



Statens haverikommission
Swedish Accident Investigation Board

ISSN 1400-5727

Report RM 2007:04e
Incident during air-to-air gun firing against
a towed sleeve target over the Gulf of Bothnia
on 11 October 2006

Case M-09/06

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

The material in this report may be reproduced free of charge provided due acknowledgement is made.

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

Translated by Interpreter Centre, City of Göteborg, from the original Swedish at the request of the Swedish Accident Investigation Board.

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



Swedish Armed Forces

107 85 STOCKHOLM

Report RM 2007:04e

The Swedish Accident Investigation Board has investigated an incident that occurred on 11 October 2006 over the Gulf of Bothnia between a Czech Republic JAS 39 and a Learjet LR 35 target towing aircraft from SAAB SFO with registration SE-RCA.

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

The Board will be grateful to receive by 18 April 2008 at the latest how the recommendations given in this report are being followed up.

Göran Rosvall

Agne Widholm

Identical to: Swedish Civil Aviation Authority

Contents

	ABBREVIATIONS AND EXPLANATIONS OF TERMS	5
	SUMMARY	6
1	FACTUAL INFORMATION	9
	1.1 History of the flight	9
	1.1.1 <i>The incident</i>	9
	1.1.2 <i>Other firing aircraft</i>	10
	1.1.3 <i>The towing aircraft</i>	10
	1.2 Injuries to persons	10
	1.3 Damage to the aircraft	10
	1.4 Other damage	11
	1.5 Personnel information	11
	1.5.1 <i>The pilot of the JAS 39 (C 219)</i>	11
	1.5.2 <i>The commander of the towing aircraft Target 03</i>	11
	1.5.3 <i>The co-pilot of the towing aircraft Target 03</i>	11
	1.5.4 <i>The flight engineer/target operator in Target 03</i>	11
	1.5.5 <i>The crew duty schedule</i>	11
	1.6 Meteorological information	12
	1.7 Aids to navigation	12
	1.8 Communications	12
	1.9 Aerodrome information	12
	1.10 Flight recorders	12
	1.11 Incident site	12
	1.12 Medical information	12
	1.13 Fire	13
	1.14 Survival aspects	13
	1.15 Tests and research	13
	1.15.1 <i>Measurement of the distance between the towing aircraft and the spare target</i>	13
	1.15.2 <i>Recordings in the Czech Republic aircraft</i>	13
	1.15.3 <i>The spare target</i>	13
	1.16 Organisation and management of the Vidsel campaign	13
	1.16.1 <i>Applicable regulations</i>	13
	1.16.2 <i>Government decision</i>	14
	1.16.3 <i>Swedish Defence Materiel Agency (FMV - Försvarets Materielverk)</i>	15
	1.16.4 <i>The Swedish Armed Forces (FM - Försvarmakten)</i>	16
	1.16.5 <i>SAAB Special Flight Operations (SAAB SFO)</i>	16
	1.16.6 <i>The Czech Republic unit</i>	17
	1.17 Additional information	17
	1.17.1 <i>Planned activities in weeks 640-641</i>	17
	1.17.2 <i>Implemented activities in week 640</i>	17
	1.17.3 <i>Live gun firing on Monday 9 October</i>	18
	1.17.4 <i>Training of the Czech pilots and preparations for the Vidsel campaign</i>	19
	1.17.5 <i>Definition of the danger area</i>	20
	1.17.6 <i>Safety instructions for the Swedish Air Force in the case of live bombing and live firing (Såkl Flyg)</i>	20
	1.17.7 <i>Equal opportunities aspects</i>	20
	1.17.8 <i>Environmental aspects</i>	20

2	ANALYSIS	21
2.1	General	21
2.2	Responsibilities	21
2.3	Governing regulations and instructions	22
2.3.1	<i>Regulations for access into Swedish territory</i>	22
2.3.2	<i>Safety instructions</i>	23
2.3.3	<i>Training instructions</i>	23
2.3.4	<i>In-flight Guide</i>	23
2.4	Timing	24
2.5	Training and competence of the pilots	24
2.5.1	<i>Languages</i>	24
2.5.2	<i>The Czech Republic JAS 39 unit</i>	24
2.5.3	<i>The Czech Republic L 159 unit</i>	24
2.5.4	<i>The Swedish LR 35</i>	25
2.6	The equipment and functions of the aircraft	25
2.6.1	<i>JAS 39</i>	25
2.6.2	<i>L 159</i>	25
2.6.3	<i>LR 35</i>	25
2.7	Calculation of miss distance	25
3	CONCLUSIONS	26
3.1	Findings	26
3.2	Causes of the incident	26
4	RECOMMENDATIONS	27

ABBREVIATIONS AND EXPLANATIONS OF TERMS

AFB	Air Force Base
ATPL	Air Transport Pilot Licence
FM	The Swedish Armed Forces
FMV	The Swedish Defence Material Agency
F7	Skaraborg Wing, Såtenäs
FÖRBE FV	Swedish Air Force department within FM Headquarters
FÖRVE FLYGI	Military Aviation Inspectorate
HKV	The Swedish Armed Forces Headquarters
hPa	Hectopascals. Pressure measurement unit
ITÖ	International testing, exercise and training operations
IR	Infrared
PROD	Production department within FM Headquarters
PC	Proficiency Check. Check of flying competence
RML	Rules for Military Aviation
SAR	Search And Rescue. Air rescue services
SFO	Special Flight Operations
SOP	Standard operating procedure. Description of flying procedures
SÄKI	Safety instructions for Swedish Armed Forces
TFMOU	Test Facilities Memory Of Understanding. Agreement between several nations on mutual use of government test facilities and co-operative test and evaluation
TU JAS 39	Tactical Development Unit for JAS 39 aircraft
WGS 84	World Geodetic System 1984
QFE	Barometric air pressure at airfield elevation or runway threshold
QNH	Sea level barometric air pressure (at Mean Sea Level)

Report RM 2007:04e

M-09/06
Report finalised 2007-10-18

Fighter aircraft

<i>Aircraft; registration and type</i>	JAS 39 C; registered no. 393/235
<i>Class</i>	Military fighter aircraft
<i>Registered owner/Operator</i>	Swedish Armed Forces/Leased by the Czech Republic
<i>Time of occurrence</i>	11 October 2006, at 09:38 hours, in daylight (<i>Note: All times are given in Swedish summer time, UTC+2 hours</i>)
<i>Place</i>	Over the Gulf of Bothnia, approx. 75 km east-south-east of Skellefteå, N 64°40', E 22°30' (WGS 84)
<i>Type of flight</i>	Air-to-air live gun firing against a towed sleeve target
<i>Weather</i>	Low clouds with a base at about 1000 feet and top at 2000 feet. Very good visibility above clouds. Wind approximately westerly at 5-10 knots. QNH 1028 hPa
<i>Persons on board: crew members</i>	1
<i>Injuries to persons</i>	None
<i>Damage to aircraft</i>	None
<i>Other damage</i>	None
<i>The pilot:</i>	
<i>Sex:</i>	Male
<i>Total flying time</i>	Approx. 1000 hours, of which 273 on type

The towing aircraft

<i>Aircraft; registration and type</i>	SE-RCA, Learjet LR 35 A
<i>Airworthiness</i>	Valid Certificate of Airworthiness
<i>Registered owner/Operator</i>	SAAB AB/SAAB AB SFO
<i>Time of occurrence</i>	11 October 2006, at 09:38 hours, in daylight
<i>Place</i>	Over the Gulf of Bothnia, approx. 75 km east-south-east of Skellefteå, N 64°40', E 22°30' (WGS 84)
<i>Type of flight</i>	Utility flight/Sleeve target towing
<i>Weather</i>	Low clouds with a base at about 1000 feet and top at 2000 feet. Very good visibility above clouds. Wind approximately westerly at 5-10 knots. QNH 1028 hPa
<i>Persons on board: crew members</i>	3
<i>Injuries to persons</i>	None
<i>Damage to aircraft</i>	None
<i>Other damage</i>	None

Commander:

<i>Sex, age, licence</i>	Male, 65 years, ATPL
<i>Total flying time</i>	16100 hours, of which 3400 hours on type
<i>Flying hrs previous 90 days</i>	110 hours, of which 11 hours on type
<i>Number of landings on type, previous 90 days</i>	9

The Swedish Accident Investigation Board (SHK) was notified on 13 October 2006 that an incident had occurred on 11 October 2006 over the Gulf of Bothnia during live gun firing with a Czech JAS 39 against a towed sleeve target.

The incident has been investigated by SHK, represented by Carin Hellner, chairperson until 8 January 2007, and thereafter by Göran Rosvall as chairperson and by Agne Widholm, Investigator In Charge.

The Board has been assisted by Göran Persson as an operations expert.

With assistance from Ivan Skala, Head of the Section for Military Aviation Inspection in the Czech Minister of Defence Inspection, SHK has been able to follow the Czech investigation and study certain records, and to interview involved personnel in the Czech Republic.

The investigation has been followed by Stefan Ungerth, representing the Swedish Military Aviation Inspectorate, and by Max Danielsson, representing the Swedish Civil Aviation Authority.

Summary

During live gun firing against a towed air target over the Gulf of Bothnia on 11 October 2006 a Czech JAS 39 in one attack fired against a spare target that was less than ten metres behind the towing aircraft instead of the correct target that was about 600 metres behind the towing aircraft. No damage occurred. The incident was discovered after landing.

The cause of the incident was a too comprehensive campaign during a limited time, not updated safety instructions and unclear division of responsibilities between FM, FMV, SAAB SFO and the Czech Republic, which altogether lead to that the pilot of a JAS 39 (C 219) misunderstood the target configuration and the responsibility between the attacking aircraft and the towing aircraft.

Additional causes were that the Czech pilots had little or no previous experience of live gun firing against air targets and that the crew in the towing aircraft had no possibilities to monitor the attacks.

Recommendations

The Swedish Armed Forces is recommended to:

- Press for a review of the regulations and responsibilities in respect of foreign governmental aviation on Swedish territory
(*RM 2007:04e R1*).
- Take the measures that are necessary to ensure that both discussions and decisions concerning foreign governmental aviation on Swedish territory take place in accordance with applicable regulations and in a safe way for both the parties involved and third parties
(*RM 2007:04e R2*).

- Revise SäkI Flyg and produce an English translation (*RM 2007:04e R3*).
- In consultation with SAAB SFO revise SäkI Flyg in those parts where SAAB SFO is affected (*RM 2007:04e R4*).

The Swedish Civil Aviation Authority is recommended to:

- Press for SAAB SFO to update their rules so that the work they do is regulated (*RM 2007:04e R5*).
- Press for SAAB SFO to improve the possibilities of monitoring attacking aircraft in order to avoid accidental firing (*RM 2007:04e R6*).

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 *The incident*

The exercise, that was managed from the Vidsel air base, comprised live gun firing from Czech military JAS 39 Gripens and L 159 ALCAs against a sleeve target that was being towed by a Swedish civilian Learjet LR 35 from SAAB Special Flight Operations (SFO).

The towing aircraft, with callsign Target 03, took off from Luleå airport at 09:07 hours. When the attacks commenced, the towing aircraft was in a left turn in the exercise area over the Gulf of Bothnia, banking at 30 degrees and at a speed of 260 knots. The altitude was 2700 feet, about 700 feet above overcast sky, and the flight was taking place in very good visibility. A spare target was in transport position 8,85 metres behind the rear edge of the elevators, and the target to be aimed at was about 600 metres behind the towing aircraft.

The first firing pair JAS 39 aircraft with callsigns C 219 and C 217 took off from Vidsel at 09:19 hours. C 219 was guided by the Örnen (Eagle) air combat command and control centre to acquire visual contact with Target 03 after which he reported that he was ready to begin. Target 03 replied “stand by”, which was acknowledged by C 219. Target 03 then reported that it was in the process of winching out the target to 600 m. After a while Target 03 reported that the target was 600 metres behind and that they were ready to begin. There was no message that there was a spare target close to the aircraft.

Both C 219 and C 217 began with three practise attacks “dry runs” each, with their guns switched off, but in all other respect the same procedure as for live firing, including radar lock-on, firing actions and recording the attacks. Evaluation afterwards showed that both aircraft had made practice attacks on the spare target. This was the pilots’ first opportunity to fire at a sleeve target, and their only planned firing mission during the campaign.

The Czech pilots discussed the target configuration in Czech on their squadron frequency. They considered that the target was close to the towing aircraft, but as they had been cleared to attack by the towing aircraft, they assumed that they had permission to fire. The crew of the towing aircraft heard the Czech radio traffic, but did not understand what was being said.

Thereafter C 219 went over to live firing, “hot runs”. During the first attack the crew of Target 03 heard a clattering sound that they had never heard before. Any hits were not registered in the target. The hit indicator on the spare target was switched off, so that false recordings would not be obtained due to turbulence. The crew of Target 03 did not report their experience by radio to the attacking aircraft nor to the fighter controller. On evaluation after the flight, it was established that C 219 had fired at the spare target. C 219 said nothing about the firing on the fighter control frequency or the firing frequency, and neither Örnen nor Target 03 realised that the wrong target had been fired at. When C 219 broke off after the attack and turned to make a new attack, he discovered the correct firing target. He reported this to C 217, and both went over to attack the correct target. When the firing was completed they returned to Vidsel, where they landed at 10:08 hours. After landing at Luleå at 11:03 hours, the crew of Target 03 found that the spare target had been hit by nine shots in its rear half. No damage had been inflicted on the towing aircraft. The com-

mander of Target 03 telephoned to the campaign commanders at Vidsel and reported what had happened, upon which the wing commander flying at FMV decided that further firing would be cancelled.

1.1.2 *Other firing aircraft*

After the C 219 and C 217 pair, a group of three L 159 ALCA aircraft, with callsigns C 240, C 202 and C 251, which had taken off from Vidsel at 09:27, arrived. Target 03 reported that the target was 600 m behind and that there was a spare target 50 feet behind. The Czech aircraft started “dry runs”, whereupon C 240 reported a radar failure due to unsuccessful radar lock and left the target. After C 202 and C 251 had completed firing, C 240 returned and carried out his firing.

When the group of three had left the exercise area to go to Vidsel, where they landed at about 10:50, a single JAS 39 arrived, that had taken off from Vidsel at 10:11, having the callsign C 200. He reported visual contact with the target. Target 03 reported that the target was 600 m behind and that there was a spare target 50 feet behind the aircraft. C 200 read this back and Target 03 confirmed that this was correct. After C 200 had performed some “dry runs” he intended to begin shooting. During the first live firing attack he said that he could not fire, that he was having trouble locking on to the target behind Target 03, and that the radar always locked on the towing aircraft. Target 03 stressed that the correct target was 600 m behind, which was confirmed by C 200. After this, firing was carried out against the correct target. C 200 landed at Vidsel at 10:59. The recording of the C 200 mission was not preserved.

1.1.3 *The towing aircraft*

The towing aircraft was a Learjet LR 35 owned by SAAB AB and operated by SAAB SFO, with registration SE-RCA and callsign Target 03. The crew consisted of the pilot in command, a co-pilot (with command authorisation), and a flight engineer/target operator.

The aircraft was equipped with two type KRN targets, which are orange-coloured fabric targets 4,5 metres long and equipped with a radar reflector and a hit recorder, with transmitter. The aircraft had one target behind each wing, a firing target and a spare target, each connected to a winch under the respective wing.

Since the aircraft was not equipped with a radar warning system, rear-facing camera, rear view mirrors or a bubble canopy, the crew could not see the target or attacking aircraft behind it.

While flying towards the exercise area the starboard target, which was the spare target, was winched out to a transport position 50 feet behind the winch to avoid the turbulence around the towing aircraft. The hit recorder on the spare target was switched off, so that false recordings would not be obtained due to turbulence from the towing aircraft. The port target, which was the firing target, was winched out about 600 metres behind the towing aircraft.

1.2 **Injuries to persons**

None.

1.3 **Damage to aircraft**

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 The pilot of the JAS 39 (C 219)

The pilot had been trained on the JAS 39 in Sweden and then undergone further training in the Czech Republic.

Flying hours

All types	About 1000 hours
This type	273 hours

1.5.2 The commander of the towing aircraft Target 03

The commander, male, was 65 years old at the time and had a valid Air Transport Pilot Licence.

Flying hours

<i>previous</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	2	110	16100
This type	2	11	3400

Number of landings this type previous 90 days: 9.

Flight training on type carried out in 1985.

Latest PC (Proficiency Check) carried out on 28 November 2005 on a LR-35.

1.5.3 The co-pilot of the towing aircraft Target 03

The co-pilot, male, was 45 years old at the time and had a valid Air Transport Pilot Licence.

Flying hours

<i>previous</i>	<i>24 hours</i>	<i>90 days</i>	<i>Total</i>
All types	2	73	7415
This type	2	65	3050

Number of landings this type previous 90 days: 39.

Flight training on type carried out in 1992.

Latest PC (Proficiency Check) carried out on 28 November 2005 on a LR-35.

1.5.4 The flight engineer/target operator in Target 03

The target operator, male, was 39 years old at the time and had appropriate authorisation issued by the company.

1.5.5 The crew duty schedule

The crew of Target 03 relocated on Sunday 8 October to Luleå. On Monday 9 October they flew one target towing mission of about 1,5 hours. On Tuesday 10 October no flying took place. On Wednesday 11 October they flew one target towing mission, during which the incident took place, of about 2 hours.

The pilot of C 219 did not fly on Tuesday 10 October, the day before the incident. The mission during which the incident took place was his first flight of the day.

1.6 Meteorological information

According to the weather briefing at Vidsel on the morning of 11 October and the crews' observations: Overcast with the base at about 1000 feet and top at 2000 feet, visibility above clouds very good, wind westerly 5-10 knots, QNH 1028 hPa.

1.7 Aids to navigation

Not applicable.

1.8 Communications

All radio communication with air traffic control and fighter controller (Örnen) as well as that between the firing aircraft and the towing aircraft was in English. In addition, the Czech pilots had internal squadron frequencies on which within units they communicated in Czech. Communication on the 211 Gripen Squadron frequency could be heard by the towing aircraft crew, although they did not understand or record it. Communication on one squadron frequency could not be heard by aircraft from the other squadron (JAS 39 and L 159 respectively).

Radio communications on the fighter control frequency, along with internal communications and telephone calls were recorded by Örnen, but only a part of these were preserved. The recording is difficult to survey and unstructured. It consists of 227 digital files with a length from a few seconds to more than five minutes. There are no time markings.

1.9 Aerodrome information

Not applicable.

1.10 Flight recorders

Recording took place in the Czech JAS 39 and L 159, mainly for follow-up of the aircraft functions and for evaluating attacks. The recordings from all the Czech aircraft involved in that particular mission were preserved, except that from the last firing JAS 39 (C 200). The recordings are Czech property, but SHK was given the opportunity to take part of them.

1.11 Incident site

The incident took place over the Gulf of Bothnia, approximately 75 km east-south-east of Skellefteå, N 64°40', E 22°30' (WGS 84).

1.12 Medical information

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

1.13 Fire

Not applicable.

1.14 Survival aspects

Not applicable.

1.15 Tests and research

1.15.1 *Measurement of the distance between the towing aircraft and the spare target*

Checks of the winch calibration and measurements while on the ground were made to determine how far the spare target was behind the towing aircraft. When the spare target was winched out to its transport position, 14,40 metres (50 feet indicated) behind the starboard winch, the hit sensor was 7,85 metres behind the rear edge of the elevator. The soft part of the target began a further metre behind the hit sensor, i.e. 8,85 metres behind the rear edge of the elevator.

1.15.2 *Recordings in the Czech Republic aircraft*

The recordings in the firing aircraft (C 219) established that the radar in all the attacks up to and including the live firing had locked on to the towing aircraft, but the aiming was on the spare target. The aiming during firing was stable, and the burst of fire short, about half a second.

The recordings in the wingman's aircraft (C 217) showed that during the dry runs this radar too had locked on to the towing aircraft.

From the radio traffic it emerged that the last JAS (C 200) had also attacked the spare target several times, with the radar locked on to the towing aircraft. However no live firing took place.

None of the L 159s attacked the spare target. Evaluation afterwards showed that the unsuccessful lock in the beginning for C 240 was due to the attack geometry causing the curve towards the target to some extent having zero doppler shift, i.e. with the target at right angles to the attacking aircraft which resulted in an impossible locking as the target was filtered as ground clutter.

1.15.3 *The spare target*

The spare target was hit by nine shots in its rear half, with a good close grouping. There were also nine exit holes.

1.16 Organisation and management of the Vidsel campaign

1.16.1 *Applicable regulations*

The incident involves civil aviation, SAAB SFO with SE-RCA, and foreign state aviation in the form of Czech military aviation.

FM and FMV considered that the campaign was covered by the respective authorisations for Swedish military aviation, their permission to arrange ITÖ and by the TFMOU that was signed by several nations.

The civil aviation is regulated in accordance with the Aviation legislation and BCL-D 2.1, and the issued operating certificate.

Foreign state aviation in Sweden is regulated in Territorial access regulations.

Swedish military aviation is regulated by the Swedish Armed Forces statute book (FFS 1997:15).

Extracts from the Aviation Act, the Ordinance concerning the Admission to Swedish Territory of Foreign Vessels and State Aircraft (Admission Ordinance) and FFS 1997:15

Aviation Act (1957/297)

Chapter 15 section 3: The King or those empowered thereto by the King will decide whether and upon what conditions foreign military aircraft or other foreign aircraft used exclusively for State purposes and not for commercial operations may be admitted to Swedish territory.

Ordinance concerning the Admission to Swedish Territory of Foreign Vessels and State Aircraft (Admission Ordinance) (1992:118)

Section 5.3: The Supreme Commander of the armed forces may grant permission to enter Swedish territory to foreign state aircraft other than military aircraft, at the request of the Civil Aviation Administration.

Section 6: In cases other than those referred to in Section 5 the Government grants permission to foreign state vessels and state aircraft to enter Swedish territory. Permission is obtained through diplomatic channels.

Section 9: When present within Swedish territory, a foreign state aircraft shall follow the regulations governing civil aviation and shall be navigated in accordance with directions from Swedish air traffic control.

Section 10: Within Swedish territory, a foreign state vessel or state aircraft may only undertake shooting exercises other than those referred to in Section 5 paragraph 2 with the permission of the Government, unless such exercises can be conducted in their entirety within the vessel or the aircraft itself. (The second paragraph of Section 5 deals with rescue efforts and exercises pertaining to such efforts.)

The Swedish Armed Forces regulations for military aviation (FFS 1997:15).

§1: Military aviation covers with respect for these rules, all activities within the military aviation system (defined according to §2), including development, acquisition deployment and operation, support, dismantling and possible recycling of military units and materiel systems belonging to the military aviation system as well as ground constructions, premises, equipment and supplies, required for the military aviation system.

§2: The military aviation system comprises of an aircraft operations system, an aerodrome and war base system, and an air space system. These sub-systems are part of the national aviation system that comprises of subsystems belonging to the civil aviation system as well.

§10: The regulations for military aviation shall be promulgated in the Rules for Military Aviation, RML.

1.16.2 Government decision

FM requested the government in a submission on 4 September 2006 (Hkv 01 800:73167) to accomplish an exercise in Sweden with common flying

with the Czech Republic Armed Forces during weeks 640 and 641, and with the applicable Czech Republican authorities and in conjunction with FMV to negotiate and enter into agreements necessary for the activities. According to the request the purpose of the common flying exercise was to increase the capability to co-operate with the flying units from the Czech Republic in international peacekeeping crisis operations. The exercise was planned to include planning, flying and evaluation. The flying was planned to be performed as a moment exercise without an underlying scenario.

The government announced its decision on this question on 28 September 2006 (Fö2006/2087/EC/RC and Fö2006/2174/EC/RC).

- FM was permitted to perform a common flying exercise in accordance with the application and further FM determination.
- Activities within the framework of and related to the exercise were permitted to be carried out on Swedish territory as determined by FM.
- FM was authorised, in conjunction with FMV, to negotiate and enter into the necessary agreements with the appropriate Czech authorities.
- The Czech combat aircraft were permitted to enter Swedish territory 2-15 October 2006 as determined in more detail by FM.
- FM would be responsible for orientation and the necessary co-ordination with the affected authorities in respect of the Czech flying unit and its presence on Swedish territory.

During its investigation the Swedish Accident Investigation Board learned that the Government's decision was in respect of all activities to be carried out by the Czech Armed Forces during the period. This was not a responsibility shared by FM and FMV, but it was FM that would be responsible for the activities.

1.16.3. *Swedish Defence Materiel Agency (FMV - Försvarets Materielverk)*

On the basis of the leasing agreement – Gripen for the Czech Republic – negotiations began in June 2006 between FMV and the appropriate Czech authorities to implement validation of the JAS 39 and L 159 air defence capabilities during two weeks in the autumn of 2006. The time frame was established as weeks 640-641. The discussions resulted in a request from the Czech side to carry out the following activities, deployed on Vidsel:

- Missile firing with the IR AIM-9M missile against towed targets.
- Live gun firing against towed targets.
- Flare dropping.
- Low level navigation flights.
- Basic fighter manoeuvring flights (offensive and defensive) with a Swedish JAS 39 unit.

Since FMV considered that low level navigation and common flying exercises were not covered by their authorisation, FM was contacted with a request to support these activities. In addition support was requested for SAR, airspace, combat command resources, the use of Luleå as an alternative airfield including hangar space, the reception of transport aircraft at Vidsel with Luleå as a back-up, briefings by meteorologist, fighter controller, base personnel and SAR, the loan of various items of technical equipment, and in the case of an accident, support with resources for cordoning off the accident site.

The use of Vidsel as a base in general along with briefings and command and control of firing with missiles and guns, and flare dropping, were dealt with by FMV.

No request was put to the government to carry out the activities, since FMV considered that this was included in the tasks and authorisation that had been granted.

1.16.4 *The Swedish Armed Forces (FM - Försvarsmakten)*

Several parts of the Headquarters were involved in the campaign.

- PROD Proj ITÖ in respect of the preparation and submission of the request to the government to permit common flying. Several staff officers in various areas of the Headquarters participated in the preparation.
- FÖRBE FV in respect of the F 7 task to implement common flying and to F 21 to support the F7 and FMV activities.
- FÖRVE FLYGI in respect of the interim authorisation for FMV until 31 December 2006.
- OPE in respect of the more detailed decisions by FM in accordance with the government's decision.

Nor did FM include in its request any decision that would enable a common flying exercise with Swedish and Czech JAS 39s with intercept at supersonic speed or navigation at minimum altitude at high speed. Both these activities are violating section 9 in the territorial access regulations.

1.16.5 *SAAB Special Flight Operations (SAAB SFO)*

SAAB SFO is part of SAAB AB and is located at Skavsta airfield. The company operates seven Mitsubishi Mu-2s and two Learjet LR 35s, mainly as targets for military and civil purposes inside and outside Sweden. The company has long experience of target aviation.

Due to cutbacks in FM, the Target Squadron that previously carried out such tasks as target towing for live gun firing was disbanded. Conversion to the JAS 39 and prioritisation of other tasks resulted in that live gun firing against towed targets has not been practised by FM for a long time. As a result of this, SAAB SFO has on only two occasions provided target towing for air-to-air firing with that particular type of target, when tests were carried out in a special testing programme for the JAS 39 under the auspices of FMV. There is no description in the company's SOP of towing targets for live gun firing from aircraft. Nor had SAAB SFO had occasion to participate in preparing safety regulations for air-to-air firing.

The flight commander and the assigned crew from SAAB SFO attended the briefing on Thursday 5 October, and presented there, among other things, the target configuration with a spare target close to the towing aircraft, and a firing target 600 metres behind. However the spare target was not shown on the illustration, and the distance between the towing aircraft and the target was not to scale.

After the briefing the personnel from SAAB SFO flew back to Skavsta, and then on the Sunday afternoon relocated to Luleå.

SHK has examined how the Finnish Air Force LR 35 towing aircraft is equipped. Apart from having its own search radar for surveillance of the sea surface, there is a camera to track and supervise the attacking aircraft. In addition to increasing safety, there is also the possibility to improve training, with an instructor in the towing aircraft.

1.16.6 *The Czech Republic unit*

The Czech unit came from the 21st Air Force Base (AFB) Čáslav and consisted of five JAS 39 C and D aircraft from 211 Gripen Squadron and five L 159 aircraft from 212 ALCA Squadron. The personnel consisted of commanders, pilots and technical personnel.

Many people had an influence on the way flight operations were conducted. Apart from the squadron commanders there was the 21st AFB commander, the wing commander flying, the flight safety officer and representatives from, among others, Joint Force Command included in the delegation.

1.17 **Additional information**

1.17.1 *Planned activities in weeks 640-641*

According to the 2006 regulatory letter for FMV, the authority within its area of operations is allowed to arrange international testing, exercise and training operations (ITÖ). As part of the efforts to offer foreign armed forces and industries the possibility of using test sites and exercise areas in northern Sweden, and as part of the agreement between Sweden and the Czech Republic concerning leasing the JAS 39, FMV representatives had agreed with the Czech authorities to run a campaign during weeks 640-641, located at Vidsel.

After a visit to Vidsel in June 2006, the Czech side asked FMV if they could carry out live gun firing against towed targets, IR missile firing against towed targets and flare dropping from aircraft. They also wished to perform low level navigation over land, and to have common flying with Swedish JAS 39 aircraft including supersonic flights over the Gulf of Bothnia.

1.17.2 *Implemented activities in week 640*

The Czech aircraft relocated to Vidsel on Wednesday 4 October, with 5 JAS 39 and 5 L 159 aircraft. In addition a transport aircraft landed with material and personnel. During the period the transport aircraft flew several times between the Czech Republic and Sweden. Before and after the campaign, missiles, flares and automatic cannon ammunition were transported. There was a certain amount of crowding at Vidsel, since the TU JAS 39 aircraft were there at the same time. This meant that the SAAB SFO aircraft and the planned common flying unit JAS 39 aircraft of F 7 were directed to Luleå.

On Thursday 5 October a so called “mass briefing” was held for all personnel involved. Several people spoke at this briefing:

- Representatives from FMV
- Air traffic controller from Vidsel
- Fighter controller
- Meteorologist
- Test commanders from Vidsel
- The search and rescue service
- Luleå airport manager
- FMV wing commander flying
- SAAB SFO flight commander
- F 7 Wing flight operations commander

Those responsible for the briefings, the FMV wing commander flying and the airspace responsible fighter controller, realised during the morning that the afternoon would also be taken up by briefings in order to have enough time for everything, so the flights planned for that day were cancelled. In addition at an early stage the planned common flying with F7 Wing JAS 39s based at Luleå, along with the supersonic flights, were also cancelled. The fighter controllers assessed, despite this, that the planned two fighter controllers would not be enough for the comprehensive activities. They therefore requested that one more fighter controller should be in post on the Sunday in order to be able to take part in the live gun firing from Monday 9 October onwards.

During the briefing on safety regulations in accordance with the not updated SäkI Flyg (see 1.17.6), the question came up of the measuring of the altitude difference between the towing aircraft and the firing target, which according to the SäkI Flyg and FMV briefing should be at least 50 metres (160 feet) in the case of a turning target and 70 metres (230 feet) for a target flying on a straight course. According to the SAAB SFO flight commander and the towing aircraft crew's opinion this was unnecessary, since they assessed the altitude difference to be sufficient. This assessment was based on the interpolation of existing tables, where however the shortest tow line length was 1500 metres. The FMV wing commander flying accepted this assessment and decided that this measuring was not required.

The briefing on safety regulations also dealt with terminology, the appearance of the danger area and danger zones, supervision of the danger area and danger zones, prohibited area behind the target, radar guidance of the firing aircraft, weather limitations, granting of permission to fire, permitted firing angles and distances, when firing would not be permitted, how to act if several aircraft were firing at the same target, how to report any damage to the target and how to proceed in the case of radio failure and when landing with remaining ammunition.

Of these it is important to note the weather limits, which among other things stated that the minimum vertical distance to cloud was 1000 feet (300 metres), that firing permission applied when the towing aircraft reported "target ready" but that there was a prohibition on firing if there was a risk that the towing aircraft could be hit.

About ten copies of a document were handed out after the briefing showing the safety briefing illustrations.

During the morning on Friday 6 October the Czech pilots practised training in air-to-air gun firing against a single aircraft, which acted as target.

In parallel with live gun firing during the campaign in weeks 640-641, missile firing, flare dropping and low level navigation took place.

On the Friday afternoon and on Saturday 7 October and Sunday 8 October no flying took place, as planned. The requested fighter control reinforcement arrived on the Sunday afternoon and received the necessary information to be able to participate from the Monday onwards.

The towing aircraft relocated from Skavsta to Luleå on Sunday 8 October and prepared to start towing targets from Monday 9 October.

1.17.3 Live gun firing on Monday 9 October

A delay on Monday 9 October resulted in that only one mission could be carried out that day instead of the two that were planned. Due to the weather situation, with overcast sky, it was decided to practice on turning targets. Since the towing aircraft had problems with one winch, the spare target detached when it was being winched out to its transport position, about 50 feet behind the winch. The firing target was winched out to 600

metres as planned. The high cloud tops meant that the towing aircraft climbed some hundred feet above the highest altitude that had been stated at the briefing. There was some uncertainty whether the maximum altitude referred to the firing aircraft, the towing aircraft or the firing target. This, in combination with the lack of clarity in the SäkI Flyg (see 1.17.6) and that the wind pushed the towing aircraft to the south-west towards the edge of the danger area, caused uncertainty for the fighter controller and a risk of ending up outside the defined danger area. A report (DA-Stri) has been written on this occurrence. A pair of JAS 39s and a pair of L 159s were planned to perform the firing. However one of the JAS 39s landed without having fired.

There was no flying on the Tuesday 10 October due to weather problems and the lack of SAR.

1.17.4 *Training of the Czech pilots and preparations for the Vidsel campaign*

As a result of the agreement between the Czech Republic and Sweden the Czech Republic leases 12 single-seat JAS 39 C and two two-seat JAS 39 D aircraft.

The Czech pilots had been trained by FM in Sweden on the JAS 39. In order to support their continuation training in the Czech Republic, two Swedish pilots was included in the “Swedish Air Force Support Group” from the spring of 2005 up to the end of 2006. Among other things, these prepared for air-to-air firing by making exercise profiles based on JA 37 aircraft training. There were no authorised Swedish training instructions for air-to-air firing against towed targets with the JAS 39. Preliminary training had been carried out in the Czech Republic, although this was only against individual aircraft and not towed targets, so the target configuration was unfamiliar to both the Swedish and Czech pilots when they came to Vidsel.

The Swedish pilots had also prepared the Czech unit with briefings in low flying and provided it with maps, and had a briefing on the Swedish safety regulations. English language terminology in connection with air-to-air firing had been prepared in conjunction with FMV.

The Swedish support before the campaign had been mainly directed towards the 211 Gripen Squadron. The 212 ALCA Squadron had prepared for the air-to-air firing using a 15 year old attack profile for the L 39 Albacross aircraft. They had only trained for firing at targets on a straight course.

To make it easier for the foreign flying units, an In-flight Guide for the Vidsel base had been put together in Sweden. Among other things this included landing cards for Vidsel and Luleå, approach procedures, etc. With this as a basis, 211 Squadron prepared its own version that was suitable for the JAS 39. 212 Squadron obtained their In-flight Guide after the briefing at Vidsel on Thursday 5 October. The Czech pilots had difficulty in understanding the In-flight Guide as there was a mixture of Swedish and English, with metres, feet, kilometres, miles and different altimeter settings (QFE and QNH).

The terminology directive in English associated with air-to-air firing had been prepared in conjunction with FMV and the Swedish pilots in the Czech Republic. The directive caused some uncertainty and misunderstandings. The personnel of 212 ALCA Squadron had participated in joint exercises with NATO units on several occasions and were familiar with the terminology, as defined in STANAG (standardization agreements). However they had not practised air-to-air gun firing. In the Czech Republic it is the target commander who has the responsibility when firing against both ground and air targets to check that the attack profile is correct. “Target ready” means there permission to fire.

1.17.5 *Definition of the danger area*

A temporary restricted/danger area for the airspace was set up over the Gulf of Bothnia within and outside Swedish territory in the Swedish Flight Information Region (FIR). The area was subjected to surveillance on Monday 9 October by a Czech pair of JAS 39s after a Swedish request to check that the sea surface in the defined area was free from vessels. The Czech pilots got a short briefing on this at the “mass briefing” and there was an illustration included in the copies that were handed out after the briefing but they considered themselves not enough trained in how to search a danger area over the sea, but despite this they reluctantly carried out the surveillance. On Wednesday 11 October surveillance was carried out by a pair of F7 Wing JAS 39s based at Luleå. The result was reported to the Örnen command and control centre, which by co-ordinating with the coastguard at Härnösand had good control of both the sea surface and the airspace.

It was assessed that there was no need to promulgate a navigational warning for maritime traffic.

1.17.6 *Safety instructions for the Swedish Air Force in the case of live bombing and live firing (SäKI Flyg)*

SäKI Flyg was signed by the Commander-in-Chief of the Air Force at Headquarters in 1996. The specialist department at Headquarters was the Flight Safety Section, and the publication was countersigned by the Head of the Military Aviation Inspectorate, FLYGI. It has not since then been updated or rewritten, but has afterwards when necessary been amended and supplemented with written additions.

After 1996 the Swedish Armed Forces and their command have been reorganised many times, so that several of the titles of decision-makers mentioned in SäKI Flyg no longer apply.

In addition, new flight systems, weapons and countermeasures have appeared which are not covered by SäKI Flyg. Also some systems have been removed from the organisation.

The particular target, KRN 27-45-450, is not described, nor is the configuration of having one firing target and one spare target.

The transition from metric units of measurement to international units (nautical miles, feet and knots) is not covered.

SäKI Flyg is only available in a Swedish edition.

A letter of intent of a total review and revision of SäKI Flyg during the autumn of 2006 was written by the Safety Inspectorate at Headquarters on 7 August 2006 (HQ document 02 810:71971). This stated that due to lack of resources for a revision of SäKI Flyg, complementary regulations involving additions and deviations were being handled by written amendments, which did not provide the desired clarity and stringency. In the letter of intent it was stated that in its present form SäKI Flyg would be cancelled once the revisions had been implemented.

1.17.7 *Equal opportunities aspects*

The investigation has not identified any circumstances that indicate that the event or its effects were caused by or affected by women or men not having the same possibilities, rights or obligations in various respects.

1.17.8 *Environmental aspects*

Not applicable.

2 ANALYSIS

2.1 General

The incident involves Swedish civil aviation (SAAB SFO) and foreign military state aviation (the Czech activities). It is understood by the Swedish Accident Investigation Board that Swedish military aviation was also involved to a limited extent as the activities were being conducted from a Swedish military air base and with Swedish command and control. By definition Czech military aviation cannot be covered by RML, which in such a case would mean that the operations had been reviewed by FLYGI by means of admission checks and inspection, resulting in an issued aviation document.

The government in its decision stated that FM was permitted to perform a common flying exercise and that the activities within the framework of and carried out in the exercise would be run in accordance with detailed decisions by FM.

It is the opinion of SHK that the largest part of the implemented activities was outside the areas of civilian or Swedish military aviation, but that the government in its decision formulated as “detailed decisions” made FM responsible for the campaign. This responsibility should have meant that FM had to decide on the details within the framework of current legislation etc. and had the responsibility for ensuring that the activities would be carried out in a professional and safe way by all parties. Within FM the government’s decision seems not to have led to any measures to analyse applicable legislation and regulations or safety requirements in this context.

The described Czech activities do not fall into the framework of any of the Swedish participants’ authorisations according to RML as this document only handles with Swedish military aviation. In general however FM and FMV should possess the required competence to be able to take responsibility for and regulate the framework for foreign military aviation within Swedish territory.

2.2 Responsibilities

In the leasing agreement with the Czech Republic, FMV has among other things undertaken to support the Czech Republic in various ways during the introduction of the JAS 39. It was initially assumed that the campaign at Vidsel in weeks 640-641 was part of the agreement, and that the activities were in respect of the validation of the JAS 39 and L 159 air defence capabilities. Afterwards, during the investigation, both FMV and the Czech Republic representatives considered that the campaign as a whole was not part of the leasing agreement, but rather concerned training of pilots, which was not covered by the leasing agreement, even though certain parts could possibly be referred to validation of the weapon systems.

The efforts by FMV to market the test range at Vidsel and Swedish airspace for foreign players, and that they therefore tried as far as possible to meet the customer’s wishes meant, in the opinion of SHK in this case, that both the Vidsel base and the airspace became overloaded. The available space at the base, along with its air traffic control, airspace and air combat control, did not meet the needs. This led to late planning changes and thereby limited the time for the pilots to prepare their various tasks and to evaluate them after the flights.

FMV assessed that IR missile firing, flare dropping and live gun firing were covered by the TFMOU and therefore did not make a request for this to the government.

Apart from providing comprehensive support to FMV, FM undertook the responsibility for a common flying exercise between Swedish and Czech JAS 39 aircraft including supersonic intercept and also the responsibility for low level navigation over land. The common flying was governed by tasking from Headquarters to F7 Wing, which planned the exercise and relocated a pair of JAS 39 aircraft to Luleå. This exercise was cancelled due to pressure of time. Low level navigation was in the whole carried out according to plan, whereby the Swedish pilots in the Swedish Air Force Support Group gave instruction to the Czechs in the Czech Republic and thereby assumed the responsibility for the training during implementation at Vidsel. This task was not included in the agreement, but this initiative probably raised the level of safety during low level navigation.

SAAB SFO did not have a description of towing targets for live air-to-air gun firing in its SOP. A profile was flown that had been determined by the FMV wing commander flying. The initiative of having a spare target close to the towing aircraft came from SAAB SFO, and this was not mentioned before the “mass briefing”. Since the target configuration with two targets was not shown on the illustrations that were presented, and nor were the pictures to scale, obviously some of the Czech pilots did not realise that in addition to the firing target there would also be a spare target.

The Czech unit, in its efforts to gain as much from the Vidsel campaign as possible, had wishes that clearly exceeded the Swedish capacity that was available during the short period of the campaign. This was accepted by FMV.

The imbalance that arose between available resources and implemented possibilities and the disregard for the application of the various regulations could have been due to the uncertainty as to where the responsibilities lay. FMV considered that it had the primary responsibility, initially via the leasing agreement with the Czech Republic. FM contributed with significant resources so that FMV could resolve its host role. FM was also responsible for planning the common flying and low level navigation after a request from FMV. The government was of the opinion that the campaign not had shared responsibility, but that FM would be responsible.

SHK considers that with a clearer division of responsibility and with activities more in balance with the available resources, the risk of uncertainty and misunderstanding would have been less during the implementation.

2.3 Governing regulations and instructions

2.3.1 Regulations for access into Swedish territory

In the regulations for access into Swedish territory it is stated that a foreign state aircraft shall follow the regulations governing civil aviation and shall be navigated accordance with directions from Swedish air traffic control.

In the view of SHK this regulation is only applicable to flights from one place to another. Military exercises carried out in accordance with Swedish military regulations cannot be based on the regulations for access into Swedish territory.

It is the opinion of SHK that the legislation should be reviewed in order to meet the needs that have arisen as a result of increased international co-operation and exercises.

2.3.2 *Safety instructions*

Flight Operations Manual for the Swedish Armed Forces (FM FOM)

Safety instructions for military flying are to be found in FM FOM. These instructions apply to Swedish military aviation, but can to some extent also be applied to foreign military aviation, mainly in respect of the protection for third parties, separation and air traffic rules. This assumes that the publication exists in an established English edition, that the Swedish commanders define which parts shall apply to foreign aviation in Sweden and that the regulations for access into Swedish territory will be revised to make it possible to apply to FM FOM.

SäKI Flyg

SäKI Flyg is in many respects out of date. For example this particular firing target is not described, and nor is this particular target configuration, with one firing target and one spare target. The review of SäKI Flyg that was decided in Headquarters has still not been done.

SäKI Flyg is written for Swedish military aviation but could in certain parts be applicable for foreign aviation in Sweden after revision of the regulations for access into Swedish territory.

SäKI Flyg is applicable, among other things, during live air-to-air gun firing. The deviation from the regulations concerning measuring of the altitude difference between the towing aircraft and the firing target was decided by the FMV wing commander flying on the recommendation of the flight commander of SAAB FSO. The right to make such a decision was not bestowed by SäKI Flyg. Measuring of the altitude difference between the towing aircraft and the firing target for the first unit to fire would have definitely resulted in the unit detecting the firing target. This condition would however not have affected the risk that succeeding units would attack the spare target.

Since there is no authorised issue in English, this means that those who have the responsibility for safety briefings with foreign units must themselves translate and produce presentation documents.

Centrally authorised safety instructions with an English translation should, in the opinion of SHK, be a requirement to permit foreign military combat forces to carry out live firings outside defined restricted areas on Swedish territory or against targets that are towed by Swedish aircraft.

2.3.3 *Training instructions*

There are no Swedish training instructions for air-to-air gun firing against towed targets by JAS 39 aircraft. The only occasion when JAS 39 has in Sweden fired on a KRN target towed by an LR 35 from the then SAAB NYGE AB was during testing in accordance with a special test programme under the auspices of FMV. That firing was performed by pilots who had earlier experience of firing from JA 37 aircraft.

The Swedish Armed Forces has not so far carried out air-to-air firing with the JAS 39 against towed targets, which can explain the lack of training instructions.

2.3.4 *In-flight Guide*

The In-flight Guide, that had been sent in advance to the 211 JAS Squadron and that was handed out to the L 159 ALCA Squadron after the briefing at Vidsel, must be reviewed. The mixture of different measuring units and languages made the document difficult for the Czech pilots to understand. It should be sent to all visiting units in good time before their arrival.

2.4 Timing

Time was very short in both the planning phase and the implementation.

With an initial visit to Vidsel for a “site survey” in June, followed by the holidays and the implementation at the beginning of October, the staff handling, consultations, issue of authorisations and preparations did not manage to be carried out in an optimal manner. The uncertainty regarding the division of responsibility between the Czech authorities, FM and FMV point to this. Nor, as far as SHK could see, had they managed to determine which flight regulations, safety instructions and mission profiles would be suitable.

The comprehensive campaign involving five activities (missile firing, flare dropping, live gun firing, common flying and low level navigation), which were initially planned to take four days, but due to the time needed for the briefings was reduced to three and a half days, and thereafter due to weather problems to two and a half days, resulted in a dense flow of information to the pilots involved. A risk analysis, which would enable flying to be performed safely, and with the risks analysed in a structured manner, which among other things is applied within Swedish military aviation, does not seem to have been done or was unknown.

The various directives and altered decisions that were generated within the Czech delegation made it even more difficult for the Czech pilots to make careful preparations and plan their flights.

Taken altogether, the tight time schedule, in the opinion of SHK, made a large contribution to the uncertainty and misunderstandings concerning which rules and responsibilities were applicable.

2.5 Training and competence of the pilots

2.5.1 *Languages*

Written communications, briefings and radio traffic on the air traffic control and combat command frequencies took place in English. SHK has not found any indication that language difficulties should have caused misunderstandings between the Swedish and Czech participants.

2.5.2 *The Czech Republic JAS 39 unit*

Despite their good knowledge of English, the Czech pilots probably found it hard to follow the dense “mass briefing” on Thursday 5 October during which, among many other things, the configuration with one spare target and one firing target was presented, since all three JAS 39 aircraft attacked the spare target on Wednesday 11 October. The fact that one of these fired its gun during its attack, which was in breach of the safety regulations, can be explained by the fact that the towing aircraft reported “target ready”, which in Czech Republic means that permission to fire is being granted.

2.5.3 *The Czech Republic L 159 unit*

As the leasing agreement only concerned the JAS 39, the L 159 squadron made its preparations almost entirely itself, without Swedish support. Without a relevant air-to-air gun firing flight profile, they made their preparations in accordance with an old flight profile for the L 39 aircraft. They practised only against targets at straight course and initially with a great altitude difference. Despite this, the squadron carried out its firing without any safety problems.

2.5.4 *The Swedish LR 35*

Both the pilot and co-pilot of the towing aircraft were very experienced, but they had very little and no experiences of towing a target with the LR 35 for live air-to-air gun firing.

SHK finds it remarkable that nothing was said by radio to the fighter controller or the attacking aircraft, when the towing aircraft crew heard the clattering sound from the firing. Thanks to the pilot in the aircraft that was firing noticing the correct sleeve target after his first live firing, and reporting this to his wingman, it is most likely that further attacks against the spare target were prevented.

2.6 **The equipment and functions of the aircraft**

2.6.1 *JAS 39*

No technical faults were present in the weapon system or gunsight presentation of the two JAS 39 aircraft (C 219 and C 217), of which the recordings have been preserved. The radar lock was stable and in all the attacks the radar switched lock from the spare target to the towing aircraft, which is normal when there is such a small distance between the two radar echoes. However it was only the last JAS 39 (C 200) that reported the change of radar locks by radio, which indicates that the pilots of the first pair (C 219 and C 217) did not notice the switchover.

2.6.2 *L 159*

None of the L 159s attacked the spare target. The aircraft operated as they should. When evaluating the attacks against the firing target, SHK saw no risks to flight safety.

2.6.3 *LR 35*

SHK considers that the SAAB SFO LR 35 is not equipped in such a way that live gun firing from other aircraft at a towed target could be carried out in a manner that is consistent with flight safety. The crew have no possibility at all to see the target or attacking aircraft in their rear sector, so they cannot order attacking aircraft to hold its fire if the attack profile is abnormal. Since the aircraft also lacks a radar warning device, it is not possible to detect whether they are being illuminated by radar or that a gunsight radar has locked on to the towing aircraft.

2.7 **Calculation of miss distance**

Calculations have been made of how close the towing aircraft was to being hit. On the basis of the hits found on the spare target and its location behind the starboard wing, the spread of the gun fire, firing distance and target angle, the projectiles most probably have passed the towing aircraft at a distance of about 10 metres.

3 CONCLUSIONS

3.1 Findings

- a) The activities involved Swedish civil aviation and foreign military governmental aviation, and also to a limited extent Swedish military aviation.
- b) The division of responsibility FM-FMV-SAAB SFO-Czech Republic was unclear.
- c) Deviations were made from the regulations for access into Swedish territory.
- d) A complex campaign was planned in limited time.
- e) All the pilots were qualified to perform their flights.
- f) There were no difficulties to talk or understand English.
- g) Responsibilities during firing were unclear and there were discrepancies in terminology.
- h) There were no technical faults in the weapon systems or gunsight presentations.
- i) There was no instruction in the SAAB SFO SOP for towing targets for firing from aircraft.
- j) The crew of the towing aircraft had no possibility to see the targets or the attacking aircraft.
- k) The towing aircraft was not equipped with a radar warning system.
- l) Three JAS 39 aircraft attacked the spare target in at least ten attacks altogether.
- m) One of these (C 219) fired at the spare target in one attack.
- n) None of the L 159s attacked the spare target.
- o) The illustration of the target configuration shown at the briefing was not consistent with reality.
- p) Deviations from the applicable SäkI Flyg were made.
- q) SäkI Flyg was not up to date.

3.2 Causes of the incident

The cause of the incident was a too comprehensive campaign during a limited time, not updated safety instructions and unclear division of responsibilities between FM, FMV, SAAB SFO and the Czech Republic, which altogether lead to that the pilot of a JAS 39 (C 219) misunderstood the target configuration and the responsibility between the attacking aircraft and the towing aircraft.

Additional causes are that the Czech pilots had little or no previous experience of live gun firing against air targets and that the crew in the towing aircraft had no possibilities to monitor the attacks.

4 RECOMMENDATIONS

The Swedish Armed Forces is recommended to:

- Press for a review of the regulations and responsibilities in respect of foreign governmental aviation on Swedish territory (*RM 2007:04e R1*).
- Take the measures that are necessary to ensure that both discussions and decisions concerning foreign governmental aviation on Swedish territory take place in accordance with applicable regulations and in a safe way for both the parties involved and third parties (*RM 2007:04e R2*).
- Revise SäkI Flyg and produce an English translation (*RM 2007:04e R3*).
- In consultation with SAAB SFO revise SäkI Flyg in those parts where SAAB SFO is affected (*RM 2007:04e R4*).

The Swedish Civil Aviation Authority is recommended to:

- Press for SAAB SFO to update their rules so that the work they do is regulated (*RM 2007:04e R5*).
- Press for SAAB SFO to improve the possibilities of monitoring attacking aircraft in order to avoid accidental firing (*RM 2007:04e R6*).