear the communication with the SAS aircraft and were therefore not aware of this part of the events. It can also be said that parts of the clearance given to LH were not read back correctly in accordance with the prescribed phraseology, and that the instruction to contact the tower was not complied with. LH then lined up on the runway without having received clearance, whereupon the air traffic controller had to instruct B1 to go around.

The air traffic controller later contacted air traffic control in Munich and asked them to inform the commander of LH to contact air traffic control at Landvetter after landing. When the commander had landed he contacted the Landvetter air traffic controller, and they discussed the events that had taken place. Both parties reported the event. The report from the crew of LH was written jointly by the commander and first officer.

The incident occurred at position N 57 39.6', E 012° 17.5, 153 m above sea level, at Gothenburg/Landvetter airport.

1.2 Injuries to persons

None.

1.3 Damage to the aircraft

None.

1.4 Other damage

None.

1.5 The crew

1.5.1 Commander of D-ACPE (LH)

The commander was 43 years old at the time and had a valid Airline Transport Pilot Licence.

Flying hours			
Previous	24 hours	90 days	Total
All types	6	144	8320
This type	6	144	7608

Number of landings this type previous 90 days: 92.
Flight training on type carried out on 2 October 2000.
Latest PC (Proficiency Check) carried out on 16 July 2007 on the same type of aircraft.

1.5.2 First officer of D-ACPE (LH)

The first officer was 35 years old at the time and had a valid CPL.

Flying hours			
Previous	24 hours	90 days	Total
All types	6	170	3176
This type	6	170	No data

Number of landings this type previous 90 days: 132.
Flight training on type carried out on 2 July 2003.
Latest PC (Proficiency Check) carried out on 27 July 2007 on the same type of aircraft.

1.5.3 Cabin crew of D-ACPE (LH)

Two persons.

1.5.4 Duty schedule of D-ACPE (LH) crew members

The crew had spent the night in Gothenburg – with a rest period of 16 hours 35 minutes – and the flight in question was the first in a planned programme for the day covering 6 hours.

The commander was on the fourth day of his duty programme and during that particular duty period had logged 13.2 hours.

The first officer was on the third day of his duty programme and during that particular duty period had logged 16.0 hours.

1.5.5 Commander of OH-SAK (B1)

The commander was 38 years old at the time and had a Finnish licence.

Flying hours			
Previous	24 hours	90 days	Total
All types	8	208	5940
This type	8	208	2850

Number of landings this type previous 90 days: 147.
Flight training on type carried out on 30 October 2003.
Latest PC (Proficiency Check) carried out on 21 September 2007 on the same type of aircraft.

1.5.6 First officer of OH-SAK (B1)

The first officer was 46 years old at the time and had a Finnish licence.

Flying hours			
Previous	24 hours	90 days	Total
All types	1	104	7600
This type	1	104	2322

Number of landings this type previous 90 days: 74.
Flight training on type carried out on 18 February 2002.
Latest PC (Proficiency Check) carried out on 9 November 2007 on the same type of aircraft.

1.5.7 Cabin crew of OH-SAK (B1)

Two persons.

1.5.8 Duty schedule of OH-SAK (B1) crew members

Not applicable.

1.5.9 Air traffic controllers' duty schedule

The air traffic controller GND had come on duty with two other air traffic controllers at 06:50 on that particular morning. Nothing has emerged to indicate that the duty and/or rest periods of the air traffic controllers had deviated from normal routines.

1.5.10 Interviews

SHK has interviewed the GND frequency air traffic controller, and also the commander and first officer of LH.

The commander considers that the readback of the first message at 07:55:06 "LH6F taxi via Hotel and Zulu to holding point runway 21", with the reply from LH being "Hotel Zulu runway 21, LH6F", was "basically OK, still safe". In his opinion the actual readback did not have any decisive effect on the sequence of events. Since the crew fully understood the clearance it was of no significance that the readback was incomplete.

In respect of the other, supplementary clearance at 07:56:36 "LH6CF continue to holding point for full length", where the reply was "Wilco" from LH, the meaning was completely clear to him. "Wilco" is of course not a term included in the standard phraseology, but it is a word that the commander believed could be used in that situation, where the crew were busy trying to understand what the other (SAS) aircraft intended to do and where it was going, so that the crew had little additional capacity for radio communication.

The first officer often uses the term "wilco". This minimised the length of the radio traffic and reduced the stress level, e.g. when there was a great deal of radio traffic on the frequency. In this particular case however the clearance should in his view have been read back in its entirety. He should also have contacted the control tower after having been instructed to do so.

In respect of the first clearance it would not have made any difference to the subsequent events even if the air traffic controller had demanded a complete readback, since the crew completely understood the clearance. If on the other hand the second clearance had been read back correctly it may have made a difference.

The Ground movements air traffic controller is of the opinion that it is very common for pilots to miss certain words while reading back, and hence shorten the readback, and sometimes several requests are necessary in order to get a correct readback. Sometimes there is a comment. The air traffic controller was aware that "holding point" had not been read back, but accepted this as he was convinced that the message had been properly understood.

The reason that "full length" was stated, and that the taxiway was not given its name, was that the air traffic controller considered that the whole of the long taxiway was called Yankee, (Y), including the entrances after 90 degree turns. According to the air traffic controller, the taxiway was called Y at three different places and this could lead to misunderstandings (compare with Figure 2).

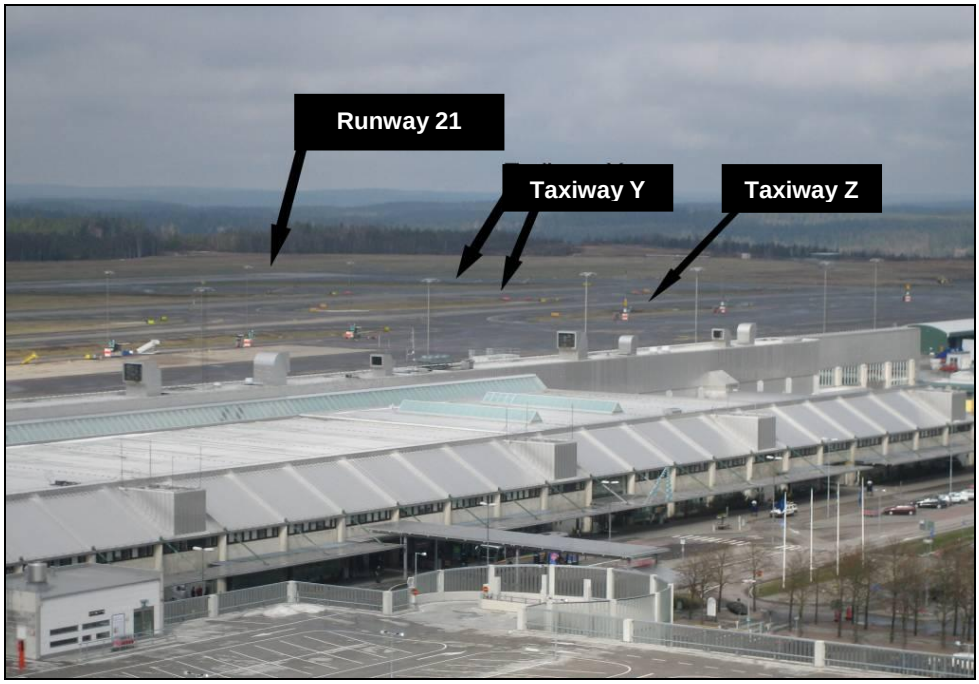

Fig.2. View from the air traffic control tower.

1.6 The aircraft

1.6.1 D-ACPE

The aircraft	
Manufacturer	Bombardier
Type	CLRJ700
Serial number	10027
Year of manufacture	8 October 2001

Engine	
Manufacture	General Electric
Engine model	CF-34-8C5
Number of engines	2

The aircraft had a valid ARC.

1.6.2 OH-SAK

The aircraft	
Manufacturer	BAE Systems Limited
Type	AVRO 146 series RJ85
Serial number	E2389
Year of manufacture	2001

Engine	
Manufacture	Honeywell (Textron Lycoming)
Engine model	LF507-1F
Number of engines	4

The aircraft had a valid ARC.

1.7 Meteorological information

According to the SMHI (Swedish Meteorological and Hydrological Institute) analysis:
Wind 180 degrees, 10 knots, visibility 8-10 km, 6-8/8 stratus with base at 500 feet, temperature/dew point +7/+7 °C, QNH 979 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Radio communications

The communications between the aircraft and air traffic control were obtained and a transcript printed out. In addition to the extract presented in Section 1.1.4 of this report, SHK has inspected the transcripts and found that these support the statements made by the parties in respect of the events.

1.10 Aerodrome information

The airport status was in accordance with AIP[3]-Sverige/Sweden. The runway entrances are equipped with stop bars, i.e. a row of red lights submerged in the taxiway asphalt. Stop bars are however only located at the holding positions that are called CAT II holdings, i.e. places to wait further away from the runway, and are used in very poor visibility. At this particular time these holding positions were not in use.

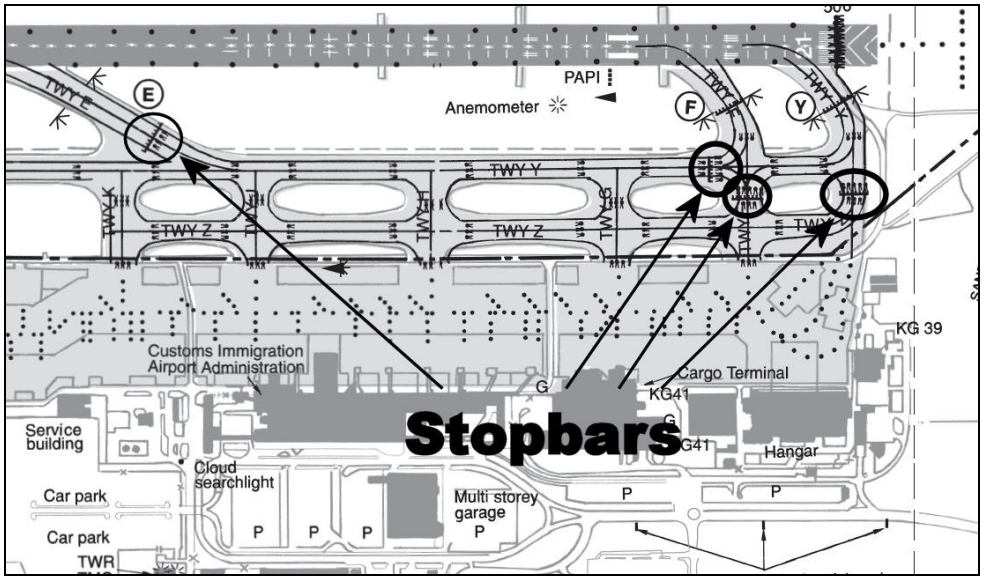

Fig.3. Runway 21 showing the stop bar locations.

1.11 Flight recorders and voice recorders

1.11.1 Flight Data Recorders (FDR, QAR, GPS)

QAR[4]data was available from both aircraft.

[3] AIP – Aeronautical Information Publication
[4] QAR: Quick Access Recorder. Recording equipment which records the flight parameters.

1.11.2 Cockpit Voice Recorders (CVR)

SHK was unable to secure the audio recording from LH. The company did not remove the CVR from the aircraft after the incident. The CVR had a recording time of 120 minutes and was of "solid state" type, i.e. it did not contain audio tape or similar material, instead the information was recorded into a digital memory. The actual flight time from Landvetter to Munich was 1 hour 43 minutes.

1.11.3 ICAO[5] Annex 6

ICAO Annex 6, Operation of Aircraft Chapter 6.3 contains the international regulations concerning Flight Recorders. In Chapter 6.3.9.1 it is stated that the basic requirement for a CVR is that it shall record at least the most recent 30 minutes. There is no requirement for 2 hours of recording time for aircraft that have received their Certificates of Airworthiness granted before 1 January 2003 (in accordance with Chapter 6.3.9.3).

It is stated in Chapter 6.3.11 that flight recorders (including the CVR) must not be switched off in flight.

The fact that the operator is responsible for the recorded information is stated in Chapter 11.6. There it states that an operator must ensure, as far as possible, that in the event of an aircraft becoming involved in an accident or incident, all the recorded information, or where necessary all the recording equipment, is safely preserved until a decision has been taken as to how it will be used, in accordance with Annex 13.

1.12 Incident site

Gothenburg/Landvetter Airport

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

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

None.

[5] ICAO. International Civil Aviation Organisation. Organisation with rules that Sweden, Germany and 188 other countries have undertaken to comply with.

1.17 Organisational and management information

Lufthansa CityLine is a wholly owned subsidiary of Lufthansa. The company operates airline traffic on behalf of Lufthansa with about 60 aircraft on routes all over Europe.

SHK has obtained certain information from the company's manuals with regulations concerning radio communication and checks of pilot competence.

In the company's OM-A Section 8.3.3.3 it states that the first en-route clearance with any changes must be written down. No requirement is defined that taxi clearances or other clearances must be written down.

The company's pilots undergo regular proficiency checks in a simulator (PC) to practice such measures as emergency procedures for the aircraft. A proficiency check may also cover certain special areas, such as technical, operational and air traffic control procedures as training measures. In respect of the commander it could be determined that one of these special areas that were practised during one of his most recent PCs was "ATC Phraseology".

In order to check and maintain the desired standard and uniformity of operations, line checks or supervision flights are carried out. These checks are performed during ordinary line operations, having a check pilot present with the crew in the cockpit for a certain number of flights. In addition to the above-mentioned, it is also the purpose of these procedures to identify and suppress undesired sub-cultures that could possibly otherwise arise during operations.

The line check reports from two years previously in respect of the commander and first officer showed nothing out of the ordinary, and the comments from the respective instructors were only of a positive character.

1.18 Other

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. No such circumstances were however found.

1.18.2 ICAO rules concerning phraseology

In ICAO Annex 10, Vol II Chapter 5.1.1.1 it is prescribed that ICAO standardised phraseology must be used in all the situations for which it has been specified. Only in circumstances where standardised phraseology cannot be applied should normal language be used.

ICAO PANS-ATM (Air Traffic Management) document 4444, Chapter 4.5.7.5.1 prescribes that crew should always read back clearances and instructions to taxi into, land on, take off from stop ahead of, cross or taxi on to runways and taxiways.

According to Chapter 4.5.7.5.2 air traffic controllers must listen to readbacks in order to ensure that crew have understood clearances or instructions correctly and take immediate action if the readback shows that the crew has misunderstood something.

According to Chapter 12.3.4.8 it is also stated that the words “Roger ”and “Wilco” are not sufficient replies to taxiing instructions.

1.18.3 *Radio communications for civil aviation*

Over the years a number of studies have been carried out into radio communications problems within civil aviation, with the aim of finding reasons for and solutions to such problems. Many studies came to comparable solutions in respect of communication problems and the causes of errors within communication. It can be said that despite all the investigations, studies and recommendations, pilots and air traffic controllers tend to make the same types of errors and mistakes.

The errors and mistakes within radio communications are often identified as the principal reasons for certain types of incident in civil aviation, such as reduced aircraft separation, altitude deviation, active runway incursions etc. One of the studies that was performed contains 535 reports concerning communication problems between pilots and air traffic controllers which took place in European airspace during the period March 2004 to April 2005. The study, *“Air-Ground Communication Safety Study: Causes and recommendations”* was carried out by Eurocontrol[6]. Apart from statistics and assessments, the study was complemented by a questionnaire sent to both air traffic controllers and pilots in respect of proposals and recommendations to solve various problem areas within radio communication. Extracts from this study presented in this report are included with the permission of Eurocontrol.

1.18.4 *Problem areas*

The problems dealt with in the report have been divided into a number of principal areas, where the five categories that most of the reports covered have been given special attention.

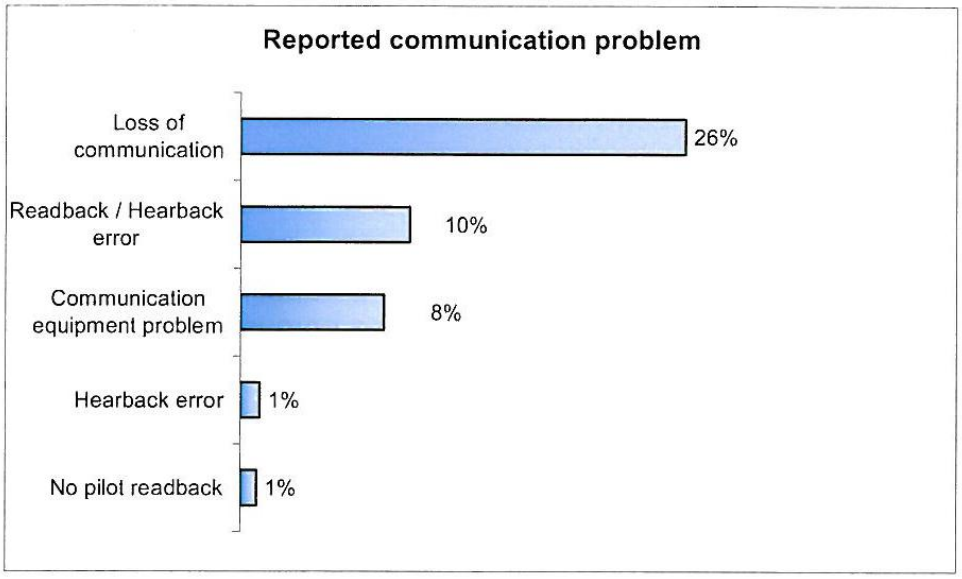

Fig. 4. Distribution of reported communication problems.
(Source: Eurocontrol)

It can be seen from the above diagram that lost radio contact is the dominant category, and that the areas which most closely affect the incident that is the subject of this investigation, “hearback error” and “no pilot readback” come lower down among the reported incidents. The percentage proportion of reported incidents that are not in the diagram is in respect of incidents that are

[6] Eurocontrol: European organisation for safety-related air traffic control issues.

categorised as singular events ("other communication problems" – 36%), and events that were not reported by pilots or air traffic control – 18%.

Among the particular areas that were studied can also be mentioned "non-standard phraseology". Almost half of those who replied to the questionnaire (47%) reported problems related to non-standard phraseology in connection with reported events and incidents. The main factors which, according to the questionnaire, were seen as contributing to deviations within this area were:

- Non-standard phraseology from air traffic controllers (64%)
- Dialects/Accents from air traffic controllers (49%)
- Language problems (46%)
- Phraseology with more than one meaning (45%)
- Non-standard phraseology from pilots (41%)

The study also included a review of the possible consequences of the reported incidents.

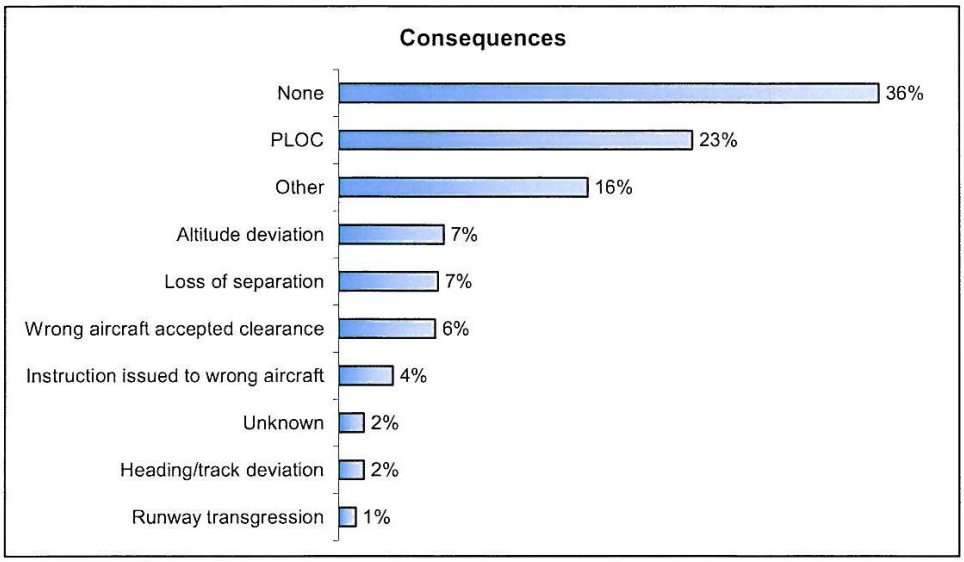

Fig.5. Distribution of consequences. PLOC: Prolonged Loss of Communication. (Source: Eurocontrol)

In the above diagram it can be seen that most of the incidents did not lead to any consequences, although a large number brought about deviations that could generate flight safety risks. This particular case at Landvetter can be placed into the last category, "*Runway transgression*". The table does not show the degree of seriousness of the incidents – only the categories into which the consequences have been assigned.

The category of runway transgressions (or incursions) belongs to an area that has seen a negative trend within the work of European flight safety. An action plan within European flight safety was therefore instituted in 2003, *"European Action Plan for The Prevention of Runway Incursions" (EAPPRI)*. This plan resulted in 56 recommendations – where a large number concerned communication – in respect of improved safety within this area, and these have thereafter been updated a number of times.

1.18.5 Safety barriers

It has often been said that by their nature communications are to be regarded as a weak link in the flight safety chain that surrounds civil aviation. This weakness is often defined as a system deficiency in regard to safety barriers,

where radio communications are difficult to “double check”, so that barriers are instead erected in order to handle the consequences of these systemic deficiencies.

Within civil aviation these consist, among other things, of airborne and ground collision warning systems based on the on-board transponder equipment. In aircraft there is TCAS (Traffic Collision Avoidance System), and air traffic control STCA (Short Term Conflict Alert). These systems form safety barriers when the separation criteria are breached, and their main area of application is in the air.

For ground operations there is no equivalent collision warning system. Certain larger airports do have ground radar, but these are of the primary radar type and are at present not integrated into automated warning systems. The basic rules are that if the manoeuvre area cannot be controlled manually – or when the ground radar is missing or out of order - only one movement at a time is allowed. It is, in other words, normally not possible to have a plane taxiing to the holding position while an aircraft is in landing phase.

There are also various types of visual barrier to prevent incursions on to active runways. These may consist of signs, runway markings, flashing lights or stop bars (see SHK Report RL 2009:18).

The system that however forms the basis for the control of airport traffic is two-way radio communication. The safety barrier that exists in respect of radio traffic is founded on the standardisation of messages and the procedures whereby instructions and clearances are verified by reading back. The strength of these barriers varies a great deal, taking into account the large number of interference sources that can affect radio traffic.

The personnel who work with this system – air traffic controllers and pilots – undergo certain recurring proficiency checks after completing their training. Pilots have regular checks in simulators, with the main emphasis on operational training in systems and emergency procedures. In addition to this supervision flights are performed on a regular basis, aimed at catching deviations and sub-cultures in their operations.

Air traffic controllers also undergo regular proficiency checks of an operational nature. The other checks of a supervisory nature that are carried out, (NOSS[7]), are however not recurring, but take place in connection with changes and/or the introduction of new systems or procedures.

[7] NOSS: Normal Operation Service Supervision.

2 ANALYSIS

2.1 General

The incident that took place can in principle be categorised as serious. The actual events at Landvetter did however not lead to more serious consequences since the air traffic controller could see on the ground radar that the aircraft had lined up on the runway, and could thereby instruct the aircraft that was landing to go around with a relatively safe margin. In this respect the safety system – with its barriers – could be considered as functional.

What however qualifies the incident as being classified as serious is that it could have occurred in poor visibility at an airport without ground radar. Most Swedish commercial airports currently do not have ground radar and must therefore rely on other barriers.

Although it is not allowed to have simultaneous movements when the manoeuvre area cannot be monitored, unexpected deterioration - of for example visibility - quickly can remove that barrier. See SHK Report RL 2009:18.

2.2 Conditions

It can be said that the work flow and events during the time period that preceded the incident had been normal and of an expected character, where the SAS aircraft taxiing in for a second time was the only disturbing factor. The traffic situation at that particular time was otherwise not particularly busy and is not assessed as having any negative effect on any of those involved in the incident. The air traffic controllers had not experienced the conditions as being any other than normal on that particular morning. All the airport systems were fully operational and the weather was not expected to cause any disturbance to traffic.

The LH crew did not state that there were any planning problems concerning their operations, neither technical nor in terms of traffic. When LH requested to taxi on the GND frequency it was with a crew who probably were not under strain from any expected problems or difficulties.

2.3 Clearances

2.3.1 The crew

Reading back a clearance has several effects. On the one hand it is an acknowledgement to air traffic control that the pilots have understood the message, and on the other hand it promotes a further effect, a kind of tuition that affects both (all) the pilots in the cockpit. If a particular word is not read back, that word has been spoken once (by the air traffic controller), and if the pilots heard the word, it has been heard once by the pilots. If the word is read back, it has then been heard twice by the pilots. The tuition effect for the pilots will thus be twice as much if the word is read back. The probability that the word will not be forgotten also increases considerably. The readback itself also means that the pilots will remember its content better. If in addition the other pilot (the one who is not conducting radio communication) repeats the word, it will have been heard once more by both pilots.

There is no requirement by the company to write down the taxi clearance. Writing it down would however achieve at least two functions: one is that it will be remembered better than if it had not been written down, and another is

that it will be possible later to look at what was written, if there is any doubt about what clearance was received.

In this particular case two sets of instructions on two occasions included the words “holding point”. At 07:55:06 (“LH6F taxi via Hotel and Zulu to holding point runway 21”, and at 07:56:36 (“LH6F continue to holding point for full length”). In neither case did LH read back the words “holding point”, and it was precisely that part of the instruction that was not carried out, since they taxied past the “holding point” and lined up on the runway. Consequently it must be regarded as significant that the clearance was not read back correctly.

2.3.2 The air traffic controller

The air traffic controller on the GND frequency who gave the two clearances was aware that he had not requested a complete readback of them. If this had been done, it would have increased the chances of the crew remembering the clearance to the “holding point” and thereby obeying it.

In a stressful situation or under time pressure it can sometimes be tempting to “save some time” by deviating from standards or take other short cuts to rationalise the work flow. It is understood by SHK that in all types of business there is always a risk of deviations and sub-cultures of various types. Operations or system management that proceed without accidents or serious incidents often have a greater exposure to risk since “everything works well and safely”. In such operations everything from minor local interpretations of rules and regulations to quiet acceptance of deviations, from for example standard phraseology can gradually become “normal” parts of the daily operations.

2.3.3 The frequency change

At 07:57:06 the crew received an instruction on the GND frequency to contact the control tower. At that time the aircraft position was approximately as shown in Fig. 1. The instruction was read back by the first officer. The commander did not remember receiving it. A contributory factor for the frequency change presumably not being performed immediately could have been that the instruction was received almost simultaneously with the SAS aircraft approaching along taxiway F, almost straight at LH, which thus was disturbed. The disturbance lay in the fact that the SAS aircraft had powerful lights lit which were dazzling, and that the commander of LH did not know where the SAS aircraft was going, which he could have taken to be a potential collision risk, and this therefore occupied his concentration at that moment.

2.4 Standard phraseology

As stated in this report, standard phraseology was not always used. It can also be determined that the readback was not requested, when, for example, acknowledgement of a clearance was not provided. According to the investigations that were carried out – referred to earlier in this report – it was found that influential factors applied, in that non-standard phraseology was a problem area in connection with reported events and incidents. The lack of standard phraseology applies to both air traffic controllers and pilots.

Since radio communication forms a weak link in the flight safety chain, communications systems in their present state must be safeguarded by both standard application and strict discipline in order to maintain a constantly high level of flight safety.

Increased traffic intensity and/or increased time pressure in respect of operational implementation must not lead to an already weak link being weakened further by deviations from standard phraseology or by quietly accepted sub-cultures.

The other factors that surrounded this particular event cannot be considered to have been of such importance that they could to a sufficient degree have been able to reduce the crew's capacity to manage communication and their understanding of the clearances. SHK therefore considers that the major individual reason why this incident could occur was the existence of a sub-culture in respect of radio communication on the part of the operator, and its quiet acceptance by air traffic control. Taken together these to a large extent contributed to that fact that this incident could occur.

2.5 The incident

It has been found that the LH crew was unaware of the radio communications with the aircraft that aborted its take-off and began to taxi back in. The reason for this was that the two aircraft were tuned to different radio frequencies. The LH crew reported that the aircraft that was taxiing in disturbed them and also had a rather confusing effect on their work in the cockpit and associated radio communications.

However a traffic situation with aircraft on different frequencies is to be regarded as standard at large airports with international traffic. Even if the LH crew had seen the unknown aircraft that was taxiing in as a latent collision risk, they did not call the control tower to report it, which indicates that the crew had not regarded the situation as posing a serious risk.

The pilots claimed that both the forgotten frequency change and the line-up on the runway without permission were the effects of the previously mentioned disturbance. As mentioned earlier, the traffic intensity - and the workload this resulted in - were not particularly high at the time. In respect of the taxiing aircraft with its intentions not completely clear to the crew, this kind of event is relatively common in the opinion of SHK, and not a good enough reason to define it as the cause of the incident.

SHK considers the reason for the development of the events is better found in the deviation from the established standard phraseology. It was found that on two occasions LH had received clearance to the "holding point" but on neither occasion read this back. On the first occasion it was completely omitted, and on the second occasion the acknowledgement was replaced by "wilco". The absence of a request by the air traffic controller for a readback probably thereafter contributed to the continued actions of the crew, based on the incorrect assumption that the clearance also included permission to line up for take-off.

2.6 Barriers

2.6.1 Self-inspection and deviation

This investigation has found deviations in the cases of both the operator and air traffic control. These were not – seen in isolation – of a serious nature. Taken together, however, the deviations did contribute to the occurrence of an incident. There are several methods of catching deviations. These can be audits or an active reporting culture, etc. Common to all of these however, is that to manage deviations there is usually a requirement for committed "errors", systems that have failed, breaching of predetermined limits, etc. so that the system will be initiated.

In the case under consideration here – given that an incident had *not* taken place – the actions of those involved would probably not have resulted in a deviation report. The reason why SHK advances this is that the deviations were of such a character that they would have become a part of the daily work in the respective organisations, and thereby would have been quietly accepted as a perhaps necessary element of operations.

This phenomenon is in no way a new occurrence, neither in aviation nor in other businesses. Since the usual methods of trapping similar deviations did not work in this case, the system of self-checking has become a barrier to minor deviations. In the case of air traffic controllers self-inspection is expressed in the form of continuation training, practice and rarely occurring supervision efforts. In the case of pilots, apart from Operator Proficiency Checks (OPC), supervision flights are an important element in this part of self-inspection in the course of operations.

The operator
It can be said that self-inspection for both air traffic control and the operator revealed deficiencies. Non-standard phraseology was according to the crew a common and necessary part of their operations. SHK has found that during one of the recently completed PCs for the commander "ATC Phraseology" was a topic. Since such specialised areas are covered by all pilots during a given period, it is probable that the first officer had also undergone the same training. No negative remarks concerning phraseology had however been recorded during either PCs or supervision flights performed.

On these grounds it can be said that the company could probably reinforce the training and continuous training of its pilots in respect of radio communications and standard phraseology.

The air traffic controller
The air traffic controller believed that the crew had understood the clearances correctly and had therefore not asked for any readback. The current investigation by SHK has not entered into any deeper study of whether this was a habitual procedure used in this particular air traffic control instance, or just this once.

It can however be said that the method with supervision as a deviation manager and barrier has not so far gained ground in Swedish or European air traffic control. SHK would however like to emphasise that a self-inspection system forms an important part of the safety structure of any business, and that supervision – on a regular basis – can be a way of reinforcing this part of the system.

2.6.2 Runway incursion

As previously pointed out, this incident meant that a runway incursion took place, i.e. an aircraft entered an active runway without the relevant clearance. A powerful contributory reason for this to be able to happen was that the communications did not comply with the applicable regulations.

What also may have had a negative impact on the course of events is the fact that the current runway name is used throughout the communication chain with different clearances, "taxi to holding point runway 21." When the name "runway 21" appears in a clearance, there is always the risk of misunderstanding/misinterpretation - possibly in a stressed or disturbed situation - that the clearance was a permission to line up on the runway. Since clearances for taxiing usually implies permission for an aircraft to taxi to a

decided (holding) point in the manoeuvre area, there is no reason according to SHK to include the runway name in these clearances. A clearance to line up on the runway appears last in the communication chain preceding movements before the final take-off clearance. The name of the runway can be excluded from the clearances until the "go-ahead" occurs and the aircraft is cleared to line up on the runway for take-off.

Re-naming should be easy to achieve without greater problem. Holding positions along the runway can be named, for example, A, B, C, etc., without mentioning the runway number. According to SHK this could be a way to reduce the risk of misunderstanding/misinterpretation of clearances during ground operations.

SHK has taken notice of the comprehensive work performed by Eurocontrol to prevent incidents in the category. Against this background there is no reason to make any particular recommendations as a result of the incident in question.

However the fact that this incident occurred shows that within both the ATC organisation and individual companies there may be a need for further information in respect of this problem area. The action plan that work within Eurocontrol resulted in – European Action Plan for The Prevention of Runway Incursions (EAPPRI) – can in SHK's opinion, be used with advantage to form the basis of an updated campaign in respect of European flight safety within this area.

2.7 CVR retrieval and recording time

The recording time on this particular aircraft was 2 hours, which is currently the highest requirement stated in ICAO Annex 6. During several investigations into incidents SHK has found that information was missing from CVRs due to the short recording time. A contributory reason for the loss of information could have been that the incident was not so serious that the commander decided it was not necessary to secure the CVR, alternatively that the operator was not made aware that an incident had taken place within a sufficiently short time. One can also imagine a case where the flight lasts longer than 2 hours, in which case, even if the commander was aware of an incident, the CVR information will be overwritten since it is not permitted to stop the CVR and FDR during flight.

The consequences of having a short recording time for sounds from the cockpit mainly arise in the case of incidents. Access to an audio recording from the cockpit is often very important in providing a possibility for the investigation of the context of reasons in the case of an incident. As far as this incident is concerned, certain aspects of the events could have been clarified much better if such a recording from the CVR or some other equipment had been available. Refer also to the SHK Report RL 2009:18.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) Both aircraft had a valid ARC.
c) The LH aircraft lined up on the runway without clearance.
d) The aircraft from B1 aborted the approach on short final.
e) Radio communications while the aircraft was taxiing were sometimes on different frequencies.
f) The LH crew considered an unknown taxiing aircraft to be disturbing.
g) The LH crew did not read back the clearances correctly.
h) The LH crew used expressions that were not standard phraseology.
i) The LH crew did not contact the control tower on the advised frequency.
j) The air traffic controller did not request readback of the clearances.

3.2 Causes of the incident

The incident was caused by deficiencies in the self-inspection system in respect of the application of standard phraseology by both the operator and air traffic control.

4 RECOMMENDATIONS

It is recommended that the Swedish Transport Agency should:

- Explore possibilities for the clearance of aircraft taxiing to take-off position to exclude runway name *(RL 2010:05 R1)*.

- In its international flight safety work to ensure that the document "*European Action Plan for The Prevention of Runway Incursions", EAPPRI,* is suitably distributed to the relevant participants within European aviation *(RL 2010:05 R2)*.