Statens haverikommission
Swedish Accident Investigation Board

ISSN 1400-5719

Final report RL 2011:08e

Incident involving aircraft SE-MDB, SE-JBN and seven skydivers above Gärdet, AB County, 21 August 2010

Case L-116/10

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

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

Statens haverikommission (SHK) Swedish Accident Investigation Board

Postal address	*Visitors*	*Phone*	*Facsimile*	*E-mail Internet*
P.O. Box 12538	Teknologgatan 8 C	Nat 08-508 862 00	Nat 08 508 862 90	info@havkom.se
SE-102 29 Stockholm Sweden	Stockholm	Int +46 8 508 862 00	Int +46 8 508 862 90	www.havkom.se

Statens haverikommission
Swedish Accident Investigation Board

17 August 2011

L-116/10

Swedish Transport Agency
601 73 NORRKÖPING

Report RL 2011:08

The Swedish Accident Investigation Board (Statens haverikommission, SHK) has investigated a serious incident that took place on 21 August 2010 above Gärdet in Stockholm, AB County, between an aircraft with registration SE-MDB and seven skydivers who dropped out of a helicopter with registration SE-JBN.

The Board hereby submits a report on the investigation under the EU Regulation, no: 996/2010 relating to the investigation and prevention of accidents and incidents in civil aviation.

The Board will be grateful to receive, by 18 november 2011 at the latest, particulars of how the recommendations included in this report are being followed up.

Göran Rosvall

Stefan Christensen

Statens haverikommission (SHK) Swedish Accident Investigation Board

Postal address	*Visitors*	*Phone*	*Facsimile*	*E-mail Internet*
P.O. Box 12538	Teknologgatan 8 C	Nat 08-508 862 00	Nat 08 508 862 90	info@havkom.se
SE-102 29 Stockholm Sweden	Stockholm	Int +46 8 508 862 00	Int +46 8 508 862 90	www.havkom.se

ATTACHMENTS

1. Radio communications
2. CD with ATV 3-D visualization (included in the paper edition)

Click here to link to the animation (web edition only)

General

The Swedish Accident Investigation Board (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended so far as possible to determine both the sequence of events and the cause of the events, along with the damage and effects in general. An investigation shall provide the basis for decisions which are aimed at preventing similar events from happening again, or to limit the effects of such an event. At the same time the investigation provides a basis for an assessment of the operations performed by the public emergency services in respect of the event and, if there is a need for them, improvements to the emergency services.

SHK accident investigations try to come to conclusions in respect of three questions: *What happened? Why did it happen? How can a similar event be avoided in future?*

SHK does not have any inspection remit, nor is it any part of its task to apportion blame or liability concerning damages. This means that issues concerning liability are neither investigated nor described in association with its investigations. Issues concerning blame, responsibility and damages are dealt with by the judicial system or, for example, by insurance companies.

The task of SHK does not either include as a side issue of the investigation that concerns emergency actions an investigation into how people transported to hospital have been treated there. Nor are included public actions in the form of social care or crisis management after the event.

The investigation of aviation incidents are regulated by the Regulation (EU) 996/2010 on the investigation and prevention of accidents and incidents in civil aviation. The investigation is carried out in accordance with the Chicago Convention Annex 13.

The investigation

On 23 August 2010, the Swedish Accident Investigation Board (SHK) was informed that a serious incident had taken place between an aircraft with registration SE-MDB, a helicopter with registration SE-JBN and seven skydivers. The incident took place above Gärdet, in Stockholm, AB County, on 21 August 2010 at 12.30.

The incident has been investigated by SHK, represented by Göran Rosvall, chairperson; Stefan Christensen, investigator in charge, Nicolas Seger, operative investigator and Pia Jacobsson, investigator human factors.

SHK has been assisted by Lars Hedlund, an operative expert in air traffic control, and Christer Magnusson, an expert in sound analysis. Seth Olofsson at the Swedish Transport Agency acted as an advisor in the investigation.

Report RL 2011:08e

L-116/10
Report finalised on 17 August 2011

Aircraft 1: registration and type	SE-MDB, ATR 72-212 A
Class/Airworthiness	Normal, Certificate of Airworthiness (CofA) with a valid Airworthiness Review Certificate (ARC)
Owner/Operator	Erik Thun AB/Golden Air Flyg AB
Aircraft 2: registration and type	SE-JBN, Eurocopter AS 350 B
Class/airworthiness	Normal, CofA with a valid ARC
Owner/Operator	SG Finans AS Norge/HeliAir Sweden AB/Private
Time of occurrence	21 August 2010, at 12.30 in daylight Note: All references to time relate to Swedish summertime (UTC + 2 hours)
Place	Gärdet, Stockholm, AB County (pos. 59°20 N 018°07 E; 750 m above sea level)
Type of flight, Aircraft 1	Commercial air transport
Type of flight, Aircraft 2	Private
Weather	According to SMHI's analysis: wind south to south-west, 7–10 kn, visibility > 10 km, 2–5/8 with a base of 1,000–1,500 feet, 3–7/8 with a base of 3,000–6,000 feet, temperature/dew point 11.7°C, QNH 1,012 hPa
Persons on board Aircraft 1:	
crew	4
passengers	33
Persons on board Aircraft 2:	
pilot	1
passengers	7 skydivers
Injuries to persons	None
Damage to aircraft	None
Other damage	None
Pilot in command SE-MDB	
Age, licence	56 years/ATPL(A)
Total flying time	20,624 hours, of which 12,131 hours on the type of aircraft in question
Flying hours, previous 90 days	38 hours, all on same aircraft type
Number of landings, previous 90 days	68
Co-pilot SE-MDB	
Age, licence	28 years, CPL(A)
Total flying time	1,671 hours, of which 79 hours on the same type of aircraft in question
Flying hours, previous 90 days	79 hours, all on same aircraft type
Number of landings, previous 90 days	48
Cabin crew	2 persons
Pilot in command SE-JBN	
Age, licence	43 years, CPL(H)
Total flying time	2,600 hours (H)
Flying hours, previous 90 days	No details
Number of landings, previous 90 days	30 on aircraft type

Summary

SE-MDB took off from Visby airport on a scheduled flight to StockholmBromma airport. The skydivers' activities were part of the Stockholm Air Show programme at Stockholm Gärdet, Stockholm, 21–22 August 2010. The skydivers were dropped over Gärdet from a helicopter, registration mark SE-JBN. The incident took place in controlled airspace where air traffic control was responsible for keeping separation between the aircraft.

SE-MDB received clearance to Nacka holding with radar guidance for the approach to Bromma. SE-JBN flew to a drop point at FL 70 (just over 2,100 metres) above Gärdet and dropped seven skydivers. All skydivers' canopies were fully deployed at approximately 750 metres.

When the final three skydivers descended through the same altitude as SE-MDB, their position was in a scattered cluster above the northern part of Gärdet. At that moment SE-MDB flew in a left turn with radar guidance just north of Djurgårdsvägen. The skydivers passed SE-MDB at a horizontal distance of 300 metres at 12.29.15. The incident was observed by an onlooker from the ground who reported the incident to SHK.

The incident was caused by deficiencies in planning and coordination between the air traffic control centres.

Recommendations

The Swedish Transport Agency is recommended to ensure that holding patterns belonging to a specific airport will be published in full under the heading for that airport (*RL 2011:08e, R1*).

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Conditions

SE-MDB took off from Visby airport on a scheduled flight to Stockholm-Bromma airport. The skydivers' activities were part of the Stockholm Air Show programme at Stockholm Gärdet, Stockholm, 21–22 August 2010. The skydivers were dropped over Gärdet from a helicopter, registration SE-JBN. The incident took place in controlled airspace where air traffic control was responsible for keeping separation between the aircraft.

1.1.2 Sequence of events

SE-MDB flew directly towards Nacka radio beacon (NAK NDB[1]) on the request of air traffic control. As the aircraft approached the radio beacon, the crew were informed that they would have to wait for five to ten minutes for their turn to fly to Bromma airport, where an aircraft of type DC-3 with registration SE-CFP had a problem with an engine. SE-MDB was therefore informed to enter a holding pattern and then the aircraft was given radar guidance for the final approach to Bromma.

SE-JBN flew to a drop point at FL 70 (around 2,150 m) above Gärdet. The skydivers left the helicopter in three groups. The first two groups consisted of two skydivers each while the third group had three skydivers. The last group jumped from the helicopter at 12.25.15. All skydivers' canopies were fully deployed at approximately 750 metres.

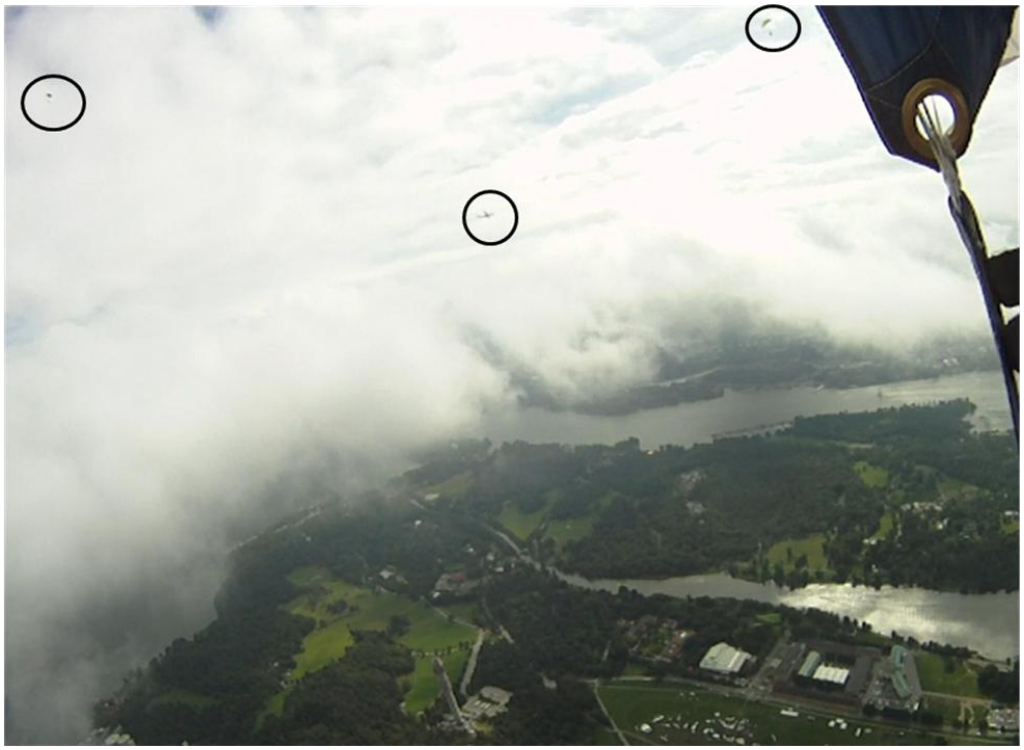

Fig. 1 Three of the skydivers with SE-MDB in the centre of the image.

When the skydivers steered their canopies down towards Gärdet there were clouds all around them, but they always had a clear view down to the ground. The lowest cloud base in the area was 400 metres. Above this altitude the clouds were layered. Between 600 and 800 metres altitude, the skydivers had

[1] NDB – Non Directional Beacon.

a clear horizontal view. When the final three skydivers descended through the same altitude as SE-MDB, their position was in a scattered cluster above the northern part of Gärdet. After the final skydivers had jumped, SE-MDB turned left with radar guidance, just north of Djurgårdsvägen. The skydivers passed SE-MDB at a horizontal distance of 300 metres at 12.29.15 (see fig. 1). The incident was observed by an onlooker from the ground who reported it to SHK.

The incident occurred at position 59°19 N 018°07 E, approximately 750 metres above sea level.

1.2 Injuries to persons

None.

1.3 Damage to the aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Pilot in command – SE-MDB

At the time of the incident, the pilot in command was 56 years old and had a valid ATPL (A). At the time of the incident, the pilot in command was PNF[2].

Flying hours				
Previous	24 hours	7 days	90 days	Total
All types	1.5	15	38	20,624
This type	1.5	15	38	12,131

Number of landings on this type over the previous 90 days: 68.
The transition course on this type of aircraft was carried out on 16 May 1989.
The previous Proficiency Check (PC) was carried out on 12 August 2010 on ATR 72.

1.5.2 The co-pilot – SE-MDB

At the time of the incident, the co-pilot was 28 years old and had a valid CPL (A) certificate. At the time of the incident, the co-pilot was PF[3].

Flying hours				
Previous	24 hours	7 days	90 days	Total
All types	0	0	79	1,671
This type	0	0	79	79

Number of landings of this type over the previous 90 days: 48.
The transition course and previous PC on this type of aircraft was carried out on 29 April 2010.

1.5.3 Cabin crew members – SE-MDB

Two persons.

[2] PNF – Pilot Not Flying.
[3] PF – Pilot Flying.

1.5.4 *The pilots' duties – SE-MDB*

Both pilots had started their duties on the same day at 09.15. The pilot in command had a rest period of more than 24 hours before the flight and had been working 28 hours over the previous seven days. The co-pilot had a rest period of 14 hours before the flight and had been working 28 hours over the previous seven days, of which 24 hours were emergency service duties.

1.5.5 *The pilot – SE-JBN*

At the time of the incident, the pilot was 43 years old and had a valid CPL (H) certificate.

Flying hours				
Previous	24 hours	7 days	90 days	Total
All types (H)	1.9	4.8		2,600
This type	1.9	4.8		

Number of landings of this type over the previous 90 days: 30. The transition course on this type of aircraft was carried out on 5 May 1997. The previous PC was carried out on 9 August 2008 on ATR AS350B.

1.6 Aircraft information

1.6.1 *Airworthiness – SE-MDB*

The aircraft	
TC-holder	ATR, Avions de Transport Regional GEI
Model	ATR 72-212A
Serial number	822
Year of manufacture	2008
Gross mass	Maximum authorised takeoff/landing mass 22,500 kg, actual approx. 18,500 kg
Centre of gravity	Within permissible limits

The aircraft (see fig. 2 below) had a CofA and a valid ARC.

Fig. 2 ATR72 – SE-MDB (photo Stefan Sjögren).

1.6.2 *Airworthiness – SE-JBN*

The aircraft	
Type certificate holder	Eurocopter
Model	AS 350 B
Serial number	1,684
Year of manufacture	1983
Gross mass	Max authorised takeoff/landing mass 1,950 kg

The aircraft had a CofA and a valid Airworthiness Review Certificate (ARC).

Fig. 3 AS350 – SE-JBN (photo Kim Ledin).

1.6.3 *Airworthiness – SE-CFP*

The aircraft	
TC-holder	MCDONNELL DOUGLAS
Model	DC-3C
Serial number	25328
Year of manufacture	1943
Gross mass	Max authorised takeoff/landing mass 11,430 kg

Fig. 4 DC-3 – SE-CFP (photo Johan Drejing).

1.7 Meteorological information

According to SMHI's analysis: wind south to south-west, 7–10 kn, visibility 10 km clouds, 2-5/8 with a base of 1,000–1,500 feet, 3-7/8 with a base of 3,000–6,000 feet, temperature/dew point 20°C/16°C, QNH 1,012 hPa.

Winds at 2,000–5,000 feet were 230–260°/20–25 kn.

1.8 Navigational aids

1.8.1 Nacka holding

NAK NDB is a non-directional beacon (NAK 355) which is 6 kilometres (3.2 Nautical Miles (NM) south-east of Gärdet. The radio beacon is used both as an approach aid to Bromma airport as well as holding pattern for the final approach to Bromma and Arlanda airports. A holding pattern is a geographic point over which an aircraft can fly awaiting further clearance.

NAK holding pattern is published in AIP[4], in the chapter Airports under the tab Stockholm/Arlanda, Holding Procedures (see fig. 5). Under the tab Stockholm/Bromma there is a reference to Stockholm/Arlanda, ESSA 4–3, regarding holding patterns that are established for Bromma airport.

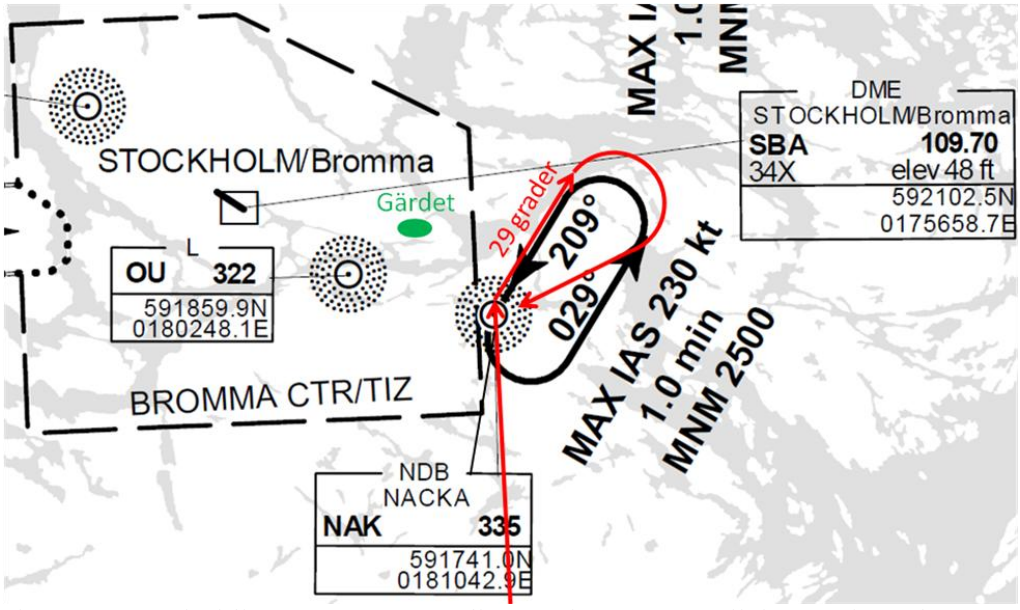

Fig. 5 NAK holding pattern according to the AIP, parallel entry in red, Gärdet is highlighted in green

1.8.2 Entry into the holding pattern

Entering the holding pattern is carried out in different ways depending on which direction the aircraft is coming from. In the present situation, SE-MDB approached the beacon from the south with a heading of 355°, which meant that a parallel entry would be performed at an initial track of 29° after the beacon had been passed (see fig. 5).

[4] AIP – Aeronautical Information Publication.

1.8.3 Approach map to Bromma airport

One of the approach maps that the pilot had access to indicates NAK as part of an approach procedure to runway 30. The approach track during this procedure is 283° (see fig. 6).

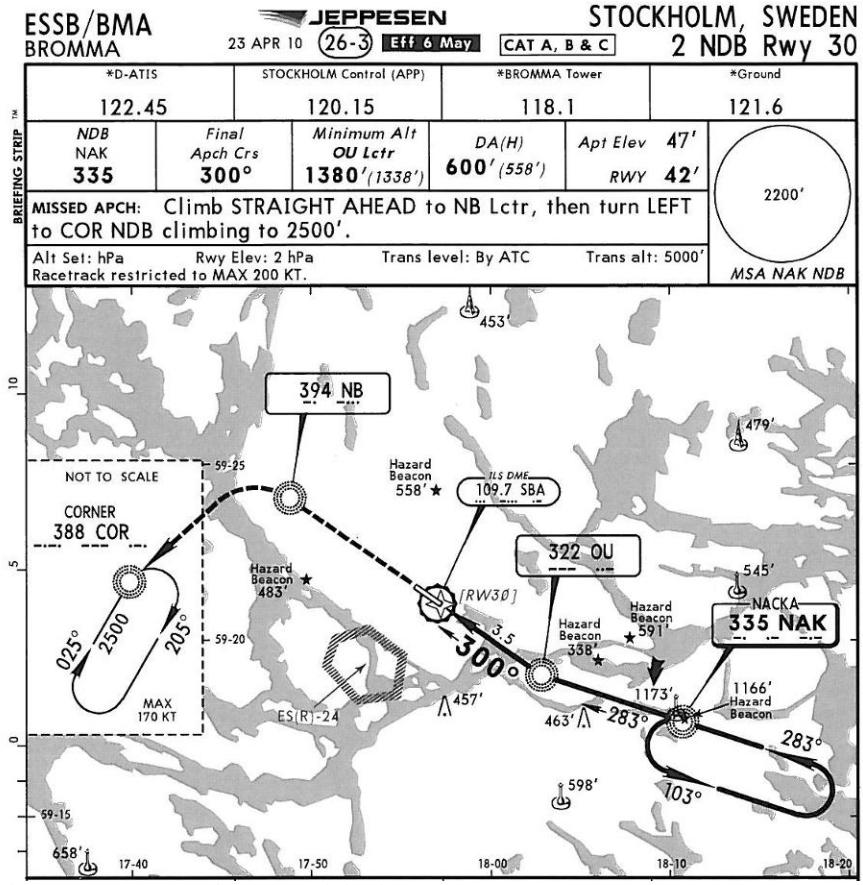

Fig. 6 Approach map with the NAK NDB.

The crew of the SE-MDB used maps from the US company Jeppesen as navigation data. In these maps the NAK holding pattern was published in the Stockholm/Bromma tab on page 20–22 that is used for approaches from the north. It was not possible to find the holding pattern under the Stockholm/Arlanda tab in this manual.

SE-MDB was equipped with an FMS[5] (see fig. 7). The FMS provides pilots with the opportunity to enter a holding pattern electronically. In order for the information to be correct, a number of parameters, such as course, direction of turn and leg time, must be entered manually. The pilots said that they chose not to use the FMS, instead navigating with an ADF-RMI[6] instrument (see fig. 8). The ADF-RMI consists of a compass rose with pointers which can display the bearing to the preselected NDB beacons.

In interviews, the crew of the SE-MDB has stated that the NAK holding pattern had an inbound track of 283°.

[5] FMS – Flight Management System.
[6] ADF-RMI Automatic Direction Finder – Radio Magnetic Indicator.

Fig. 7 FMS

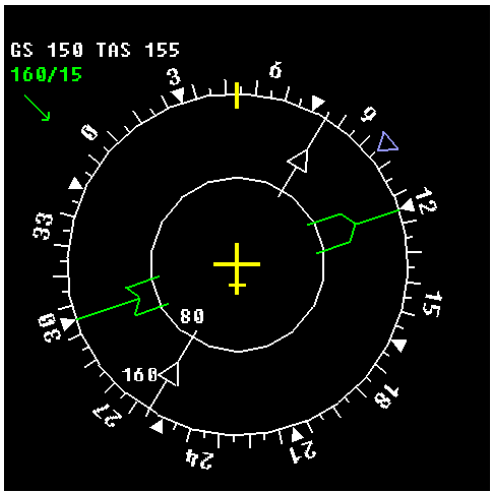

Fig. 8 ADF-RMI.

1.9 Communications

1.9.1 Frequencies, clearances and phraseology

Three different radio communication frequencies were used during the incident:

BMA TWR (Bromma Tower)	118.10 MHz	Bromma CTR[7]
STO SYD (Stockholm Syd)	120.15 MHz	Stockholm TMA[8]
GÄRDET (Temporary frequency)	123.55 MHz	Person in charge of the air show

For the aircraft, the following call signs were used:

SE-MDB	"Extrans 928", "Extrans"
SE-JBN	"SE-JBN", "Helicopter BN", "BN"
SE-CFP	"SE-CFP", "SFP", "CFP", "FP", "DC3FP", "DC-3", "Old Daisy"

According to section 32 of Transportstyrelsen's regulations on skydiving, the following permits must be obtained so that skydiving can be carried out within controlled airspace: *"The pilot of the aircraft shall, before each drop or series of drops of skydivers or supplies by parachute, obtain permission from air traffic control."*

According to section 24 of the Transportstyrelsen's instructions on radiotelephony and phraseology, the following expressions should be used in parachuting from the dropping aircraft to air traffic control:

- "*intend to drop in (number) minutes*".
- "*on final [for dropping]*".

Air traffic control most give clearance with the following expression:

- "*Clear to drop*".

1.9.2 Communication between the helicopter SE-JBN, BMA TWR and STO SYD

The helicopter pilot took off from Gärdet with seven skydivers on board and was given an initial clearance up to 2,000 feet, which is the upper altitude limit for the control zone Bromma (BMA CTR) and for the temporarily established show area. After that, BMA TWR agreed with STO SYD to retain responsibility for SE-JBN, which was cleared up to FL 70 (7,000 feet, approx. 2150m) above Gärdet.

[7] CTR – Control Zone.
[8] TMA – Terminal area.

12:10:54	BMA TWR to SE-JBN	Helicopter BN you have clearance up to FL 70 above Gärdet.
12:11:00	SE-JBN	70 Gärdet BN, thanks.
12:11:24	BMA TWR to SE-JBN	And BN, report back when you intend to drop the skydivers.

Shortly afterwards the new shift began to work at Bromma Tower.

1.9.3 Communication between the DC3 SE-CFP, Bromma Tower and Stockholm Syd

The DC-3 that had previously taken off from Bromma to participate in the air show at Gärdet had engine problems and contacted BMA TWR, which then set off the warning alarm. The previous flight controller noticed the warning alarm and returned to assist his replacement colleague who was already at his position. BMA TWR coordinated clearance with STO SYD to prioritise the DC-3 which was cleared to approach runway 30 at Bromma airport.

1.9.4 Communication between SE-JBN, BMA TWR, Gärdet and STO SYD during the drops

STO SYD, which had previously cleared SE-MDB to 4,000 feet directly to NAK, contacted BMA TWR to get an update on the situation regarding the dropping of the skydivers.

BMA TWR called SE-JBN but did not receive a response. After having given landing clearance to the DC-3, BMA TWR made another attempt to contact SE-JBN, this time on Gärdet's frequency 123.55, using a manual Becker radio. The helicopter pilot then answered and was told to wait to drop the skydivers due to incoming traffic. SE-JBN explained that it was not possible to delay the drops as the skydivers were already on the skids outside the helicopter.

At 12:25:06 the helicopter pilot said that the drops had commenced, which was acknowledged by the BMA TWR. BMA TWR also asked that the SE-JBN follow the skydivers down and inform the tower when they reached the ground.

At 12:25:29 the helicopter pilot called BMA TWR and announced that there would be a pause in the drops in order to fly to a different drop point.
At 12:26:05 SE-JBN notified Gärdet that there were skydivers in the air.

1.9.5 Communication between SE-MDB and STO SYD

STO SYD cleared SE-MDB to NAK holding in a right turn, which was acknowledged at 12.26.57. SE-MDB, which had the call sign Extrans 928, asked about a direction of turn and how many minutes he would have to remain on the outbound heading. STO SYD answered "right turn and two minutes", which was acknowledged by SE-MDB and which reported the entry into the holding pattern at 12.28.03.

12:26:30	STO SYD to SE-MDB	Extrans 928 ... could you please join Nacka holding just ...
12:26:57	SE-MDB	Okay, no problem. We are joining Nacka holding and maintaining now 2,500.

1.9.6 Communication between the helicopter SE-JBN and Gärdet on the final drop

The helicopter dropped the final three skydivers at 12.28:15 and reported this at 12.28.20 on Gärdet's frequency, which was also intercepted by the BMA TWR.

1.9.7 Communication during the final stages of the incident

BMA TWR now asked STO SYD to turn SE-MDB towards the final. SE-JBN notified BMA TWR that all skydivers were in the air at 12.28.54.

12:28:25	BMA TWR to STO SYD	You are moving down Extrans, so that he does not go in there directly under BN.
12:28:28	STO SYD	Yes, right turn, I said over Nacka, you see?
12:28:30	BMA TWR to STO SYD	Yes, but turn him again towards the final, so, now you can continue. Yes.
12:28:34	STO SYD	Yes.
12:28:35	STO SYD to SE-MDB	Extrans 928 turn left, left turn to heading 200.
12:28:41	SE-MDB	Okay left heading 200, Extrans 928.

The skydivers descended past SE-MDB at a distance of 300 metres at 12.29.15. This was followed by a discussion about the positions of the helicopter, the skydivers and SE-MDB, which lasted just under two minutes. From the conversation, it was understood that BMA TWR did not mean Nacka holding when it came to the holding pattern, while STO SYD understood that was that it was just that. As the conversation ensued, STO SYD explained to SE-MDB that there had been a misunderstanding regarding holding and cleared SE-MDB to 4,000 feet on a southerly heading.

1.9.8 Other communication

Only parts of the communication have been presented in this section. A more detailed description is available as an annex to this report.

The air show director in Gärdet had access to a mobile phone and this number had been reported to BMA TWR. This channel was not used as the line was busy.

1.10 Aerodrome information

1.10.1 The airfield at Gärdet

Before the air show, the organisers had arranged a temporary landing strip at Gärdet, where the skydivers were due to land.

1.11 Flight and sound recorders

1.11.1 Flight and sound recorders

Not applicable.

1.11.2 Radar recordings from the Armed Forces and LFV (the Swedish CAA)

The SHK has gathered the radar records from the Armed Forces and LFV at the time of the actual incident. The records show that the aircraft SE-MDB flew past the skydivers at a distance of approximately 300 metres (see fig. 9).

Fig. 9 SE-MDB's flight line over Gärdet, the skydivers are shown in red.

1.12 Incident site

1.12.1 Gärdet

The incident took place above Gärdet in conjunction with the Stockholm Air Show. The management of the Stockholm Air Show had marked out the area and a temporary runway of approximately 300 metres (see fig. 10).

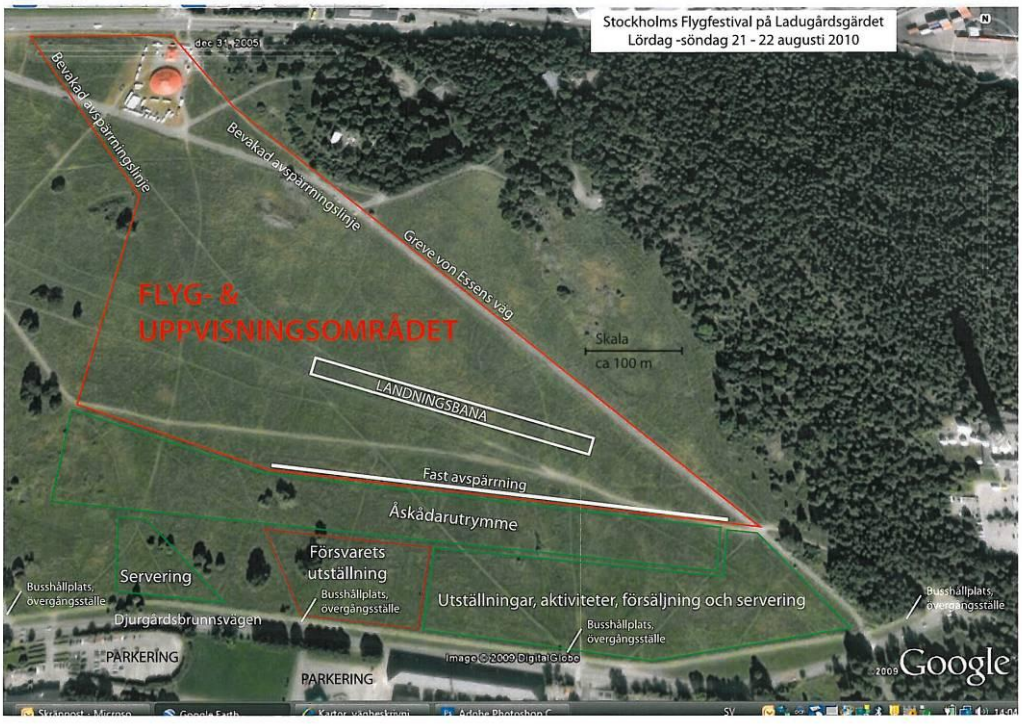

Fig. 10 Air show area at Gärdet.

1.12.2 *Airspace classification and separation rules*

The airspace in Sweden's FIR[9] is divided into controlled and uncontrolled airspace. Controlled airspace is a defined airspace in which all air traffic must comply with the air traffic controllers' instructions with regard to, for example, altitudes, headings and separations. The incident in question took place in controlled airspace.

Swedish airspace is also divided into classes of airspace. This case took place in airspace class C, in which air traffic flying under IFR[10] should be separated from aircraft flying under VFR[11]. SE-MDB was flying under IFR while SE-JBN was flying under VFR. Normal separation in the Stockholm TMA is 3 NM laterally or 1,000 feet in terms of altitude.

LFV's Central Operations Manual, part 3, section 5, chapter 10, paragraph 3.2, describes how the separation must be implemented between aircraft from which the skydivers will be jumping and non-participating aircraft: "*a minimum of 5 NM/10 km to the aircraft that has been given permission to drop the skydivers.*".

1.12.3 *Airspace in the incident area*

The airspace in the incident area includes Stockholm TMA and Bromma CTR. Stockholm TMA is controlled by Arlanda ATCC[12] and Bromma CTR is controlled by Bromma Tower.

At the time, a civilian and a military NOTAM[13] applied, and a navigation warning describing a temporarily established airspace for the air show at Gärdet (see red frame in fig. 11), from ground level to an altitude of 2,000 feet AMSL[14].

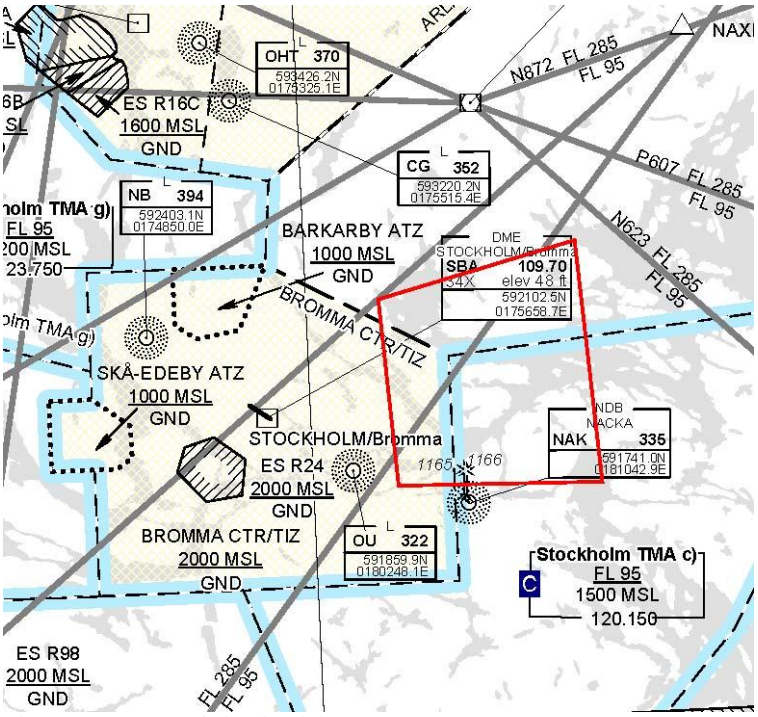

Fig. 11 Map of the incident area.

[9] FIR – Flight Information Region.
[10] IFR – Instrument Flight Rules.
[11] VFR – Visual Flight Rules.
[12] ATCC – Air Traffic Control Centre.
[13] NOTAM – Notification for Airmen.
[14] AMSL – Above Mean Sea Level.

1.13 Medical information

Nothing has emerged to suggest any impairment to the pilots', skydivers' or air traffic controllers' mental or physical condition before or during the incident.

1.14 Fire

Not applicable.

1.15 Survival aspects

1.15.1 The rescue operation

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

Not applicable.

1.18 Other

1.18.1 Gender issues

Not applicable.

1.18.2 Environmental aspects

Not applicable.

1.18.3 The planning of the show and instructions for the manager of the air show

Both Bromma Tower and Stockholm ATCC had taken note of the flight programme which had been established by the managers of the air show (see fig. 12).

Fig. 12 Part of the flight programme.

[Translation of the "Part of the Flight Programme", fig.12.]

12:00	Inauguration of the Stockholm Air Show Flight of the Bleriot XI which belongs to Tekniska Museet, the same type of aircraft that Carl Cederström used to fly over Gärdet 100 years ago Skydivers jumping from a helicopter Display: Radio-controlled model aeroplanes
12:30	DC3 overflight (12:30) and Biltema Spitfire (12:40)

The Civil Aviation Authority's regulation on air shows sections 11–19 describes the responsibilities of an air show leader. The regulation's section 12 is worded as follows: "*The air show director is responsible for the coordination between the air show's various elements and to the air traffic that will not be participating. A request for the establishment of a restriction area is presented to the CAA, alternatively, support documentation for NOTAM is submitted to the CAA. Coordination also includes contacts with the air traffic control organisation concerned.*" Section 19 states: "*The air show director is responsible for ensuring that the air show, or separate parts of the show, is cancelled in the event of danger to life or property or if flight safety requirements are not met.*"

The air show area was located partially inside the Bromma control zone. This meant that Gärdet's flight area and the air show area where the skydivers were to land was within BMA CTR and that BMA TWR had a formal responsibility for the area. The management of the air show had agreed with BMA TWR to deal with the radio communication with the participants in the area on their own radio frequency.

1.18.4 Interviews with air traffic controllers

Bromma Tower

During the actual event, two air traffic controllers were on duty at Bromma Tower. Only one air traffic controller was in position while the other was on his/her break. They relieved each other during the day. Shortly before SE-CFP had engine problems, an exchange of duties between the air traffic controllers took place. The air traffic controller that had finished his/her shift did had not left the operating space when SE-CFP reported engine problems. The relieved air traffic controller decided to remain to help out when the workload increased due to the emergency situation. Without further discussion, the work assignments were divided as follows: the air traffic controller who was still working took care of the operational radio traffic and was responsible for traffic while the relieved controller handled the alarm lists and information concerning the warning alarm. Despite this, much attention was given to dealing with the emergency situation, and these events took place literally "behind the air traffic controller's back" who was in charge of the air traffic, and he had to frequently turn around to visually (with binoculars) keep an eye on what was happening.

The air traffic controllers at Bromma Tower have said that many people who were involved with the air show called BMA TWR due to the poor radio communications with Gärdet. The air traffic controllers were informed about SE-JBN and what activities were to be carried out but did not know from what altitude the drops would occur. One of the air traffic controllers said that the

holding pattern that was intended for SE-MDB was an immediate holding pattern in the position the air craft had at that moment.

Both controllers also reported that they experienced a number of communication misses from all involved. The air traffic controllers failed to convey to STO SYD that SE-MDB should remain outside BMA CTR. The air traffic controllers were also of the opinion that SE-JBN had never been cleared to drop the skydivers.

Stockholm Syd

The air traffic controller at STO SYD said that the shift leader left a piece of paper with information that the drops would take place from the helicopter in the air show area and that BMA TWR coordinated the jump with STO SYD.

1.19 Special or effective investigation techniques

1.19.1 ATV3D

The ATV3D[15] project is a collaboration between Eurocontrol[16] and Division C-research at Linköping University. The goal of the collaboration has been to develop experimental software in order to visualise air traffic information in real time, reality or simulated, and to conduct experiments to assess the potential value of three-dimensional presentations for air traffic controllers.

SHK has chosen to illustrate the event with the help of ATV3D because the method allows for precise synchronisation and a clear visualisation of the incident.

A CD which includes the visualisation is enclosed with this report as attachment 2.

2. ANALYSIS

2.1 Workload at Bromma Tower

The increased workload at Bromma Tower, when the warning alarm was triggered, probably had a negative impact on the monitoring of other air traffic.

2.2 Communication between SE-JBN, BMA TWR and Gärdet

In connection with the dropping of the skydivers, the correct phraseology was not used during radio communications. The air traffic controller at Bromma Tower asked SE-JBN: “BN, you will notify us when you drop the skydivers later then.” SHK is of the opinion that this may have been interpreted as clearance to drop the skydivers.

SHK believes that the use of proper phraseology and clearance would have made it easier to understand the radio communications and improved the possibilities of planning other air traffic with due consideration to the parachute drop.

---

[15] ATV3D – Air Traffic Visualisation Three Dimensional.
[16] Eurocontrol – A European organisation that controls the airspace over parts of Europe (http://www.eurocontrol.int/).

2.3 Holding for SE-MDB, separations and clearance

When Bromma Tower discovered that SE-MDB was heading for the jump area, the air traffic controller contacted Stockholm Syd at Arlanda ATCC and asked them to put the aircraft in a holding pattern until further notice. This was understood in a way that SE-MDB should be cleared to the published holding pattern at NAK. The real intention was that the aircraft should be placed in a holding pattern at the position the air craft had at that moment. The air traffic controller at Arlanda however cleared SE-MDB to NAK holding and explained the reason. This was acknowledged by SE-MDB.

The crew asked the air traffic controller for a direction of turn and a time for the holding pattern and was told: right turn and two minutes, which would have placed the route for SE-MDB south-east of Gärdet's runway. While the aircraft was still on the way to Nacka, the air traffic controller at Bromma Tower discovered that SE-MDB was beginning to approach the helicopter and contacted his colleague at Arlanda. STO SYD explained that the aircraft had already been given clearance to turn right over Nacka beacon. Bromma Tower then said to the air traffic controller at STO SYD that he could allow SE-MDB to continue for the final approach.

The pilots did not feel there was time to program the FMS and instead chose to navigate to the holding pattern using the ADF RMI instrument. NAK holding was interpreted in accordance with the approach map's available turn procedure. This implicated that the pilot's intention was to turn right on an easterly heading after NAK had been passed (see fig. 13). SHK believes that the pilots did not have the opportunity to rapidly identify NAK holding with the map data used for the approach in question.

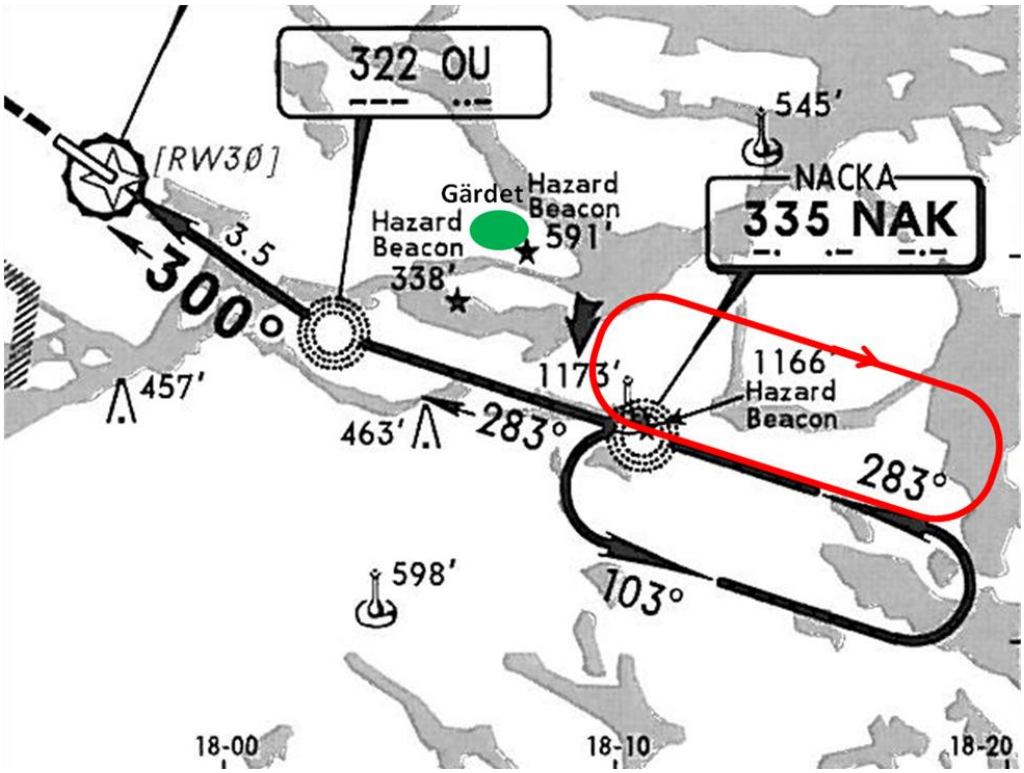

Fig. 13 The Nacka procedure turn. Right turn in red.

On this occasion, SE-MDB had still not begun a right turn but was on a heading of 350°. The nearest route to get to the final was to turn left, which is why STO SYD ordered a left turn at 200°. As this left turn was initiated, STO SYD had no knowledge that there were skydivers in the air, which meant that only

normal separation (3 NM laterally or 1,000 feet in altitude) was maintained to the helicopter. SE-MDB passed the skydivers during the left turn at a horizontal distance of approximately 300 metres.

SHK is of the opinion that there were shortcomings in coordination and communication between STO SYD and BMA TWR on how to deal with the separation between the helicopter and SE-MDB.

3 CONCLUSIONS

3.1 Findings

a) The pilots on all aircraft were qualified to perform the flights.
b) All aircraft had a CofA and a valid ARC.
c) The skydivers had valid licences.
d) All air traffic controllers had valid authorisations.
e) NOTAM and navigation warnings were issued for the air show area.
f) The programme was established and known to the air traffic controllers.
g) Air show management coordinated the show with an aircraft radio.
h) Air traffic control was informed of the parachuting operation.
i) BMA TWR was responsible for traffic in the control zone up to an altitude of 2,000 feet.
j) STO SYD was in charge of the airspace above 2,000 feet above Gärdet.
k) STO SYD handed SE-JBN over to BMA TWR.
l) The air show management had no direct contact with air traffic control.
m) The correct phraseology was not used in radio communications.

3.2 Causes

The incident was caused by deficiencies in planning and coordination between the air traffic control centres.

4. RECOMMENDATIONS

The Swedish Transport Agency is recommended to ensure that the holding patterns belonging to a specific airport will be published in their entirety under the heading for that airport *(RL 2011:08e, R1)*.

ATTACHMENT 1

Radio communications

Time	From	
12:08:14	SE-JBN to BMA	Yes hello, eight on board and taken off Gärdet, 7,000 on. Request climb over Frihamnen. We need up to 4,000-5,000.
12:08:31	BMA TWR	BN, set the transponder to 0541, climb to 2,000 feet to begin with QNH 1012.
12:08:37	SE-JBN	0541, 2000 1012, BN.
12:08:41	BMA TWR	And you want 5,000 feet, correct?
12:08:42	SE-JBN	I will drop the first group at 1,200 meters and the second at 2,000 meters.
12:10:01	BMA TWR to SYD	This is Bromma. At Frihamnen, east of...east of Bromma 0541. Can you see it?
12:10:03	STO SYD	At Frihamnen, yes. Uh... I see it, yes.
12:10:10	BMA TWR	He wants to go up to 70, he wants to drop jumpers.
12:10:14	STO SYD	Over Gärdet yes. And you have no objections to that?
12:10:17	BMA TWR	No.
12:10:18	STO SYD	Will keep him or what? You know what's happening with the others there, don't you?
12:10:22	BMA TWR	Yes, I can do that. Yes, I have no control of what happens otherwise.
12:10:25	STO SYD	Well, you've still have the airspace under him there.
12:10:26	BMA TWR to SYD	Yes but then I will keep it up to flight level 70, if it is OK?
12:10:54	BMA TWR to JBN	Helicopter BN you have clearance up to FL 70 above Gärdet.
12:11:00	SE-JBN	70 Gärdet BN, thanks.
12:11:24	BMA TWR	And BN, report back when you intend to drop the skydivers.
12:11:29	SE-JBN	Of course.
12:11:36	BMA TWR	And BN, you will coordinate it with Gärdet afterwards.
12:11:39	SE-JBN	Will do.
12:17:25	SE-CFP	Bromma SE-CFP Vaxholm. We have an engine problem and we are going towards Bromma for landing.
12:17:35	BMA TWR	SE-CFP, yes, continue towards Bromma. What is your altitude?
12:17:42	SE-CFP	1,200 feet, we are going runway 30 for landing, FP.
12:20:43	SE-CFP	Bromma FP is passing Bosön. Going directly to the left base 30.
12:20:48	BMA TWR	FP yes, cleared approach right turn, runway 30.
12:20:52	SE-CFP	Cleared approach 30, FP.
12:23:35	STO SYD	I thought of the skydivers contra 928 there, what do you think?
12:23:38	BMA TWR	Well, now, they are pretty high up with BN so that ... I will talk to BN so that he maintains [position] Bye.
12:23:50	BMA TWR	Helicopter BN from Bromma.
12:24:27	BMA TWR	DC 3 SE-CFP, the wind is 230 degrees 8 knots, runway 30, cleared to land.

Time	From	
12:24:34	SE-CFP	Cleared to land runway 30, SFP.
12:24:37	BMA TWR	Yes, SE-JBN from Bromma tower, are you on 123.55?
12:24:43	SE-JBN	Yes, that and 1810
12:24:46	BMA TWR	Yes, this is Bromma tower here BN. You must maintain present position and to the north for a while and wait before you drop the skydivers, we have some traffic on the way in from southeast.
12:24:57	SE-JBN	But they are already on the skids, so it's probably too late.
12:25:06	SE-JBN	Yes, and they have just jumped so... BN, did you hear that?
12:25:11	BMA TWR	Yes, okay, understood.
12:25:14	BMA TWR	BN you follow them down then and report back when they are on the ground.
12:25:21	SE-JBN	No, wait.
12:25:29	SE-JBN	BN no skydivers leaving at the moment and they want to move 500 meters further on, so if we can maintain our present position, that would be great.
12:26:05	SE-JBN	Gärdet, skydivers in the air, for information.
12:26:07	Gärdet?	Many thanks! [Very faint, probably not from BMA TWR]
12:26:23	STO SYD	Well, what do we do now?
12:26:24	BMA TWR	Bromma, put Extrans in a holding pattern until further notice until I get back to you. Okay.
12:26:27	STO SYD	Okay, yes.
12:26:30	STO SYD	Extrans 928 we have some conflicting traffic, some problems, maybe we have an aircraft... Old Daisy[17] is returning with one engine out of service about to land now but I don't know exactly what happens to the runway. And we also have parachuting activities over Gärdet so could you please join Nacka holding just. I think it will be maximum two orbits.
12:26:57	928	Okay, no problem. We are joining Nacka holding and maintaining now 2,500
12:27:04	STO SYD	OK
12:27:27	BMA TWR	DC-3 FP you are cleared in via Delta and the fire trucks will follow you.
12:27:33	928	And Stockholm Extrans 928 approaching Nacka and we have only figures. Left or right turns at Nacka?
12:27:41	STO SYD	Make it right turn.
12:27:43	928	Okay, right turn. And one or two minutes out, do you want?
12:27:47	STO SYD	Two minutes is fine with me.
12:27:49	928	Okay two minutes and right turn out. Thank you.
12:27:51	STO SYD	[Two clicks]
12:28:03	928	And Extrans 928 we are joining Nacka holding.
12:28:08	STO SYD	Extrans 928 that's copied. I call you back shortly.
12:28:11	928	Thank you.
12:28:20	SE-JBN	Jumpers in the air and BN is descending at Lidingö bridge.
12:28:22	BMA TWR	[Ringing once] Hello.

[17] Old Daisy – The name of the DC-3, SE-CFP

Time	From	
12:28:24	STO SYD	Hello, yes.
	BMA TWR	You are turning Extrans down, so that he does not move in there directly under BN.
12:28:28	STO SYD	Yes right turn, I said over Nacka, you see.
12:28:30	BMA TWR	Yes, but turn him down again towards the final, so, now you can continue. Yes.
12:28:34	STO SYD	Oh I see.
12:28:35	STO SYD	Extrans 928 turn left, left turn to heading 200.
12:28:41	928	Okay left heading 200, Extrans 928.
	928	And is speed 180 good?
12:28:50	STO SYD	That is fine.
12:28:51	SE-JBN	Bromma from BN.
12:28:53	BMA TWR	BN come in.
12:28:54	SE-JBN	Yes, all jumpers are in the air and we are descending above Lidingöbron.
	STO SYD	[Ringing two times]
12:29:00	BMA TWR	Yes, understood thanks.
12:29:02	BMA TWR	Hello.
12:29:06	STO SYD	Now he's turning down to the left here.
12:29:04	BMA TWR	Well, okay, but it was BN, it was he who had the skydivers so...
12:29:09	STO SYD	But you said I should enter Nacka holding, until further notice.
12:29:12	BMA TWR	Ah, I told you to wait with him, I did not say Nacka holding but perhaps there was a little misunderstanding. But climb him instead and turn him south.
12:29:22	STO SYD	Should I climb him now and turn south?
12:29:24	BMA TWR	Yes, do that.
12:29:25	STO SYD	OK
12:29:29	STO SYD	Extrans 928 climb now to, there is some misunderstanding between Bromma and the operating parachuting aircraft, climb to 4,000 feet and continue on southerly heading.
12:29:44	928	Okay, present heading and leaving 2,500 and climbing 4,000 Extrans 928
12:30:01	BMA TWR	Hello again.
12:30:02	STO SYD	What would you like me to do?
12:30:03	928	And Extrans 928, heading 180 is good?
12:30:07	STO SYD	180 is good, yes.
12:30:09	STO SYD	You wanted me to climb him.
12:30:11	BMA TWR	*Yes, no, but the thing was well that I did not want him under the BN. That's why we pulled BN north. So, there was a little misunderstanding.*
12:30:19	STO SYD	Has he dropped the skydivers now?
12:30:20	BMA TWR	Yes he has. But continue in then now in a left turn, now you can of course continue for landing.
12:30:27	STO SYD	Then I go in for one, for the final yes.