Runway overrun, Incident involving aircraft UK76824, 27 December 1998, at the Stockholm/Skavsta Airport, D county, Sweden

Micro-summary: **Miscommunication and misset expectations between ATC and the airplanes results in a late landing and runway overrun.**

Event Date: **1998-12-27 at 0643 UTC**

Investigative Body: **Swedish Accident Investigation Board (AIB), Sweden**

Investigative Body's Web Site: **http://www.havkom.se/**

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Report RL 2000:05 e

Incident involving aircraft UK76824, 27 December 1998, at the Stockholm/Skavsta Airport, D county, Sweden

L-125/98

Translated by Bob Arnesen
From the original Swedish at the request of the Board of Accident Investigation.

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

2000-02-16 L-125/98

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2000:05e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an incident which occurred on 27 December, 1998, at the Stockholm/Skavsta airport, D county, in Sweden, involving an aircraft under the registration UK 76824.

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

Ann-Louise Eksborg

Monica J Wismar Henrik Elinder

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APPENDICES (Not icluded in Internet version / webmaster)

ABBREVIATIONS

AFIS Aerodrome Flight Information Service

AOC Air Operator`s Certificate

BFU Bundesstelle Für Flugunfalluntersuchung

BCL Bestämmelser för Civil Luftfart (Civil Air Regulations)

ºC Degrees Celsius

cm Centimetre(s)

CRM Cockpit Resource Management

CVR Cockpit Voice Recorder

ECAC European Civil Aviation Conference

FAA Federal Aviation Administration

FD Flight Director

FDR Flight Data Recorder

FL Flight Level

FMS Flight Management System

FRA Försvarets radioanstalt (National Defence Radio Centre)

ft Feet

GP Glide Path

GS Ground Speed

h(rs) Hour(s)

hPa Hectopascal

IAL-chart Instrument approach and landing chart

IAS Indicated airspeed

ICAO International Civil Aviation Organization

IFR Instrument Flight Rules

ILS Instrument landing system

IMC Instrument meteorological conditions

JAA Joint Aviation Authorities

km Kilometre(s)

kt Knot(s)

LLZ Localizer

LFS Luftfartsverkets författningssamling (amplified version of Civil Aviation Regulations)

m Metre(s)

mm Millimetre(s)

MUST Försvarsmaktens Militära Underrättelse- och Säkehetstjänst **(**Defence Intelligence Service)

NDB Non-directional radio beacon

nm Nautical mile(s)

PAR Precision Approach Radar

QFE An altimeter subscale setting to obtain elevation above aerodrome

QNH An altimeter subscale setting to obtain elevation above mean sea level

S Second(s)

SAFA Safety Assessment of Foreign Airlines

SMHI Sveriges Meteorologiska och Hydrologiska Institut (Swedish Meteorological and Hydrological Institute)

TWR Aerodrome control tower

Report RL 2000:05e

L-125/98

Report finalised 2000-02-16

Aircraft: registration and type		**UK76824,** IL-76TD (Ilyushin)
Owner		Uzbekistan Havo Yullari 41, Movarounnakhr Street Tashkent, 700061, Uzbekistan/ East Line Russia, Moscow, 1 Lambousa Street, Nicosia, 1095 Cyprus
Date and time		27 December 1998 at 0743 hrs. in darkness *Note:* All times in the report are given in Swedish normal time (SNT) = UTC + 1 hour
Place of occurrence		Stockholm-Skavsta airport, D county, (pos 5847N 1654E; 42 m above sea level)
Type of flight		Cargo
Weather		Actual weather reported at 0750 hrs. : wind 180°/12 kt., visibility 2,000 metres in snow, clouds 3–4/8 at 300 ft., 5–6/8 at 500 ft., temp./dewpoint –0/-0 °C, QNH 986 hPa.
Persons on board:	*crew*	7
	passengers	2 (loading personnel)
Injuries to persons		None
Damage to aircraft		Limited
Other damage		Limited property damage
Commander´s age and licence		52 years old, licence valid until 26 May 1999
Commander´s total flying hours		14,009 hours, of which 2,376 on type
Commander´s flying hours previous 90 days		93 hours, all on type
Commander´s number of landings previous 90 days		24
First Officer´s age and licence		34 years old, licence valid until 26 May 1999
First Officer´s total flying hours		3,994 hours, of which 1,247 on type
First Officer´s flying hours previous 90 days		93 hours, all on type
First Officer´s number of landings previous 90 days		24

The Board of Accident Investigation (SHK) was notified on 27 December 1998 that an incident with an aircraft registered UK 76824 had occurred at the Stockholm/ Skavsta airport, D county, on the same day at 0743 hrs.

The incident has been investigated by SHK represented by Ann-Louise Eksborg, chairman, Monica J Wismar, Chief investigator flight operations, and Henrik Elinder, Chief technical investigator (aviation).

The investigation was followed by the Swedish Civil Aviation Administration represented by Max Danielsson.

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.

SUMMARY

The flight departed the Moscow/Domodedovo airport on the 27 December 1998 at around 0500 hrs. in the morning, bound for the Stockholm/Skavsta airport. Onboard were seven crew members and two loading personnel. The commander was the flying pilot for the flight.

When approaching the airport the flight was asked by Stockholm Control to reduce speed as snow clearance operations were in progress. When the flight was approximately 30 nm. from the airport ATC cleared the flight to descend to 2,500 ft altitude on a QNH setting of 984 hPa and to join the standard hold over the "PEO" NDB-navigation beacon to the east of the airport. The controller also informed the crew that the braking action had been measured at 0.25/0.25/0.28 along the runway and asked if it was their intention to carry out the approach to runway 27. The controller interpreted the crew's response as being that they were indeed ready and clearance for a direct approach was given. They were then handed over to the duty AFIS-operator at the airport. The AFIS-operator informed the crew about the braking action and the fact that the runway was covered by 5 mm. of snow. When the crew reported that they were established on the ILS they were informed that the wind was 190 degrees at 13 knots and told that they were cleared to land.

The aircraft approached the runway fast, with a noticeable bank angle applied. It touched down about halfway down the runway. The aircraft continued its rollout with no real reduction in speed, went off the runway at the runway end and finally came to rest 75 m. beyond the runway end.

The investigation shows that a clear misunderstanding arose between the crew and the air traffic controllers with regard to both communication and the distribution of responsibility. It has also been established that the approach to the airport was not performed in accordance with standard procedures. The aircraft descended below the prescribed minimum height before it was established on the ILS. The approach was rushed and when passing the threshold the aircraft´s speed was 30–40 km/h too fast and height 60 m too high. This resulted in the aircraft touching down about halfway (1,270 m) down the runway. Since the runway was slippery the crew did not manage to bring the aircraft to a rest until it was around 75 m. beyond the runway end, despite the fact that full braking and engine reverse was used.

No technical fault has been found on the aircraft.

The incident was caused by the aircraft landing too far down the runway and the braking coefficient being low. Contributing was that the approach was not flown according to standard procedures and that a missed approach was not executed when the aircraft was not stabilized on the ILS at the prescribed minimum height.

RECOMMENDATIONS

It is recommended that the Swedish Civil Aviation Administration informs ATC personnel that not all foreign operators are fully aware of all operational procedures specific to Sweden and that special attention should be made to avoid any misunderstanding that may arise when communicating with these operators *(RL 2000:05e R1).*

1. FACTUAL INFORMATION

1.1 History of the flight

An Ilyushin 76TD cargo flight with callsign ESL9703 departed the Moscow/ Domodedovo airport around 0500 hrs. on the morning of 27 December 1998, bound for the Stockholm/Skavsta airport in Sweden, with Stockholm/Arlanda as the filed alternate. On board were seven crew members and two loading personnel. The crew consisted of a commander, a first officer, a navigator, a flight engineer, a radio operator and two technicians. The commander himself was the flying pilot for the flight.

Upon entering Swedish airspace the flight was handed over to Stockholm Control at 0712 hrs. and reported they were maintaining FL290 (8,850m). They then received clearance to descend to FL100 (3,050m). At 0719 hrs. the flight was asked to start reducing speed early to avoid a long holding over Skavsta as snow clearance operations were in progress at the airport. Shortly afterwards they were cleared to descend to FL 060 (1,850m). When the flight was approximately 30 nm. from the airport, ATC cleared the flight to descend to 2,500 ft altitude on a QNH setting of 984 hPa and to join the standard hold over the "PEO" NDB-navigation beacon to the east of the airport. The flight joined the holding at 0733 hrs. and two minutes later they were informed by Stockholm Control that the braking action on the runway at the airport was "medium to poor". This information was not acknowledged by the crew. About one minute later the controller advised the flight that the braking action had been measured at 0.25/0.25/0.28 along the runway and asked if it was their intention to carry out the approach to the active runway 27. The controller interpreted the crew's response as being that they were indeed ready and clearance for a direct approach was given. They were then handed over to the duty AFIS-operator at the airport.

When the crew reported in to the AFIS-operator they were told to continue with their direct approach to runway 27. The crew was asked by the operator if they had been informed on the braking action figures 25/25/28 and that the runway was covered by 5 mm. of snow, cleared to a width of 40 m. Both questions were acknowledged by "Roger" (understood). About two minutes later the crew reported that they were established on the ILS, 10 km. from the runway. The AFIS-operator informed the flight that the wind was 190 degrees at 13 knots and told them they were cleared to land.

Witnesses on the ground have stated that the aircraft approached the runway rather fast, with a noticeable bank angle applied and that it touched down about halfway down the runway. The aircraft continued its rollout with what appeared to be no real reduction in speed and finally came to rest 75 m. beyond the runway end. The crew relayed to the AFIS-operator what had happened and requested assistance.

The incident occurred at position 5847N 1654E, at a height of 42 m. above sea level.

1.2 Injuries to persons

	Crew	*Passengers*	*Other*	***Total***
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	7	2	-	9
Total	**7**	**2**	**-**	**9**

1.3 Damage to the aircraft

Limited

1.4 Other damage

Limited property damage.

1.5 The crew

The commander was 52 years old at the time and his licence was valid until 26 May 1999.

Flying hours previous	*24 hrs*	*90 days*	*Total*
All types	2.5	93	14,009
This type	2.5	93	2,376

Number of landings this type previous 90 days: 24.

The First Officer was 34 years old at the time and his licence was valid until 26 May 1999.

Flying hours previous	*24 hrs*	*90 days*	*Total*
All types	2.5	93	3,994
This type	2.5	93	1,274

Number of landings this type previous 90 days: 24.

The navigator was 59 years old, had 8 years experience as a navigator and had 2,100 hours on type.

The flight engineer was 39 years old, had 6 years experience as a FE and had 1,100 hours on type.

The radio operator was 41 years old, had 4 years experience as RO and had 5,100 hours on type.

There were also two technicians, needed to perform between flight inspections, and two loading personnel on board.

1.6 The aircraft

1.6.1 *General*

Owner:	Uzbekistan Havo Yullari 41, Movarounnakhr Street, Tashkent, 700061, Uzbekistan
Operator	East Line Russia, Moscow, 1 Lambousa Street, Nicosia, 1095 Cyprus

Type:	IL-76TD (Ilyushin)
Serial number:	76824
Year of manufacture:	1992
Gross weight:	Maximum Allowed Takeoff Weight 190,000 kg Actual Takeoff Weight 160,300 kg Actual Landing Weight 142,000 kg
Centre of gravity:	Allowable limits 20–40% MAC Actual at landing 30.2% MAC
Engine manufacture:	"Rybinsky Motors" Corporation, Russia
Engine model:	D-30KP2
Number of engines:	4
Fuel loaded before event:	68,000 kg
Total Aircraft flying time:	4,367 hours
Total Aircraft cycles:	1,352 cycles
Aircraft flying time and number of cycles since latest periodic check:	145 hours/ 59 cycles

Engines operating time:

Engine	#1	#2	#3	#4
S/N	03053049202043	03053019202008	03053019202007	03053048902023
TT hours.	4,201	4,224	4,052	5,040
TC cycles	1,027	1,467	1,498	1,664
TSO hours	1,498	1,310	1,138	2,062
CSO cycles	357	343	357	525

The aircraft had a valid Certificate of Airworthiness.

1.6.2 *The aircraft type*

IL-76TD

The IL-76 was first and foremost designed as a military transport aircraft and flew for the first time in 1971. According to information received from the Civil Aviation Administration in Uzbekistan the following recommendations apply for landing:

Crosswind Limits

Runway Condition (μ=braking action)	Max allowed crosswind-component m/s (Kt.)
0,55 = μ	15 (29)
0,50 = μ = 0,55	12 (23)
0,40 = μ = 0,50	10 (19)
0,30 = μ = 0,40	7 (14)
Dry snow =12 mm	7 (14)
Wet snow =12 mm	4 (7,8)
Slush = 10 mm	3 (5,8)
Water = 10 mm	4 (7,8)

Recommended approach speed with landing weight 142 tonnes	250 km/h
Recommended threshold speed with landing weight 142 tonnes	215 km/h
Lowest height for glidepath intercept and capture	200 m (656 ft)
Lowest certified decision height	60 m (199 ft)
Reversing of the outer engines	when rollout speed > 50 km/h
Reversing of all engines	only in extreme situations
Braking	with nosewheel on ground and speed $\leq$ 240 km/h

The aircraft braking system is aided by anti-skid protection to eliminate the locking of brakes.

1.7 Meteorological information

1.7.1 Airport weather

A warm front with associated snowfall and temperatures around zero degrees Celsius was moving across the area. SMHI estimated that the wind ahead of the front at a height of 1,000 ft. was from the south at 25 knots. Associated turbulence was not forecasted and no reports were received.

Before the approach the flight received a surface wind of 180 degrees at 12 knots and about two minutes before landing a wind of 190 degrees at 13 knots. The airport's own equipment for measuring runway temperature also recorded at the same time a wind of 160 degrees at 14 knots, with no gusts.

The actual weather at the airport as reported at 0750 hrs. was:

Wind 180°/12 kt., visibility 2,000 m. in snow, clouds 3–4/8 at 300 ft., 5–6/8 at 500 ft., temperature –0 °C, dewpoint –0 °C, QNH 984 hPa.

1.7.2 Runway condition

It began to snow quite heavily at the airport shortly before 0600 hrs. that morning. Snow clearance operations on runway 09/27 were commenced at 0600 hrs., using so called PSB-vehicles (plough, sweep and blow). Clearance was done working from the southern edge towards the northern. The runway was cleared along its full length

(2,601 m.) and to a width of 40 m. The runway was covered by 2 mm. of wet snow after it was cleared and outside the northern edge there was a 20 cm. high layer of wet snow remaining.

The braking action figures obtained along the whole runway length at 0710 hrs. using a Saab Friction Tester were:

Northern side A[1] = 0.24 B = 0.24 C = 0.27
Southern side A = 0.27 B = 0.26 C = 0.30

The AFIS-operator was then informed of the average values:

A = 0.25 B = 0.25 C = 0.28

Snow clearance operations were temporarily suspended at 0737 hrs. due to the anticipated landing of the flight. The cleared part of the runway was at this time covered with 3–5 mm. of wet snow.

After the incident and before snow clearance operations were recommenced, a new measurement of the braking action was carried out at 0817 hrs. in the same fashion as before, where the following values were obtained:

Northern side A = 0.34 B = 0.29 C = 0.31
Southern side A = 0.31 B = 0.36 C = 0.41
Average value A = 0.33 B = 0.32 C = 0.36

1.7.3 Braking action classifications

The following international standards exist for the classification of braking action:

Braking Action μ	Classification
0.40 and above	GOOD
0.39 to 0.36	MEDIUM/GOOD
0.35 to 0.30	MEDIUM
0.29 to 0.26	MEDIUM/POOR
0.25 and below	POOR
9	UNRELIABLE

1.8 Navigational aids

The Stockholm/Skavsta airport (ESKN) runway 27 is equipped with ILS (CAT 1) and NDB. The aircraft was equipped according to standards acceptable in Uzbekistan. It was equipped with ILS, but it was neither equipped with a Flight Management System nor a Fight Director, and the autopilot could not be coupled to the ILS.

1.9 Radio communications

1.9.1 *General*

A readout of all radio communication with Stockholm Control and with the AFIS-operator at Stockholm/Skavsta by the flight are found in *appendix 1*.

1.9.2 *Phraseology*

ICAO has a published standard phraseology to be used in international civil aviation. English is the language to be used in all IFR operations. When doubt does arise in the

[1] A, B, C = third parts of runways length, counted from the runway with the lowest runwaynumber. In this case runway 09.

exchange of communication, the pilot and the controller may use other more acceptable phrases to make themselves better understood. These shall be short and concise and shall be so expressed that no misinterpretation or conflict can arise.

1.9.3 *AFIS*

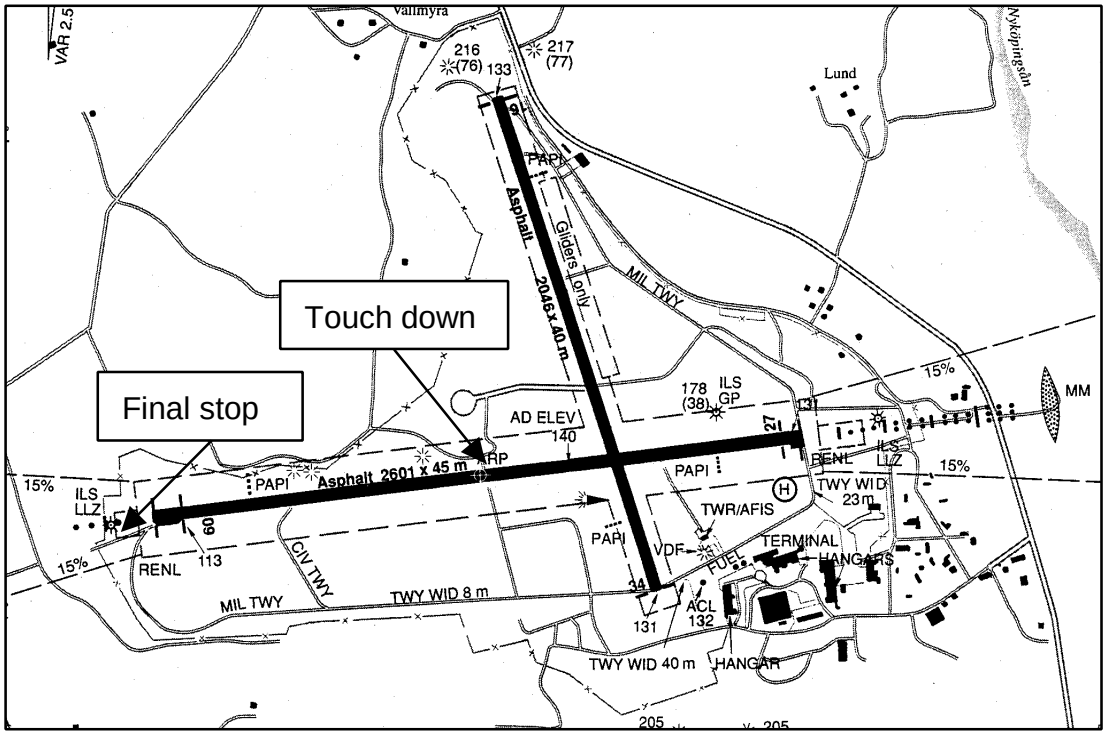
At the time of the incident the Stockholm/Skavsta airport was providing a flight information service (AFIS) only. Between the hours of 0800–2200 the air traffic control tower (TWR) was operational.

The primary difference between AFIS and TWR is that TWR issues instructions and clearances while an AFIS gives information only. Upon arrival by IFR traffic at an airport with AFIS, the radio operator will suggest a suitable runway and give traffic information. Before landing the operator will inform the flight of any restrictions or conflicting traffic and that "the runway" is free when such is the case. TWR will however exercise control and issue the clearance "cleared to land".

When the flight contacted the AFIS-operator at the Stockholm/Skavsta airport they were cleared for a direct approach to runway 27 and prior to landing the radio operator used the phrase "cleared to land". This was contrary to standard procedure, as he should have only informed the flight of the runway condition and reported "runway is free". The operator's explanation for this departure from standard procedure was to eliminate any misunderstanding. The absence of formal clearances had in several earlier cases caused confusion and misunderstanding between ATC and flights coming from eastern countries, where crews are perhaps not always aware of the difference between AFIS and TWR.

1.10 Airport data

The Stockholm/Skavsta airport has full facilities as outlined in the Swedish AIP. The airport chart below shows where the aircraft touched down and where it ran off the runway end.



The ILS equipment for runway 27 was calibrated after the incident the same day at 1930 hrs. and no disturbances or deviations were found. The instrument approach and landing chart for runway 27 is attached as *appendix 2*. In a normal approach the threshold shall be passed at a height of 50 ft (15 m).

1.11 Flight and sound recorders

1.11.1 *General*

The aircraft was equipped with a MSRP-64 Flight Data Recorder (FDR), and a MARS-BM Cockpit Voice Recorder (CVR). These recorders were removed from the aircraft after the incident and sent to BFU in Germany to be analysed and transcribed under the supervision of SHK.

1.11.2 *FDR*

The FDR registered 55 parameters with a frequency of two frames per second. Those parameters considered relevant for the investigation have been compiled and presented in diagram form in *appendix 3*. The times for the sequence of events are presented on the vertical x-axis, where two frames equal one second.

The FDR did not measure the horizontal acceleration, making it impossible to accurately calculate groundspeed and the touchdown point on the runway. The information taken from the FDR that has been used in the investigation has been obtained graphically through diagram interpretation and based on the assumption that the touch down occurred 1,300 m. down the runway, and that the surface wind was 190 degrees at 13 knots.

Through the FDR diagram we see that the aircraft made a significant heading change slightly less than two minutes before landing, from 200 to 250 degrees, with a bank angle of almost 25 degrees. During the turn the aircraft descended from 450 m. (1,500 ft) to 315 m. (1,000 ft). All manoeuvring of flaps, slats, speed brakes and ground spoilers was normal. The low vertical (g) acceleration at touch down is an indication that the landing was most likely very soft.

In the tables below the frame number, time, aircraft radar height, magnetic heading, bank angle, indicated airspeed (IAS) and calculated position along the runway are compiled for significant events during the approach and landing. Time "0" is defined as the time the aircraft touched down.

Events during the approach

Frame nr	Event	Time in sec. (min)	R^2-height. metres	Mag. hdg degr.	Bank angle degr.
4120	Leaving 2,500 ft[3]	+ 239 (3,98)	722	216	0,0
4243	Passing 2,100 ft	+ 177 (2,95)	600	201	1.0 left
4350	Start "ILS turn-in"	+ 124 (2,06)	435	197	3.0 right
4379	Max bank angle	+ 109 (1,82)	405	227	23 right
4382	Min alt over PEO	+ 108 (1,79)	384	234	19 right
4397	End of "ILS-turn-in"	+ 100 (1,67)	315	244	7.0 left

[2] Radar height

[3] QNH

4477	Min.ht. for establ. ILS	+ 60 (1,00)	200	253	20 right

Events during the landing

Frame nr	Event	Time in sec. (min)	R height metres	IAS (GS[4]) km/h	Runway pos. appr. m
4397	End of ”ILS turn-in”	+ 100 (1.67)	315	250 (241)	+5,358
4557	Threshold passage	+ 20.0 (0.33)	75	250 (241)	0.0
4560	Decision height	+ 18.5 (0.31)	60	250 (241)	100
4584	Roundout begins	+ 6.5 (0.11)	3	238 (229)	884
4597	**Touch down**	**± 0.0 (0.00)**	**0**	**219 (210)**	**1,270**
4622	Engine-rev. x 4	-12.5 (0.21)	0	- (163)	1,918
4670	Pass runway end	-36.5 (0.61)	0	- (42)	2,601
4696	Aircraft stopped	- 49.5 (0.83)	0	0	2,676

1.11.3 *CVR*

All cockpit communication from 0721 hrs. has been analysed and translated into English by the Accident Investigation Board in Uzbekistan. After having listened to the recording and read the English translation, the Swedish FRA has further provided supplemental information to the initial translation at certain points. According to the FRA, a female voice, which one minute before touch down warns “bank angle steep” and approximately half a minute before landing says “can I have the commanded altitude”, is missing.

The FRA found that there was a certain degree of uncertainty amongst the crew members during the approach and landing. They neither understood that the delayed landing was caused by snow clearance on the runway nor that the braking action was as marginal as it was for landing. The commander appeared to be irritated and swore several times while the other crew members tried to calm him.

The original readout including FRA’s supplemental information can be found in *appendix 4*.

1.12 Incident site and aircraft

1.12.1 *The incident site*

The aircraft came to rest off the end of the runway in the stopway area, the main landing gear approximately 75 m. from the runway end. The stopway surface was made up of flattened earth and till that at the time was wet.

1.12.2 *The aircraft*

The aircraft had no visible damage except for a crushed landing light on the aircraft nose. The aircraft was returned to service after being examined by company engineers.

[4] Speed corr. to the wind at ground

1.13 Medical information

Nothing indicates that the mental and physical condition of the crew had been impaired before the flight. The tests for alcohol taken on the crew after the incident all showed negative results.

1.14 Fire

Not a factor.

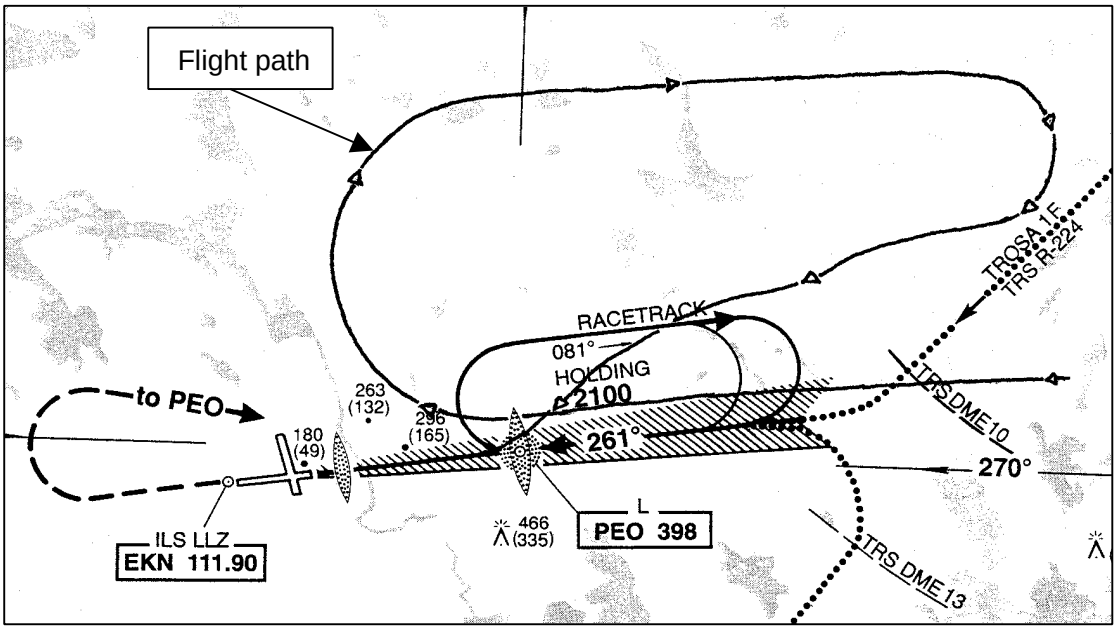
1.15 Survival aspects

The aircraft came to rest smoothly on the stopway and there was no risk for the crew and passengers on board .

1.16 Special tests and investigations

1.16.1 *Radar plot*

The aircraft's track in relation to the PEO NDB and the airport during the last 12 minutes of flight has been determined with the aid of a radar plot from MUST and is contained in *appendix 5*. All height information is the aircraft's altitude above sea level (QNH). The same radar plot has been transposed onto an approach and landing chart (appendix 2) in the diagram below.



1.16.2 *Point of touch down*

The commander has stated that the touch down occurred about 300 m. down the runway. Witnesses have stated that the touch down occurred after about half the

runway length. The runway was inspected after the incident by airport personnel accompanied by the commander. The airport personnel were able to determine that the aircraft's wheelmarks began approximately level with a road that crosses the runway at midpoint, that being 1,270 m. from the threshold.

1.16.3 *Aircraft braking system*

The aircraft's flight control and braking systems were examined after the incident by company engineers and everything was found to operate normally. The depth of the tread on the 16 main wheels varied from 0 to 5 mm.

1.17 The airline's organisation and management

1.17.1 *General*

East Line is an airline certified for transport of cargo with heavy aircraft. Since start-up in 1996 the airline has performed cargo operations to and from Sweden.

1.17.2 *Operational procedures*

The Civil Aviation Administration in Uzbekistan has stated that the airline train the crews in CRM according to what is presented in the manual "Technological procedures for crew members of the IL-76". The commander alone decides whether the landing shall be carried out or not.

The crew was unable to show SHK any checklists or quick reference performance charts for use during flight when asked to do so.

1.18 Additional information

1.18.1 *The commander's statement*

The commander and the first officer were interviewed by SHK, with the assistance of an interpreter, the day after the incident. At that time they both stated that they had

understood through Stockholm Control that the braking action was 0.25 and that snow clearance was in progress. They had no recollection of any other information given them at any other time. When they were instructed to leave the holding pattern to commence an approach to runway 27, they interpreted this to mean that snow clearance was complete and the airport was “approved for landing”. They assumed that the braking action was at least 0.30, which is their company’s minimum acceptable value for landing. If the braking action had been below 0.30 they assumed that the airport would have been closed.

The commander stated that he flew the aircraft manually without autopilot. He felt that the approach with a crosswind and turbulence had been difficult. The aircraft configuration, the landing speed and the touch down were in his estimation all normal. The threshold speed at the actual landing weight should have been 210–220 km/h. All aircraft systems had functioned normally.

1.18.2 *Inspections of foreign operators*

The regulations in force at the time of the incident were the articles contained in the Swedish Air Regulations-Rules for Charter and Air Taxi between Sweden and abroad (LFS 1997:45;BCL-A 2). These regulations were replaced on 01 April 1999 by new regulations under the same title found in LFS 1999:50.

According to both the old and new regulations, charter flights between Sweden and abroad may be performed by foreign operators who have been authorised and received all the necessary certification by the Civil Aviation Administration (CAA) in their home countries.

According to regulations at the time of the incident, if an airline wished to fly a charter cargo flight between Sweden and abroad, it was not necessary to apply for permission ahead of time. The airline, however, was required to send a notification to the Swedish CAA at least 48 hours before the flight. The notification was required to contain amongst other things the necessary information about the airline´s name and address, the aircraft type-registration-nationality, the airline´s insurance policies and additionally, when the flight was to occur, it’s flight number, and route to be flown. Airlines were always expected to be able to present a valid Air Operating Certificate (AOC). As a matter of routine all questions of a flight safety nature that arose at the time of the notification were delegated to the Inspection Branch of the Swedish CAA. However there was at the time no strict formal requirement to do so. A normal inspection looked at the airline´s ability to meet all the necessary requirements and regulations, based on what was contained in the articles issued by ICAO, ECAC and JAA. The information contained in “FAA Flight Standards Service” and its “International Aviation Safety Assessment Program” (IASA) were also used. The airline was also checked against a list published by the FAA on how different airlines fulfilled ICAO standards when operating within the ICAO states. The list contained three categories:

- Category 1 Meets ICAO Standards
- Category 2 Does not meet ICAO Standards (Conditional)
- Category 3 Does not meet ICAO Standards

The assessment done by the Swedish CAA after receiving a notification was normally not based on flight safety, but rather on other factors such as environmental.

According to present regulations permission is now required by the Swedish CAA to carry out charter cargo flights between Sweden and abroad. Airlines registered within the EU are, however, exempt from this requirement. The inspection is per-

formed by SAFA (Safety Assessment of Foreign Airlines) for the same reasons as before and it is SAFA's responsibility to perform random checks of foreign operators in Sweden.

East Line notified the Swedish CAA of its intention to perform cargo flights for the first time in December 1996. An AOC valid until 01 April 1997 was presented at the time and there is no record of the notification being further passed on to the Inspection Branch. Since then the airline has performed a number of cargo flights in compliance with the regulations in force and has been able to present a valid AOC.

2 ANALYSIS

2.1 Events leading up to the incident

The weather conditions at the Stockholm/Skavsta airport were challenging. There was crosswind, a low cloud base, it was snowing, the braking action was not good and the landing would take place in darkness. The flight was asked to join the holding pattern to the east of the airport as snow clearance operations were in progress.

Stockholm Control informed the flight that snow clearance was complete and that the braking action was "MEDIUM TO POOR". It is evident from the CVR-readout that the crew did not understand the significance of this information and did not acknowledge it. When the flight a short while later received braking action figures 0.25/0.25/0.28 from the air traffic controller this was acknowledged only with "Roger".

The commander has stated after the incident that the crew's interpretation of the information that snow clearance was complete meant that the runway was "open for landing" and that the braking action was at least 0.30, which was the company's minimum requirement. The commander was of the impression that the airport would be closed if the braking action dropped below 0.30, which is not the case, at least not in the Nordic countries.

At the time of the incident there was an AFIS-operator on duty at the airport. When Stockholm Control queried the flight if they were ready to commence the approach to runway 27, they were attempting to determine if the flight was ready to accept the landing under the existing conditions. Their reply to this question led ATC to believe that they indeed were ready. However circumstances point to the conclusion that the flight had understood the query more as a clearance to commence the approach to an airport with a TWR-controller on duty. The flight was then handed over to the AFIS-operator at Stockholm/Skavsta.

This misunderstanding led to the commander not realising that the braking action was far worse that 0.30 when the approach was commenced. Had he had complete understanding of this fact he might have chosen to delay the landing to allow more clearing or he might have proceeded to his alternate.

SHK found the lack of checklists or quick-reference tables to be used in flight to determine if a landing can be made under such extreme circumstances, taking into consideration the runway length, crosswind and low braking action, to be unusual and inconsistent with normal practice.

2.2 The approach

While waiting to commence the approach the aircraft flew about ¾ of a circuit in the holding pattern before it got the landing clearance. As shown in section 1.16.1 the aircraft's altitude varied between 1,050 and 1,020 m. (3,442–3,344 ft.), approximately 900 ft higher than the published 2,500 ft on the IAL-chart.

The ILS approach procedure for runway 27 at Stockholm/Skavsta airport is designed so that the aircraft shall first be established on the localizer at 2,100 ft. At approximately 6 nm. from the threshold the aircraft intercepts the glidepath. Minimum altitude when passing over the outer marker, in this case the PEO-NDB beacon, is 1390 ft which the aircraft shall at no time be below. (See appendix 2)

The FDR-readout shows that, when the flight received clearance for a direct approach about four minutes before landing, they commenced a descent from 2,500 ft on a heading of 216 degrees. The aircraft continued to descend during approximately a two minute period and the heading during this time decreased to 197 degrees, up to the point where it made a sharp and abrupt turn towards the ILS runway to a heading of 244 degrees, 124 seconds before touch down. At the completion of this sharp turn the aircraft was at 315 m radar altitude and 2.9 nm. from the threshold.

It becomes clearly evident from the information presented in 1.16.1 that the commander did not follow correct instrument flight procedures, when he steered the aircraft directly from the holding pattern towards the PEO-beacon to establish the aircraft on the ILS. During this manoeuvre the aircraft was outside of the localizer sector, below the minimum safe altitude of 2,100 ft for almost a minute, putting the aircraft below acceptable safety margins to obstacles.

With the southerly wind the aircraft intercept heading decreased successively, the closer the aircraft came to the PEO-beacon, so that the localizer was finally intercepted at an angle of more than 60 degrees, resulting in a sharp and abrupt turn to establish on the ILS. During the turn, which was made with up to 23 degrees bank angle and took 24 seconds to complete, the aircraft descended 120 m which translates to a descent rate of 300 m/min (984 ft/min). This was a remarkable and risky instrument manoeuvre considering the aircraft was flying under IMC. After the flight had passed a height of 200 m, which is the company's minimum acceptable height to be established on the ILS, the aircraft heading varied between 240 and 265 degrees, with bank angles of up to 20 degrees. It is evident that the commander had not succeeded in stabilizing the aircraft on the ILS and should therefore have considered initiating a missed approach.

2.3 The landing

The rushed and unstabilized approach is most probably the foremost reason why the aircraft passed over the threshold "high and hot", the speed being 30–40 km/h too high and the height being 60 m higher than normal. When landing on a runway with a low braking coefficient, a firm and positive touch down without delay is recommended. The commander in this case let the aircraft float for almost six seconds above the runway before smoothly putting it down. All these factors combined resulted in the aircraft touching down nearly half way down the runway, with only approximately 1,330 m remaining in which to stop.

With only a limited amount of runway remaining and a low braking coefficient, all efforts by the crew to stop the aircraft through the use of maximum braking and

engine reverse were insufficient and the aircraft overshot the runway end. None of the crew were injured and damage was at an absolute minimum, due to the flattened and even stopway and almost no obstacles off the end of the runway.

After the incident the commander stated that he felt that it had been a tough landing to carry out because of the difficult wind conditions. The most probable reason is however the rushed and unstabilized manner in which the approach was flown. The CVR-readout indicates that he was quite stressed and irritated.

Other operational mistakes were also made during the approach and landing. The crew let themselves believe that the altimeter setting for landing was height above the aerodrome (QFE), when it was in fact referenced to sea level (QNH). This meant that the aircraft altimeter was showing altitude above sea level but the crew was reading it as height above aerodrome. This would have had serious safety implications for the flight if the aircraft had not been equipped with a radar altimeter. The crew also did not understand the AFIS-operator when he reported the latest braking coefficient.

The last braking action figures of 0.25/0.25/0.28 were passed on to the flight in a routine fashion. These figures should however have been reported in the reverse order as 0.28/0.25/0.25, as the AFIS-operator knew that they should be reported as for the direction for landing, in this case runway 27. It can be reasonably assumed that this departure from standard procedure most probably had no bearing on the final outcome.

As has been mentioned before, the crew was under the impression that TWR service was in operation at the airport. This view can have been supported by the fact that the AFIS-operator gave the flight clearance for both the approach and for the landing.

2.4 Operational procedures

SHK has found it quite remarkable that so many mistakes, some even serious, were made by an experienced crew operating a heavy transport internationally. The approach and landing appears to have been carried out without proper regard for standard ILS instrument procedures, without reference to checklists and with the absence of standard so called “call outs”. The crew seemed unfamiliar with the situation they were in and there was a fair degree of uncertainty. The commander exercised very little cockpit resource management (CRM) during the approach, leaving the rest of the crew to play a secondary roll. The possibility of executing a missed approach when the aircraft was not stabilized early enough was never mentioned.

A contributing factor could also have been that a large part of the crew’s previous instrument landing experience was from operating in eastern countries, under quite different regulations and procedures. When operating in IMC conditions there is a great reliance on PAR-approaches where the aircraft is vectored and controlled by a radar operator laterally and vertically.

A similar occurrence where the crew on an IL-76TD belonging to Aeroflot had obvious difficulties in doing an ILS-approach to Evenes in Norway is reported on by the Norwegian Aircraft Accident Investigation Board (HSL) in bulletin BUL 17/99.

Attention must also be drawn to the absence of modern CRM-techniques on board. This would have seen the effective use of strict procedures and checklists, to create a more co-operative and supportive atmosphere in the cockpit. Each crew member’s abilities and resources are optimally applied to the task at hand and he is delegated an active roll to play in the safe and successful outcome of the flight. Had these methods

been applied that day, it is quite possible that the approach may never have been flown or had at least at some point been discontinued.

2.5 Communication

This incident not only highlights problems in communication between ATC and crews, but also the misunderstandings that arise in regard to the division of responsibility between controllers and pilots. As was shown in 1.9.3 crews from eastern countries are not always familiar with the difference between AFIS and TWR. This can partly be explained by the fact that a different aviation culture exists in the east, where daily routines and the lines of responsibility between ATC and pilots are altogether different.

These differences, combined with the language disparities and misunderstandings that arise, do of course pose a flight safety risk. SHK is fully aware that operational standards vary between individual eastern countries and between different operators. SHK would however like to point out that it is important for all parties to be reminded of the fact that, when uncertainty does arise due to differences in operational procedures, it should always be questioned so no misunderstanding remains.

2.6 Inspections by the Swedish CAA

The inspection that the Swedish Civil Aviation Administration (CAA) does on foreign airlines performing cargo operations in Sweden does not normally cover flight safety aspects. However each airline must be in possession of all the proper certification and authorisation by the CAA in its home country. According to present day regulations this check is not always performed on airlines registered inside the EU.

The level of co-operation that exists between all ICAO-members is founded on the trust members have for the individual CAAs in the member states to perform inspections aimed at maintaining a high level of competency. This is most likely the only acceptable way to reach international agreement in the field of civil aviation. There is however no guarantee that airlines inspected in one country will automatically be in possession of the competency to operate outside its boarders. In an effort to maintain a high level of flight safety, it is therefore of great importance that all knowledge concerning differences in operational procedures between countries is readily made available to airlines operating internationally.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft was airworthy.
c) Misunderstanding arose between ATC and the crew.
d) The landing conditions were difficult.
e) Standard procedures were not followed during the approach.

f) The aircraft descended below the prescribed minimum safe altitude before it was established on the LLZ.
g) The aircraft was not established on the ILS when passing the prescribed minimum height.
h) When passing the threshold the aircraft's speed was 30–40 km/h too fast and height 60 m. too high.
i) The braking coefficients in the direction for landing were 0.28/0.25/0.25. The company´s minimum acceptable value for landing was 0.30.
j) The aircraft touched down 1,270 m. down the runway.
k) After touch down full braking and engine reverse was used.
l) No technical fault existed on the aircraft.
m) There was an insufficient use of proper CRM.

3.2 Causes of the incident

The incident was caused by the aircraft landing too far down the runway and the braking coefficient being low. Contributing was that the approach was not flown according to standard procedures and that a missed approach was not executed when the aircraft was not stabilized on the ILS at the prescribed minimum height.

4 RECOMMENDATIONS

It is recommended that the Swedish Civil Aviation Administration informs ATC personnel that not all foreign operators are fully aware of all operational procedures specific to Sweden and that special attention should be made to avoid any misunderstanding that may arise when communicating with these operators *(RL 2000:05e R1).*