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Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report No. 2226 of the Swiss Transportation Safety Investigation Board STSB

concerning the serious incident (Airprox)

involving the Dassault Falcon 2000 aircraft, registration OM-OPF, operated by Opera Jet AS under flight plan callsign OPJ 700

and the Hawker Hunter T Mk 68 aircraft, registration HB-RVP, operated by the 'Verein Fliegermuseum Altenrhein'

on 14 June 2012

15 NM south-southeast of radio beacon WIL

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General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident and serious incident causes and circumstances is expressly no concern of the accident/incident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, follow the coordinated universal time (UTC) format. At the time of the incident, Central European Summer Time (CEST) applied as local time (LT) in Switzerland. The relation between LT, CEST and UTC is:
LT = CEST = UTC + 2 hours

Contents

Final Report

Synopsis

Aircraft 1	
Owner	Baca Hydra Leasing GmbH, Operngasse 21, 1040 Vienna, Austria
Operator	Opera Jet AS, Trenčianska 56/A, 821 09 Bratislava
Manufacturer	Dassault Aviation, Paris, France
Aircraft type	Falcon 2000 (F2TH)
Country of registration	Slovakia
Registration	OM-OPF
Fligh plan call sign	OPJ 700
Radio call sign	Opera jet seven hundred
Flight rules	Instrument flight rules (IFR)
Type of operation	Commercial
Departure point	Buochs (LSZC)
Destination point	Naples (LIRN)
Aircraft 2	
Owner	Verein Fliegermuseum Altenrhein, Postfach 11, Flughafenstr. 11, 9423 Altenrhein, Switzerland
Operator	Verein Fliegermuseum Altenrhein, Postfach 11, Flughafenstr. 11, 9423 Altenrhein, Switzerland
Manufacturer	Hawker Aircraft Ltd., Kingston, Great Britain
Aircraft type	Hunter T Mk 68
Country of registration	Switzerland
Registration	HB-RVP
Radio call sign	Hotel bravo romeo victor papa
Flight rules	Visual flight rules (VFR)
Type of operation	Private
Departure point	Emmen (LSME)
Destination point	Emmen (LSME)
Location	15 NM south-southeast of radio beacon WIL
Date and time	14 June 2012, 12:08 UTC
ATS unit	Delta / area control centre sector (ACC) – sector west/south
Airspace	Class E
Minimum separation of the aircraft	0.9 NM horizontally and 400 ft vertically
Minimum prescribed separation	None, traffic information if feasible
AIRPROX category	ICAO category A (high risk of collision)

Investigation

The serious incident occurred on 14 June 2012 at 12:08 UTC. The notification was received by the former Swiss Accident Investigation Board (SAIB) on 15 June 2012. After preliminary clarifications, which are typical with this type of serious incident, the investigation was opened on 25 June 2012.

The SAIB notified the serious incident to the Slovakian authorities. Slovakia appointed an authorised representative.

The final report is published by the Swiss Transportation Safety Investigation Board (STSB).

Summary

On 14 June 2012 at 12:00:31 UTC, the Falcon 2000 aircraft, flight plan call sign OPJ 700, received take-off clearance from aerodrome control at Buochs aerodrome. After take-off, OPJ 700 followed its previously assigned standard instrument departure route (SID) WIL1A and climbed to the cleared flight level 100. Approximately three minutes later, the Hawker Hunter aircraft registration HB-RVP received clearance to take off from runway 04 from the aerodrome control officer in the control tower of the Emmen military airbase for a flight under visual flight rules. After take-off, HB-RVP turned left onto a south-south-westerly heading and continued to accelerate during its climb.

At 12:07:16 UTC the ground-based short term conflict alert (STCA) system in air traffic control triggered. Shortly afterwards, the traffic alert and collision avoidance system (TCAS) on the Falcon 2000 generated a traffic advisory, followed at 12:07:54 UTC by a resolution advisory which the crew of OPJ 700 obeyed immediately. The two aircraft were flying in opposing directions and crossed at 12:08:14 UTC approximately 15 NM south-southeast of radio beacon WIL at flight level 100 with a lateral distance of 0.9 NM and an altitude difference of 400 ft. At this time, the ground speed of OPJ 700 was 247 knots and that of HB-RVP was 372 knots.

Visibility conditions were good. The crew of the Hunter were not aware of the dangerous convergence. With the help of the TCAS the crew of OPJ 700 were able to establish visual contact with the other aircraft just before they crossed.

Causes

The serious incident is attributable to the dangerous convergence of a business jet aircraft in instrument flight and a civil registered fighter aircraft flying under visual flight rules; it was able to occur because of a combination of the following factors:

- With regard to flight operations by civil high-performance aircraft, in particular former fighter aircraft, the supervisory authority requested to adhere to speed limitations and the operator did systematically not comply with because they were convinced that higher speeds were a necessity.
- The measures taken by the supervisory authority after having done a risk assessment were only partially put into practice.
- The high airspeed of the civil registered fighter aircraft increased the closing speed remarkable and reduced the time for traffic information from the air traffic control units involved and made it more difficult for the crews to carry out a visual search and establish visual contact with the other aircraft.
- The two aircraft were not in contact with the same ATC unit.
- The alert from the ground-based conflict alert system was in fact noted by the air traffic control officers involved. Appropriate traffic information to the crew of the business jet was given, but it was too late and imprecise.
- Traffic information to the crew of the civil registered fighter aircraft did not take place.

The serious incident was facilitated by the fact that the standard instrument departure route (SID) WIL 1A from Buochs aerodrome was never published. This led to the following contributory factors:

- Two air traffic control units and the crew of the business jet aircraft were unclear about the flight rules governing an aircraft on this SID. This led to discussions on the radio and hence to delayed traffic information.
- The crew of the civil registered fighter aircraft were unaware of the existence of the standard instrument departure route.

Safety recommendations

In the context of the investigation, one safety recommendation was issued.

1 Factual information

1.1 Pre-history and history of the serious incident

1.1.1 General

The recordings of the radio communication, radar data, the data transmitted to the ground radar stations via the Mode S downlink from the traffic alert and collision avoidance system (TCAS) on board aircraft OPJ 700 as well as the statements of crew members and air traffic controllers were used for the following description of the pre-flight history and history of the serious incident.

On board the OPJ 700 business jet aircraft the commander was pilot flying (PF) and the copilot was pilot not flying (PNF). According to the flight plan, take-off was scheduled at 12:00 UTC from the aerodrome at Buochs (LSZC), under instrument flight rules (IFR); the destination airport was Naples (LIRN) in Italy.

On board the two-seater Hawker Hunter, registration HB-RVP, were the pilot in the left seat and an examiner in the right seat. The flight was planned as a 'flight with examiner' which took place under visual flight rules (VFR), with take-off and landing at the Emmen military airbase (LSME).

In air traffic control at the time of the serious incident the following air traffic services (ATS) were involved:

- Workstation Zurich Delta on the working frequency: 119.225 MHz
  This was usually operated by an air traffic control officer (ATCO). At the time of the serious incident a trainee ATCO and an air traffic control officer as coach were working at this workstation.
- West Sector ACC Zurich on the working frequency: 135.675 MHz
  The two sectors 'West' and 'South' of the Zurich area control centre (ACC) had been combined because of the relatively low volume of traffic at that time, i.e. they were controlled from one workstation with two ATCOs, a radar executive (RE) and a radar planner (RP).

Emmen Radar and the approach control unit (APP) were not occupied, because due to the visual meteorological conditions (VMC) no IFR traffic was expected. The aerodrome control tower (TWR) in Emmen was occupied by two air traffic control officers.

The serious incident occurred in class E airspace. At the time of the serious incident, the 'MIL ON' status applied in relation to the upper limit of Swiss airspace ECHO; this meant that the upper limit of airspace ECHO was at flight level (FL) 130 (cf. chapter 1.6).

There were no air traffic control-related or technical restrictions.

1.1.2 Pre-flight history

On the day of the serious incident the Falcon 2000 aircraft, arriving from Lugano, had landed in Buochs. Up to waypoint AGERI this flight took place under instrument flight rules, and from AGERI until the landing in Buochs under visual flight rules. The landing took place at 09:25 UTC.

Before 14 June 2012, maintenance work had been performed on HB-RVP in St. Gallen-Altenrhein. Because work had also been performed on the braking system, those responsible wanted to make the first landing on a runway which was longer than that at St. Gallen-Altenrhein (LSZR). The first flight on 14 June was therefore performed as a technical check flight and at the same time as a ferry flight by HB-RVP to Emmen.

After this ferry flight to Emmen, three training or test flights were conducted; during the second flight, a so-called 'flight with examiner[1]', the dangerous convergence with OPJ 700 occurred.

Flights were, among other things, also made from Emmen because operations from HB-RVP's home airfield of St. Gallen-Altenrhein are limited for this aircraft type to 20 take-offs and 20 landings per calendar year for noise reasons. After the third take-off from Emmen, a ferry flight took place to St. Gallen-Altenrhein, which was also used for the training.

1.1.3 History of the serious incident

On 14 June 2012 at 11:59:12 UTC the responsible aerodrome control officer in Buochs gave the crew of the Falcon 2000 with the flight plan call sign OPJ 700 the following clearance: "Opera jet seven hundred, cleared to Napoli via Willisau one alpha departure, climb to flight level one hundred, squawk five seven two six." The Buochs TWR air traffic control officer had previously received this clearance by telephone from Bern approach control centre. This procedure corresponded to the requirements of the arrangements in the letter of agreement (LoA) between the aerodromes of Buochs, Emmen and Bern, when the Emmen Radar workstations are not occupied. According to the aerodrome control officer in Emmen, the departure of the Falcon 2000 from Buochs was also communicated to him.

At 12:00:31 UTC, the ATCO in Buochs TWR gave the crew of OPJ 700 take-off clearance on runway 25: "Opera Jet seven hundred, the wind is calm, runway two five, cleared for take-off, report established on track two four five inbound to the Charlie six zero one." This clearance was confirmed correctly by the pilot of OPJ 700. Approximately two and a half minutes later, at 12:03:02 UTC, the Buochs TWR ATCO instructed the crew of OPJ 700 to make contact with the Bern approach control centre. According to the radar recording, the altitude of OPJ 700 at this time was approximately 4500 ft above mean sea level (AMSL).

At 12:03:44 UTC the Hawker Hunter, registration HB-RVP, received clearance to take off from runway 04 for a flight under visual flight rules from the aerodrome control officer in the Emmen airbase TWR: "Hotel Victor Papa, wind zero eight zero degrees three knots, runway zero four, cleared for take-off, via downwind climb to four thousand feet and report Hellbühl." The pilot of HB-RVP confirmed this take-off clearance. After take-off, HB-RVP turned left onto a south-south-westerly heading and continued to accelerate during its climb. One minute after the take-off clearance, the aerodrome control officer in Emmen revised his altitude clearance to 3500 ft QNH for traffic-related reasons. Thereafter, no further explicit altitude clearance was given for the remainder the flight; at 12:05:53 UTC, the Emmen TWR control officer gave the following clearance to the crew of HB-RVP: "Hotel Victor Papa, further climb is approved." Approximately 30 seconds later, the crew of HB-RVP were informed by the Emmen TWR control officer that they could now leave the frequency. During the communication with the crew of HB-RVP, no traffic information was provided by the aerodrome control officer in Emmen regarding the Falcon 2000 which had taken off from Buochs.

The crew of OPJ 700 reported at 12:03:46 UTC to the Bern approach control centre and received confirmation of the original clearance to climb to FL 100 from the responsible air traffic control officer. According to the radar recordings, OPJ 700 reached the cleared altitude at 12:05:08 UTC.

[1] This is required if a candidate cannot, with regard to a type rating proficiency check, provide evidence of the required training on ten sectors (with at least 15 minutes cruising) on the corresponding aircraft type within the period of validity of the type rating.

Shortly afterwards, the crew of OPJ 700 was instructed to make contact with the Sector West/South of ACC Zurich, where they reported at 12:07:09 UTC.

In the meantime, the crew of HB-RVP had reported to ACC Zurich Delta at 12:07:06 UTC and enquired as follows about training airspace to carry out their aerobatics programme: "Eight five climbing, ah, requesting Schrattenfluh for aerobatic, if available." For the ATCO, this meant that he had to obtain corresponding clearance from the competent military air traffic control unit.

At this time, the radar data for the climbing OPJ 700 indicated a ground speed (GS) of approximately 225 kt, which after the transition to level flight fluctuated between 235 and 247 kt. HB-RVP, still climbing, registered a GS of 390 kt at 12:07:12 UTC, which increased in the subsequent 30 seconds to 426 kt.

At 12:07:16 UTC the ground-based short term conflict alert (STCA) system was triggered at the Sector West/South and Delta workstations of ACC Zurich. At the Delta workstation this alert is emitted only visually, but not aurally. According to the statements of the two ATCOs at the Zurich Delta workstation, the coach and the trainee, they were not consciously aware of the STCA alert. Just two seconds after the STCA alert was triggered, the crew of OPJ 700 informed the Sector West/South ATCO that they would like a cruising altitude of FL 350. The ATCO confirmed this wish, and then responded to the initial call from a commercial aircraft. A short time later, he recognised the imminent conflict between OPJ 700 and HB-RVP and asked the crew of OPJ 700 at 12:07:46 UTC about their flight rules as follows: "Operajet seven hundred, just for my confirmation, you are still ah VFR?" The crew responded promptly at 12:07:54 UTC with: "still VFR, ah we are ah, ready for IFR." The ATCO replied: "Roger, I call you back in two minutes, we have opposite traffic, and, ah, yes."

At the same time, at 12:07:54 UTC, the traffic alert and collision avoidance system (TCAS) on board OPJ 700 generated the resolution advisory (RA) "descend, descend", which the crew promptly obeyed. Since they had established visual contact with HB-RVP shortly before, they also initiated a left turn.

The two aircraft crossed at 12:08:14 UTC approximately 15 NM south-southeast of radio beacon WIL with a lateral distance of 0.9 NM and an altitude difference of 400 ft. At this time, OPJ 700 had a GS of 247 kt and HB-RVP a GS of 372 kt.

The two pilots on board HB-RVP stated that they had not been aware of the dangerous convergence. They had in the meantime received a negative decision concerning the use of the desired training airspace from the ATCO and continued their flight without further incident.

At 12:09:33 UTC, the crew of OPJ 700 received clearance to climb to FL 140 and authorisation to continue their flight under instrument flight rules. The remainder of the flight to Naples was uneventful.

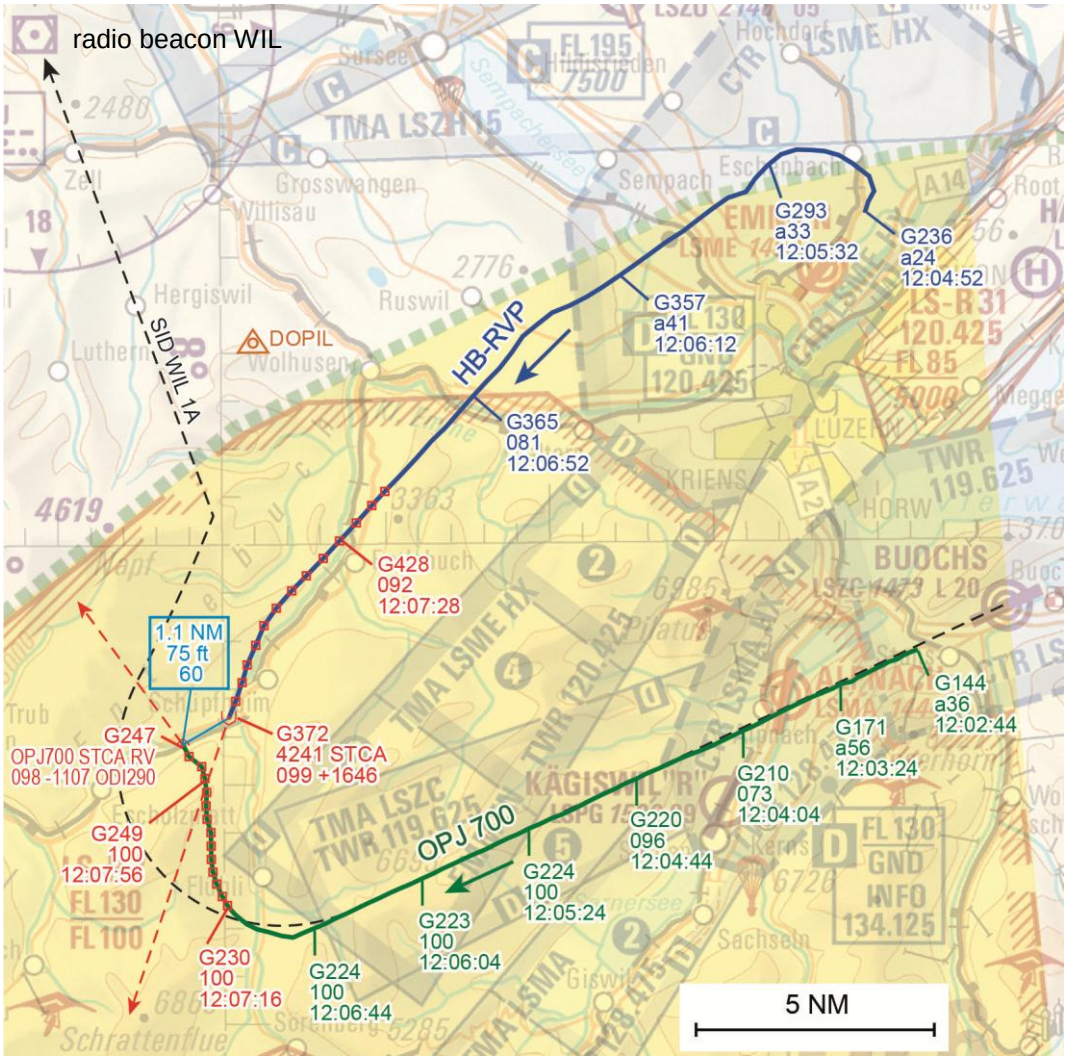


Figure 1: Overview of the flight paths of the two aircraft HB-RVP and OPJ 700. The radar labels consist of three lines that include the following information: first line: ground speed in knots; second line: altitude in hundreds of feet; third line: time in UTC. The radar echoes and the radar labels during the active STCA alarm are displayed in red. The nominal flightpath of the SID WIL 1A is displayed as black dotted line, containing the overfly waypoint ZC601. The radio beacon is situated in the left upper corner of the figure. The military training area "Schrattenfluh" is yellow shaded accented. The layers of the basic chart come from Swisstopo.

1.1.4 Location and time of the serious incident

Position	Approximately 15 NM south-southeast of radio beacon WIL
Date and time	14 June 2012, 12:08:14 UTC
Lighting conditions	Day
Height above sea level or flight level	FL 100

1.2 Personnel information

1.2.1 Crew of OPJ 700

1.2.1.1 Commander

1.2.1.1.1 General

Person	Slovakian citizen, born 1972
Licence	Airline transport pilot licence aeroplane (ATPL(A)) according to joint aviation requirements (JAR), first issued by the civil aviation authorities of the Slovak Republic on 31 October 2007.
Ratings	Type rating Falcon 2000 as captain, valid till 30 September 2012.
Language proficiency	Radiotelephony in English and Slovakian. ICAO English level 5, valid till 30 November 2016.
Instrument rating	Instrument rating aircraft IR(A), valid till 30 September 2012.
Last proficiency check	Line check on 30 November 2012. Licence proficiency check on 16 September 2011. Operator proficiency check on 14 March 2012.
Training on ACAS[2]	First training in 2002 during military service; TCAS refresher 2009.
Medical fitness certificate	Class 1, no restrictions Start of validity: 23 August 2011. End of validity: 12 September 2012.
Last medical examination	23 August 2011
Commencement of pilot training	1992

1.2.1.1.2 Flying experience

Total	4700 hours
on the type involved in the incident	450 hours
during the last 90 days	147 hours
of which on the type involved in the incident	99 hours

1.2.1.1.3 Duty times

Start of duty in the 48 hours before the serious incident	13 June 2012: 08:00 UTC 14 June 2012: 08:00 UTC

[2] The basic concept of this collision avoidance system is known as an airborne collision avoidance system (ACAS). The International Civil Aviation Organisation (ICAO) uses this term when drawing up the standards with which the system must comply. The traffic alert and collision avoidance system (TCAS) is a concrete implementation of this concept.

	End of duty in the 48 hours before the serious incident	13 June 2012: 19:05 UTC
	Flight duty times in the 48 hours before the serious incident	13 June 2012: 11:05 hours
	Rest times in the 48 hours before the serious incident	from 13 to 14 June 2012: 12:55 hours
	Flight duty time at the time of the serious incident	4:10 hours

1.2.1.2 Copilot

1.2.1.2.1 General

Person	Slovakian citizen, born 1977
Licence	Commercial pilot licence aeroplane – CPL(A) according to JAR, first issued by the civil aviation authorities of the Slovak Republic on 11 May 2009.
Ratings	Type rating Falcon 2000 as copilot, valid till 28 February 2013.
Language proficiency	Radiotelephony in English and Slovakian. ICAO English level 4, valid till 30 April 2015.
Instrument rating	Instrument flight aeroplane with multi-pilot crew IR(A) MPA valid till 28 February 2013.
Last proficiency check	Line check on 16 May 2012. Licence proficiency check on 28 February 2012. Operator proficiency check on 14 February 2012.
Training on ACAS	First training 2010, ACAS refresher February 2012.
Medical fitness certificate	Class 1, no restrictions Start of validity: 10 January 2012. End of validity: 17 January 2013.
Last medical examination	10 January 2012
Commencement of pilot training	1998

1.2.1.2.2 Flying experience

Total	1700 hours
on the type involved in the incident	120 hours
during the last 90 days	120 hours
of which on the type involved in the incident	120 hours

1.2.1.2.3 Duty times

Start of duty in the 48 hours before the serious incident	13 June 2012: 08:00 UTC 14 June 2012: 08:00 UTC

	End of duty in the 48 hours before the serious incident	13 June 2012: 19:05 UTC
	Flight duty times in the 48 hours before the serious incident	13 June 2012: 11:05 hours
	Rest times in the 48 hours before the serious incident	13 to 14 June 2012: 12:55 hours
	Flight duty time at the time of the serious incident	4:10 hours

1.2.2 Crew of HB-RVP

1.2.2.1 Pilot

1.2.2.1.1 General

Person	Swiss citizen, born 1957
Licence	ATPL(A) according to JAR, first issued by the Federal Office of Civil Aviation (FOCA) on 11 May 1993.
Ratings	Type rating Hunter Mk 58/68 - restricted to HB-registered aircraft as commander, valid till 9 July 2012.
Language proficiency	Radiotelephony English ICAO English level 4, valid till 31 October 2013.
Last proficiency check	Licence proficiency check Hunter Mk 58/68 - restricted to HB-registered aircraft, 9 July 2011.
Training on ACAS	February 1999, conversion to Airbus A320.
Medical fitness certificate	Class 1 with the following restrictions: RXO (requires specialist ophthalmological examinations). VML (shall wear corrective lenses and carry a spare set of spectacles). Start of validity: 6 February 2012. End of validity: 17 February 2013.
Last medical examination	6 February 2012
Commencement of pilot training	1976

1.2.2.1.2 Flying experience

Total	14 900 hours
on the type involved in the incident	691 hours
during the last 90 days	116:21 hours
of which on the type involved in the incident	00:27 hours

1.2.2.1.3 Duty times

Start of duty in the 48 hours before	12 June 2012: 12:55 UTC 13 June 2012: 11:00 UTC

the serious incident	14 June 2012: 10:40 UTC
End of duty in the 48 hours before the serious incident	12 June 2012: 19:02 UTC 13 June 2012: 20:19 UTC
Flight duty times in the 48 hours before the serious incident	12 June 2012: 6:07 hours 13 June 2012: 9:19 hours
Rest times in the 48 hours before the serious incident	12 to 13 June 2012: 15:58 hours 13 to 14 June 2012: 14:21 hours
Flight duty time at the time of the serious incident	1:28 hours

1.2.2.2 Examiner

1.2.2.2.1 General

Person	Swiss citizen, born 1951
Licence	ATPL(A) according to JAR, first issued by the FOCA on 22 May 1989.
Ratings	Type rating Hunter Mk 58/68 - restricted to HB-registered aircraft, valid till 11 October 2012. Class rating instructor (CRI), valid till 30 November 2014.
Language proficiency	Radiotelephony English. ICAO English level 4, valid till 26 February 2014.
Last proficiency check	Licence proficiency check Hunter Mk 58/68 - restricted to HB-registered aircraft, 6 September 2011.
Training on TCAS	First TCAS training 1995; last TCAS refresher January 2009.
Medical fitness certificate	Class 1 with the following restrictions: VML (shall wear corrective lenses and carry a spare set of spectacles). Start of validity: 8 February 2012. End of validity: 23 August 2012.
Last medical examination	8 February 2012
Commencement of pilot training	1968

1.2.2.2.2 Flying experience

Total	18 393 hours
on the type involved in the incident	1167 hours
during the last 90 days	59 hours
of which on the type involved in the incident	1:03 hours
during the last 24 hours	1:03 hours
of which on the type involved in the incident	1:03 hours

1.2.2.2.3 Duty times

The examiner was no longer employed in a commercial aviation operator.

Flight duty time at the time of the serious incident	6:08 hours

1.2.2.2.4 Additional information

The examiner was involved in a near-collision with two air force fighter aircraft on 9 October 2009 (cf. chapter 1.11.1.2).

1.2.3 Air traffic control personnel

1.2.3.1 Air traffic control officer RE

Function	Air traffic control officer RE sector west/south.
Person	Swiss citizen, born 1979
Duty days before the day of the incident	12 June 2012: off duty 13 June 2012: 07:00 - 14:00 UTC
Start of duty on the day of the incident	07:20 UTC
Licence	Air traffic control officer licence based on European Community Directive 2006/23, first issued by the FOCA on 24 September 2002, valid till 5 November 2012.
Ratings	Air traffic control with radar in ACC Zurich (Upper- and Lower Sectors) valid till 5 November 2012. Additional rating for: on the job training instructor (OJTI) valid till 5 November 2012. Language proficiency English level 5, valid till 14 October 2014.
Medical fitness certificate	Class 3, no restrictions, issued on 10 October 2011, valid till 25 October 2013.

1.2.3.2 Air traffic control officer Delta

Function	Air traffic control officer Delta coach	
Person	Swiss citizen, born 1971	
Duty days before the day of the incident	12 June 2012: 03:30 - 11:00 UTC 13 June 2012: 06:15 - 15:00 UTC	
Start of duty on the day of the incident	09:00 UTC	
Licence	Air traffic controller licence based on European Community Directive 2006/23, first issued by the FOCA on 13 May 1994, valid till 9 January 2013.	
Ratings	Aerodrome control instrument (ADI) Approach control surveillance (APS) Surveillance radar approach (SRA) Tower control (TWR)	6 April 1994 17 June 1996 8 May 1998 6 April 1994

		Additional rating for: OJTI and examiner valid till 9 January 2013. Language proficiency English level 5, valid till 28 November 2014.
	Current competences	LSAZ Delta APS valid till 9 January 2013 LSMD TWR ADI valid till 9 January 2013 LSMD LRA APS valid till 9 January 2013 LSAZ ARFA APS valid till 9 January 2013
	Medical fitness certificate	Class 3, no restrictions, issued on 8 December 2011, valid till 23 December 2013.

1.2.3.3 Air traffic control officer Delta

Function	Air traffic control officer Delta trainee
Person	German citizen, born 1984
Duty days before the day of the incident	12 June 2012: 06:50 - 11:25 UTC 13 June 2012: off duty
Start of duty on the day of the incident	09:00 UTC
Licence	Trainee air traffic controller licence based on European Community Directive 2006/23, first issued by the FOCA on 6 October 2011, valid till 1 February 2014.
Training status	End of training stage 2; Test for transfer to stage 3 was scheduled for approximately one week after the serious incident.
Medical fitness certificate	Class 3, restrictions: VDL (shall wear corrective lenses and carry a spare set of spectacles) issued on 25 January 2012, valid till 25 January 2014.

1.3 Aircraft information

1.3.1 OPJ 700

Registration	OM-OPF
Aircraft type	Dassault Aviation Falcon 2000
Characteristics	Twin-jet business aircraft, constructed as a cantilever low-wing monoplane, all-metal construction, engines fitted aft on the side of the fuselage, with retractable landing gear in nosewheel configuration.
Manufacturer	Dassault Aviation, Paris France
Year of manufacture	2004
Licence	IFR/VFR
Relevant equipment	TCAS II, Version 7.0

1.3.2 HB-RVP

1.3.2.1 General

Registration	HB-RVP
Aircraft type	Hunter T Mk 68
Characteristics	Single-engined fighter aircraft, of cantilever high-wing all-metal construction with retractable landing gear in nosewheel configuration, with two adjacent pilot seats.
Manufacturer	Hawker Aircraft Ltd., Kingston, Great Britain
Year of manufacture	1976
Licence	VFR day, aerobatics
Relevant equipment	Transponder Mode S Garmin GTX 330 D. No equipment to warn the crew of dangerous convergences with other aircraft.

1.3.2.2 Flight performance and flight envelope

The crew of HB-RVP claimed that this former combat aircraft could be flown only with difficulty under the 250 knots indicated airspeed (KIAS) limit for flights below FL 100 which are applicable to civil aircraft.

Assuming that, for example, an adequate safety margin above stalling speed must exist for an evasive manoeuvre and the concomitant increase in the load factor, the flight performance of the Hawker Hunter T Mk 68 was referred to. For this aircraft, no details of the stall speed were published in the aircraft flight manual of the former operator, the Swiss Air Force. The following graphic, 'Operating range of the aircraft' gives information about the buffeting speed, which is somewhat higher than the stall speed.

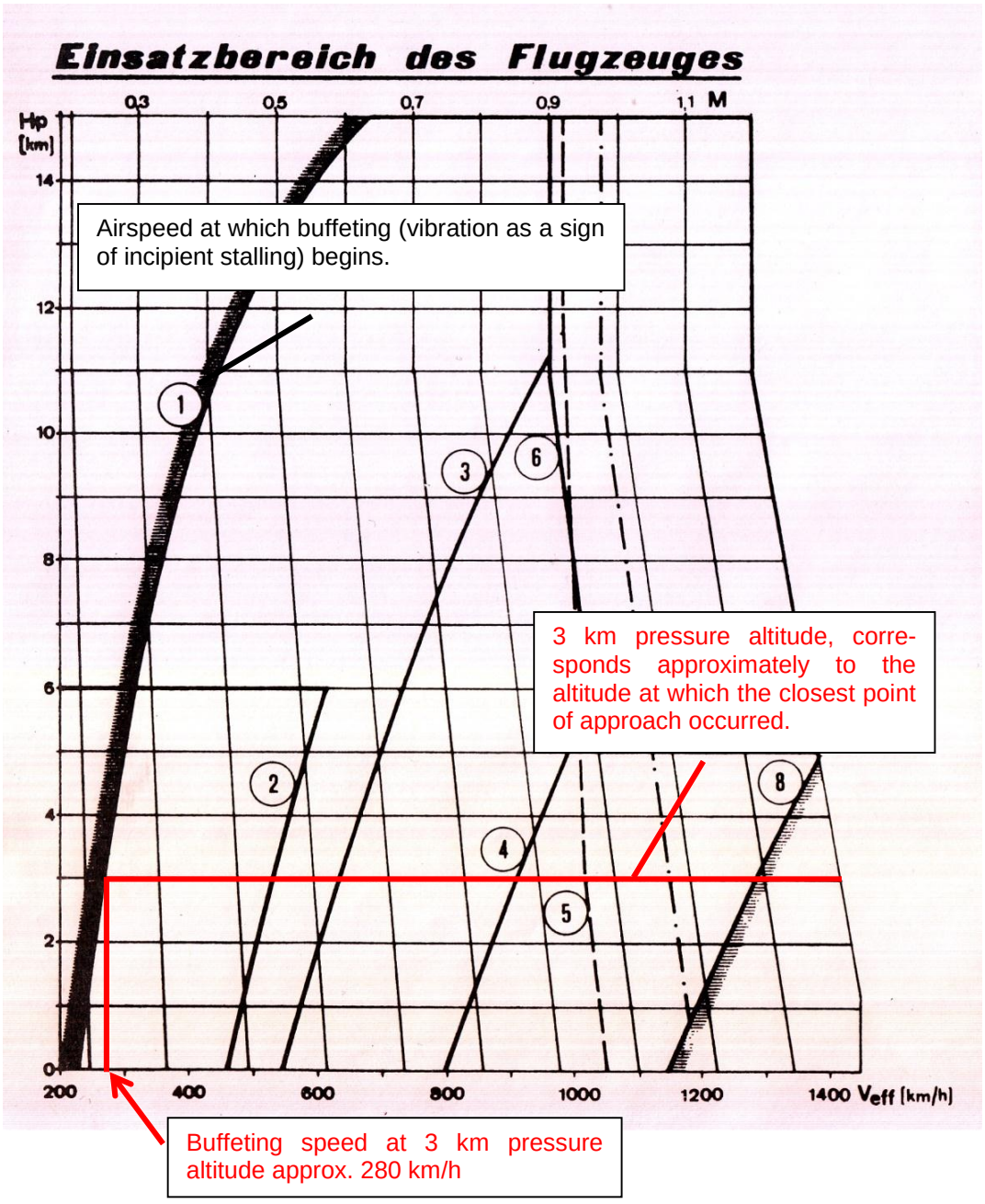


Figure 2: Operating range of the Hawker Hunter T Mk 68 aircraft according to the aircraft manual. Only the relevant data was referred to.

According to this information, the speed at which an incipient stall is indicated - in the form of shaking of the aircraft (buffeting) - was approximately 280 km/h (corresponding to 152 kt) true airspeed (TAS) at an altitude of 3 km (approximately 10 000 feet). With a safety margin factor of 1.5 on the buffeting speed, the Hawker Hunter can be flown at TAS of 230 kt, corresponding to approximately 200 KIAS.

1.4 Meteorological information

1.4.1 General meteorological situation

A flat area of high pressure determined the ground pressure field over Central Europe. A low was located to the west of the British Isles. At high altitude, the westerly winds extended from the Atlantic Ocean over the Alps as far as Ukraine.

1.4.2 Weather at the time of the dangerous convergence

The weather was dry and mainly sunny. Between Lake Thun and Lake Lucerne, as well as east of the Napf, partial cloud prevailed. Cloud surface temperature measurements by the MSG geostationary satellites show that the cloud ceiling was between 2500 and nearly 3000 m AMSL.

Webcam images from the Lucerne Hinterland show fine-weather cloud with modest vertical extension. The cloud base over the Swiss Plateau was lower than along the foothills of the Alps. The increase in thermal stability and the dew point difference in the radiosonde profile above 8757 ft AMSL indicate that there was very little cloud above 9000 ft AMSL.

1.4.3 Astronomical information

Position of the sun	Azimuth: 202°	Elevation: 65°
Lighting conditions	Day	

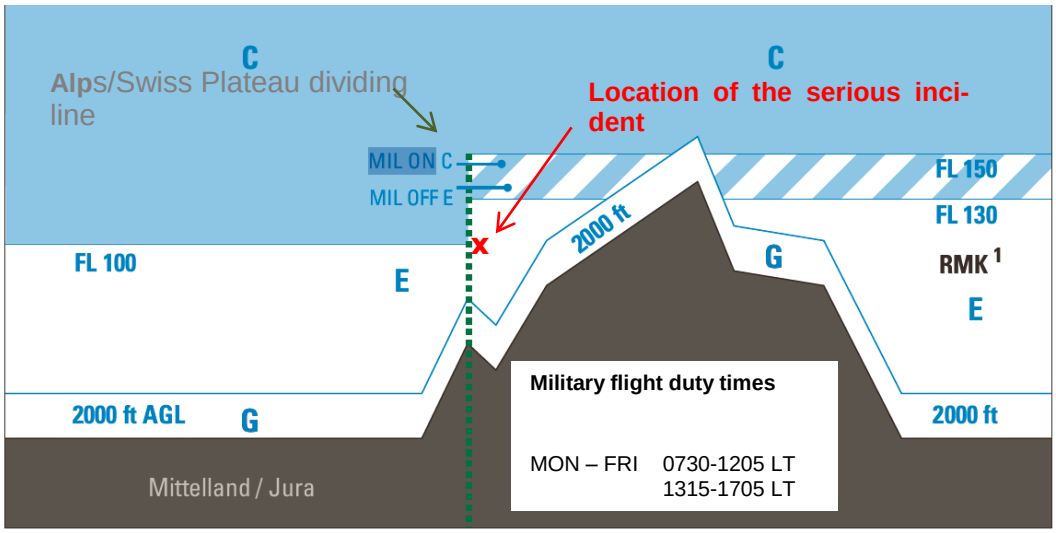
1.5 Communications

Radio communications between the crews and the air traffic control officers concerned took place without any technical restrictions up to the time of the serious incident.

1.6 Airspace information

The serious incident took place in class E airspace. At the time of the serious incident, the status 'MIL ON' applied in relation to the upper limit of ECHO airspace, i.e. to the south of the line separating the Alps from the Swiss Plateau, the upper limit of ECHO airspace was flight level (FL) 130.

General airspace classification



[1)] Transponder ON code 7000 mandatory > 7000 ft AMSL, below this mandatory if fitted

Figure 3: Vertical structure of airspace ECHO with 'MIL ON' status

1.7 Flight recorders

A flight data recorder (FDR) and a cockpit voice recorder (CVR) was neither prescribed nor installed in HB-RVP.

In the case of OPJ 700 the recordings of both the FDR and the CVR were no longer available to the investigation.

1.8 Traffic alert and collision avoidance system

The Falcon 2000 was equipped with a TCAS II, version 7.0. The Hawker Hunter T MK 68 was not equipped with any technical equipment which could have informed the crew of any aircraft in the vicinity or on a collision course.

1.9 Organisational and management information

1.9.1 Swiss Hunter Team

1.9.1.1 General

The Swiss Hunter Team was established in 1994 under the name 'Hunter Flying Group'. At the time of the serious incident, the Swiss Hunter Team was an association of people who were committed to the continued operation of the Hawker Hunter type former military aircraft. This group consisted of mechanics, aviation personnel and pilots who carried out the work involved on a voluntary basis. The examiner involved in the present serious incident was involved in the establishment and organisation of most of the activities of the Swiss Hunter Team. Among other things, he organised the flying activities of the civil registered former combat aircraft of the Hunter and Vampire types. He also obtained the necessary permits and organised the flight operations.

1.9.1.2 Regulations for flight operations

For the operation of the former military jet aircraft licensed in the 'Special Category, Subcategory Historical', the person responsible drew up, on behalf of the 'Verein Fliegermuseum Altenrhein', regulations which governed flight operations by this aircraft. These 'Operating rules for flights by historic jet aircraft (in Switzerland)' were approved by the FOCA on 5 May 1997.

Under the heading Legal Basis in the General section, the following is stated [translated from German]: "The present operating regulations were prepared to guarantee safe operation of historic jet aircraft and are based on the regulations and provisions of Swiss aviation law." The regulations also include stipulations concerning minimum equipment, crew, maintenance, minimum altitudes, oxygen availability, low-noise flying, guidelines for operation and much more. The regulations do not include any explicit information about the maximum permitted airspeeds.

In a 'Technical Notice' concerning 'Special Category, Subcategory Historical' dated 31 January 2004, the FOCA laid down, among other things, specific rules applicable to the operation of such historic aircraft as follows [translated from German]:

"[…]

3.2.3 In addition, the following restrictions apply to high-performance aircraft, namely former military combat or training aircraft:

- Supersonic flight is prohibited (art. 14 para. 1 LFG)
- The maximum speed (250 KTAS) must be complied with in accordance with Article 9 of the VVR (SR 748.121.11) […]" [typo in the original]

For the pilots, who were all former military pilots, operation of the Hawker Hunter whilst complying with the 250 knot speed limit for flights below FL 100 was unusual. According theirs opinion it was necessary to fly faster for safety reasons (cf. chapter 1.11.2).

In practice, from a certain point in time, ATC flight plans in which a speed of 360 knots was specified were submitted for all flights. Thus the pilots of the Swiss Hunter Team were of the opinion that they were allowed to fly at more than 250 KIAS below FL 100, by way of the exceptional approval required in Article 9, para. 1 of the VVR [Verordnung über die Verkehrsregeln].

1.9.1.3 Airspeeds in the present serious incident

The crew of HB-RVP had no knowledge of the crossing Falcon 2000 flying under instrument flight rules. The information about the airspeed at the time of the closest point of approach with the Falcon 2000 was contradictory. The unit of measurement of the airspeed display on the former military aircraft was 'kilometres per hour'; the information from the crew refers to the indicated airspeed. The pilot stated he had flown at 400-450 km/h indicated airspeed (IAS); the examiner in the right-hand seat stated an IAS of 600-700 km/h.

The unit of measurement on the radar recordings of the serious incident is 'knots' and refers to the speed over the ground (ground speed – GS). According to the radar recording, HB-RVP accelerated after take-off and in the subsequent left turn reached a GS of approximately 250 kt (approximately 460 km/h). It continued to accelerate whilst climbing and at 4000 ft AMSL reached a GS of approximately 350 kt, and approximately 30 seconds before the crossing with OPJ 700, at 12:07:48 UTC, at a pressure altitude (PA) of 9200 ft, a GS of 426 kt was recorded. At this altitude the headwind component was approximately 20 knots, which for HB-RVP corresponded to a TAS of approximately 450 kt, or an IAS of approximately 720 km/h equal to 389 kt.

It was essentially clear to the pilots, who both had extensive experience in civil instrument flight, that they might encounter aircraft in class E airspace which were en route in both visual and instrument flight, and which they would be able to avoid only according to the 'see and avoid' principle.

1.9.2 Air navigation services company skyguide

1.9.2.1 Departure procedures from Buochs aerodrome

Buochs aerodrome (LSZC) was in a control zone classified as DELTA airspace, which was operated by civilian skyguide personnel. Approaches could be made only under visual flight rules. For departures, a standard instrument departure route (SID) existed - WIL 1A; according to skyguide and the Buochs aerodrome authority this was a departure route under instrument flight rules, which had been introduced in 2007 after extensive clarifications (PANS-OPS report) (cf. Annex 1). According to statements by the Buochs aerodrome authority and skyguide, since 2002 Buochs aerodrome had had only provisional operating regulations. For this reason, this departure route could not yet be published; definitive operating regulations would be a prerequisite for publication. It is not apparent from the operating regulations themselves that they were of a provisional nature. Departure route WIL 1A was assigned at the request of pilots who were familiar with the Buochs aerodrome. Corresponding departure charts were issued to pilots on request.

1.9.2.2 Agreement

Since 12 March 2009 reciprocal agreements and arrangements (letter of agreement - LoA) existed between the ATS units of Zurich, Bern, Dübendorf, Alpnach, Buochs and Emmen, governing the coordination and handover procedures for aircraft between the cited ATS units.

It is stated, inter alia, how and with whom a departure from Buochs under instrument flight rules should be coordinated. A distinction is made as to whether approach control in Emmen is active or not (Emmen on / Emmen off).

Excerpt from: Letter of agreement between Zurich ACC & APP, Berne APP and Emmen APP, Alpnach TWR, Buochs TWR and Dubendorf APP

"[…]

Annex 4:

IFR-Flights from Buochs

1 General

1.1 These procedures regulate the departure and coordination procedure for civil IFR departures from LSZC/LSMU.

2 Air Traffic Control Procedures

2.1 Departures LSZC/LSMU on the SID direction ZC601 are cleared to 10 000 ft AMSL.

2.2 Departures LSZC/LSMU direction ZC601 climb direction WSW and turn right at ZC601 (MCA 10 000 ft AMSL) direction WIL.

2.3 WIL 1A departures shall be monitored by EMMEN ARRIVAL beginning at 9 NM out RWY 25 until transfer to BERN.

2.4 BUOCHS shall:

- consider the departure slot and inform EMMEN ARR.
- assign the SSR code to the departing aircraft before take-off.
- transmit ETO WIL revisions of 5 minutes and more to the concerned ATC units.

3 IFR Flights from BUOCHS when EMMEN ON

3.1 In case of a failure of WIL VOR, EMMEN ARRIVAL shall vector the IFR departure according to coordination with BERN.

3.2 Air Traffic Control and Coordination Procedures

3.2.1 EMMEN shall transfer departures when over ZC601 to BERN ARRIVAL.

3.2.2 For LSZC/LSMU RWY 25R SID direction ZC601, BUOCHS shall:

- clear the aircraft for start-up after verification with EMMEN, indicating the ETO[3] WIL.
- assign the departure clearance according to the SID or instruction from EMMEN.
- clear the aircraft for take off after verification with EMMEN.

[3] ETO: *estimated time over*

- transfer the flight to EMMEN ARR as early as possible.
- report the ATD[4] to ZURICH AIM.

3.2.3 EMMEN shall:

- coordinate a FL and ETO WIL with BERN.
- inform BUOCHS about revisions

4 IFR Flights from BUOCHS when EMMEN OFF

4.1 IFR Procedures

4.1.1 BUOCHS shall:

- coordinate IFR departures directly with BERN.
- obtain the ATC clearance and SSR-Code from BERN for IFR departures, indicating the call sign, SID and ETO WIL.
- handover the departure to BERN when leaving the BUOCHS / ALPNACH CTR.
- Ensure that the required BUOCHS CTR/TMA and ALPNACH CTR are correctly activated / de-activated according to Annex 6 § 4.4. […]"

Under this agreement, coordination or an exchange of information with Zurich Delta air traffic control unit concerning a take-off of IFR traffic from Buochs or concerning a VFR departure from Emmen was not specified.

1.9.2.3 Tasks and competency of Zurich Delta air traffic control unit

Excerpt from the Air Traffic Management Manual (ATMM) Zurich Lower Airspace, Section 1 Tasks of Personnel, Section 1.2 Tasks DELTA ATCO:

- "Provide ATS according airspace classification to all aircraft under his responsibility
- Management of the traffic presentation for flights inside AoR[5] DELTA according Section2, Chapter 3
- Transmit recommendations for possible alternate routes on pilots request
- Inform concerned traffic about fuel dumping in progress, according to Emergency Manual
- Use best judgement to support an aircraft in a state of emergency
- Receive flight plan data from pilots and process via homebriefing system
- Activate and close flight plans on request of pilot
- Coordination of VFR flights requesting to enter airspace C and D with all responsible civil and military ATC units and if required transmit clearances and instructions on their behalf
- Warn responsible units, in case of an aircraft under his control getting close or having already entered airspaces C or D without clearance

[4] ATD: *actual time of departure*

[5] AoR*: area of responsibility*

- Handling of special flights (e.g. PARA, photoflights, testflights, glider cloud flights etc.)
- Initiate strip creation and distribution by FDO/TS for flights intending to enter airspace class C
- Inform SPVR ACC of reported ATIR and on incidents which may require to file an OIR
- Delegate specific tasks to FIA or FDO/TS”

In summary: consequently no airspace is assigned to the Delta air traffic control officer; he coordinates and acts on behalf of the civil or military air traffic control, depending on who is responsible for the respective airspace.

1.10 Information on departures from Buochs aerodrome

1.10.1 General

In the course of the investigation it was established that standard instrument departure route (SID) WIL 1A was not published (cf. chapter 1.9.2.1). Such a SID is flown under instrument flight rules. For this reason, the persons involved in the serious incident were interviewed regarding their knowledge.

1.10.2 Crews

- OPJ 700: The crew of the Falcon 2000 stated that they were not entirely clear about the flight rules (IFR/VFR) governing their flight during departure. On the one hand they apparently followed SID WIL 1A on a prescribed route, and on the other hand they answered the enquiry by Sector West/South air traffic control officer RE about flight rules with the following words: "still VFR; "ah we are ah, ah ready for IFR."
- HB-RVP: The crew were unaware that on their flight path over the Entlebuch towards Schrattenfluh they crossed a standard instrument departure route which extended from Buochs towards WIL VOR. The crew were, however, clear that they were operating with the Hunter in class E airspace, in which the 'see and avoid' separation principle applied.

1.10.3 Aerodrome controller

- The responsible ATCO in Buochs control tower stated that SID WIL 1A was a full IFR procedure from the take-off of an aircraft.
- The aerodrome control officer in Emmen control tower answered the question about whether, during the time in which this serious incident occurred, he had considered providing the Hunter HB-RVP with information about the take-off of OPJ700 from Buochs as follows [translated from German]: "The Hunter HB-RVP was flying the Hellbühl VFR outbound route and the pilot reported over Hellbühl, I don't remember the precise wording, but it was along the lines of "Hellbühl leaving Westbound", at an altitude of approximately 5000 ft AMSL. Since this flight was being made under a civil VFR flight plan, and also because of the altitude, I was not aware that the pilot intended to fly into the military Schrattenflueh/High Centre TSA. Nor did the pilot inform me of this intention. I assumed, after the VFR circuits which he had previously flown in Emmen, that this was a perfectly normal training circuit. On the basis of this situation, I did not inform HB-RVP about OPJ700 either. We very often have this conflict with IFR-outbound from Buochs as well as VFR and also IFR-outbound Emmen towards the south-west. However, it is then typically military flights by aircraft types F-5 or F/A-18, where it is clear to us, or where the pilot

has informed us, that he will fly into the military TSAs. In such a case the outbound Emmen is separated from the outbound Buochs, respectively at least informed on the basis of the airspace structure in this area."

1.10.4 ACC West/South and Zurich Delta workstation

- The Sector West/South RE control officer stated that he assumes that if an aircraft is flying on an SID it is en route under instrument flight rules. However, he had experienced several times that flights from Buochs were following the SID but still flying VFR, that's why he asked the crew of OPJ 700 about their flight status.
- The RP air traffic control officer for Sector West/South replied to the question to the effect that he was not exactly familiar with SID WIL 1A, but that, according to the operating rules of ACC Zurich, departures from Buochs or Emmen came to ACC Zurich as IFR flights.
- The two ATCOs (coach/trainee) at the Zurich Delta workstation both stated that though they did have knowledge of SID WIL 1A, they were not exactly aware of its trajectory and the related procedures.

1.11 Previous incidents and risk management

1.11.1 Dangerous convergences of licensed civil fighter aircraft

In the course of the investigation, in order to ascertain systemic risks, research was conducted on other dangerous convergences between civil operated fighter aircraft and other aircraft. In particular, the question of the investigation or processing of such an event was of crucial importance - a thorough analysis can make a contribution to the prevention of dangerous situations. In addition to various other events, the following dangerous situations were of significance:

1.11.1.1 Dangerous convergence on 12 April 2007

On 12 April 2007 a Swiss Air Force Aérospatiale Alouette III helicopter was on a flight in the mountains. In the region of Les Diablerets, the pilot detected an object which was flying from right to left at high speed. Immediately afterwards, he was able to identify this object as licensed civil fighter aircraft, a de Havilland Vampire, which was climbing away from him. The lateral distance between the aircraft was zero and the altitude difference, according to the pilot's estimate, was between 50 and 100 metres. This incident is classified as a Class A airprox, i.e. a serious incident with a high risk of collision. Though it was reported to the Air Force aviation safety service, no in-depth analysis or investigation of the circumstances took place.

1.11.1.2 Dangerous convergence on 9 October 2009

On 9 October 2009, two Swiss Air Force Northrop F5 Tiger fighters were returning from their training area to Sion. The wingman was flying in an open formation at a distance of 200 to 400 m from his leader. Coming from the North, the formation reported to Sion aerodrome control at an altitude of approximately 9000 ft AMSL over Leuk. The latter cleared the formation to join the runway 26 upwind at Sion aerodrome, at an altitude of 6000 ft AMSL.

A short time beforehand, two civil registered Hunter fighter aircraft had signed off from Sion aerodrome control and were flying towards the Gemmi Pass on a northerly heading. The formation was led by a two-seater Hunter. The single-seat version of a Hunter fighter aircraft was being deployed as the wingman.

Just south of Leuk the wingman of the Tiger formation suddenly saw out of the corner of his eye the Hunter fighters flying in a tight formation and approaching him at angle of approximately 120°. To avoid a collision, he had to take pronounced evasive action, and the crossing finally took place with a lateral distance of approximately 200 m and with no vertical separation.

The dangerous convergence is categorised as a near-collision. It was reported to the Air Force aviation safety service and the head of aviation safety stated that he had carried out a debriefing by phone with all the crews involved. According to his statement, a recording was deliberately not made, in order to protect the crews. Nobody remembers whether any lessons were drawn from the near-collision. The pilot of the two-seater Hunter stated that the head of Air Force aviation safety had promised him an appraisal of the case. Footage of the incident recorded on board the two-seater Hunter apparently showed that the Hunter crew had behaved correctly and that the error lay rather with the Air Force crew. From the perspective of the Air Force there was no need for action, that's why processing the case was discontinued.

1.11.1.3 Dangerous convergence on 31 August 2010

On 31 August 2010, a civil registered fighter aircraft, a Dassault Mirage III DS, wanted to practise an emergency landing at the military airbase Payerne in the event of engine failure. To arrive at the starting point for this exercise, the pilot of the Mirage III DS requested a climb to flight level 200. He received clearance for flight level 150 and initiated a climb at a rate in excess of 10 000 ft/min. Because the pilot was momentarily distracted, he failed to halt the climb at the cleared flight level. As a result he climbed to approximately FL 160, which was occupied by a business jet aircraft flying from Geneva to Zurich. A dangerous convergence occurred, with a lateral distance of approximately 2.6 NM and an altitude difference of 200 ft.

The incident was reported to the former Swiss Accident Investigation Board, which classified it as a Category A airprox, i.e. a serious incident with a high risk of collision. The serious incident was thoroughly investigated by the SAIB in accordance with international standards and a safety recommendation was issued (cf. Final Report 2128).

1.11.2 Risk management

Fighter aircraft with jet propulsion were first registered as civil aircraft in Switzerland in 1988. Once the Swiss Air Force Hawker Hunters had been decommissioned at the end of 1994, various aircraft of this type were also kept in an airworthy condition by civil operators. The HB-RVP aircraft involved in the serious incident under investigation was registered as the first civil Hawker Hunter in Switzerland on 10 August 1995. Subsequently the regulations mentioned in chapter 1.9.1.2 were drawn up. On 5 May 1997, the FOCA approved the ‘Operating regulations for making flights in historical jet aircraft (in Switzerland)’. Furthermore, on 31 January 2004 the FOCA issued a technical bulletin which, among other things, stipulated that such historic aircraft were to be operated at a maximum airspeed of 250 KIAS below FL 100.

During this investigation, the representatives of the Swiss Hunter Team stated that from their point of view a higher speed of up to approximately 400 KIAS is required in lower airspace for safety reasons. The reason mentioned was a sufficient reserve of kinetic energy allowing pulling-up of the aircraft and a subsequent long glide in the event of an engine failure. The time thus gained would allow a more thorough analysis of the fault and offer an improved situation for re-

starting the engine. If this was unsuccessful, at least an attempt could be made to control the aircraft over an uninhabited region before using the ejector seat.

Though the United Kingdom supervisory authority does allow operation of a comparable Hunter fighter aircraft at airspeeds up to 400 KIAS even below FL 100 (see Annex 2), justification for this permission is however lacking and flights at high speed are associated with several conditions.

As part of this investigation, the Swiss Accident Investigation Board clarified how the risks of operation of high-performance aircraft were determined by operators and by the FOCA and how they dealt with them.

First, it should be noted that given the private operation of such aircraft there is no legal basis for the FOCA for supervisory measures or audits unless there is a special reason for this. The supervisory authority therefore takes action only subject to notification. In the years 2008 to 2011, complaints were received by the FOCA from individual hikers about unbearable noise emissions from civil registered fighter aircraft. Individual helicopter operators also reported sudden encounters with such aircraft during their commercial activity. According to the FOCA, it was predominantly a case of the surprise or the shock of the helicopter pilots, rather than a specific risk of collision.

The FOCA then sought contact with a representative of the relevant circles and admonished him to ensure that the interests of hikers and the activities of the helicopter operators be given greater consideration in the future and in particular that the legal limits be strictly complied with.

As a further result of these communications, the Flight Operations Safety Division of the Federal Office of Civil Aviation carried out a preliminary risk assessment sub-titled “High speed flying (Hunter flights)”, which was completed on 28 December 2010. In the context of this risk assessment, the FOCA assessed the probability of a collision between a civil registered fighter aircraft and a general aviation aircraft as unlikely. On the other hand, however, it described the effects of such a collision as catastrophic. For this reason, it assessed the operation of civil registered fighter aircraft, as carried out up to this point in time, as unacceptable. It was subsequently recommended that the following measures be introduced in combination to reduce the risks [translated from German]:

- All flights must be approved by the FOCA.
- Publication of a NOTAM during private military jet flights with precise indication of the route and altitude.
- The operation is carried out only on certain predefined routes.
- Transponders are compulsory for all flights.
- A VFR flight plan must be submitted to air traffic control for all flights
- Stricter supervision of compliance with the above-mentioned measures.

The implementation of the above measures was carried out on a voluntary basis, such that none of these measures was implemented by the 'Swiss Hunter Team' apart from the task of submitting a flight plan to air traffic control (see chapter 1.9.1.2).

According to the FOCA, however, the reports from the helicopter operators were observed to reduce dramatically.

2 Analysis

2.1 Technical aspects

There are no indications of any pre-existing technical defects that might have caused or influenced the serious incident.

2.2 Human and operational aspects

2.2.1 Air traffic control

After an evaluation of the statements of all the air traffic control officers involved, the conclusion has to be drawn that there was no clarity regarding the status of the standard instrument departure (SID) WIL 1A. While some clearly assumed that an aircraft on this SID was flying under instrument flight rules, others were unclear about the flight status of such an aircraft or were not precisely acquainted with the procedures for this departure route. This fact has promoted the occurrence of the serious incident.

According to the statements of the Emmen aerodrome control officer, the departure of OPJ 700 from Buochs was coordinated with him. He was therefore the only control officer who was aware of both aircraft involved. During the communication with the crew of HB-RVP, no traffic information was provided by the air traffic control officer (ATCO) in the Emmen control tower concerning OPJ 700, which had taken off from Buochs. This was on the assumption that after the previous aerodrome circuits this was a similar training flight. The absence of a traffic information made it more difficult to the crew of the Hunter to recognise the OPJ 700 in time.

After the ground-based short term conflict alert (STCA) had responded at 12:07:16 UTC and the radar executive (RE) air traffic control officer for Sector West/South became aware of the conflict involving the Falcon 2000 and HB-RVP, he was already in radio contact with the crew of OPJ 700 and at 12:07:20 UTC confirmed that he had understood the request from the crew concerning FL 350 as a cruising level. A few seconds later, the first call from a Swiss commercial aircraft occurred. This call was answered immediately by the air traffic control officer. At 12:07:46 UTC, i.e. 30 seconds after the first alert from the STCA, the Sector West/South ATCO then asked the crew of OPJ 700 about their flight status. It is surprising that from the first triggering of the STCA alert, valuable seconds elapsed before the Sector West/South RE addressed the impending conflict, especially as he was already in radio contact with the crew of OPJ 700. However, this can be explained by the fact that HB-RVP, a few moments later, maintained level flight at FL 92 for approximately 20 seconds, so the situation no longer appeared critical to the ATCO. However, given the STCA alert, answering the first call from the Swiss commercial aircraft at this moment should not have been assessed as a priority.

When the crew of OPJ 700 stated in response to the enquiry by the Sector West/South RE control officer that they were still flying under visual flight rules and were ready to continue their flight under instrument flight rules, the RE control officer answered: "Roger, I call you back in two minutes, we have opposite traffic, and, ah, yes." For the RE air traffic control officer this response was confirmation that this was indeed a dangerous, but from his point of view legal incident, because two aircraft were closing on each other at a high speed in ECHO airspace, although under visual flight rules. The air traffic control officer had no information about HB-RVP, but saw that it was flying fast and at approximately the same altitude. Probably owing to the uncertainty about the prevailing flight rules of OPJ 700, the inaccurate (in terms of altitude) reference to the other aircraft was made only after the enquiry about the flight rules, which again lost valu-

able time. This chronological sequence of these events prevented a mitigation of the situation.

According to the excerpt from the ATMM "Zurich lower airspace" concerning the tasks of the Zurich Delta air traffic control officer (see chapter 1.9.2.3), these duties include among other things coordination with the competent civil or military ATC units of VFR flights which wish to fly into Class C or D airspace. The coach and trainee in the Zurich Delta air traffic control unit stated that they were unaware of the serious incident, because they had been busy with their obligations in relation to the coordination of the request for a suitable training area for HB-RVP. Nor had they become aware of the triggering of the visual STCA alert; the reason for this was that they were confronted with a variety of alerts on a daily basis. Though these alerts do correlate to the design of the system, the fact that the system is not designed to cover every situation means they can be described as nuisance alerts. Such alerts are actually unwarranted, but they must still be analysed by the air traffic control officer and then mentally blanked out. They therefore represent an additional workload for the air traffic control officer at the Zurich Delta workstation. It is therefore not surprising that no attention was paid to the STCA alert in connection with the dangerous convergence. From an aviation safety perspective, it is regrettable that a large number of alerts from this safety net have to be ignored, because, as in the present case, this means that even legitimate alerts are not perceived as such.

2.2.2 Crews

2.2.2.1 OPJ 700

Although the crew of OPJ 700 had received clearance from the air traffic control officer in Buochs control tower to climb via SID WIL 1A to flight level 100, it was not clear to them whether they were flying under visual or instrument flight rules. This is apparent from the transcript of the radio recording of the communication with the Zurich ACC Sector West/South and from the statements of the crew. It must be assumed that the crew were of the opinion that they were flying under visual flight rules despite being on an instrument departure route.

After detecting an opposing aircraft on their primary flight display (PFD) and even before the issuing of a resolution advisory (RA) by their traffic alert and collision avoidance system (TCAS) the crew of OPJ 700 attempted to establish visual contact with HB-RVP. The reaction of the crew to the resolution advisory was immediate and they initiated a descent. In addition to this vertical evasive manoeuvre, they turned slightly to the left. Lateral evasive action is not part of the TCAS concept, which provides only for vertical evasive action. In the present case, this initiation of the slight left turn is understandable, if the crew of OPJ 700 had made visual contact with HB-RVP before the TCAS RA was triggered. Assuming that they were flying under visual flight rules, lateral evasive action seemed appropriate for the crew of OPJ 700, but did not result in adequate separation between the two aircraft as the convergence progressed. The TCAS then triggered an RA, which according to the basis of calculation of the TCAS software was intended to achieve a minimum vertical distance between the two aircraft of 350 ft at the time of the closest point of approach. Since the crew of OPJ 700 obeyed the resolution advisory without delay, this vertical separation was achieved at the time of the closest point of approach. In the absence of the left turn made in addition to the vertical evasive action, the lateral distance to HB-RVP would have been less at the time of the closest point of approach.

2.2.2.2 HB-RVP

The buffeting speed of the Hawker Hunter with flaps retracted at 10 000 ft is equivalent to approximately 280 km/h true air speed (TAS) (cf. chapter 1.3.2.2). If a margin of 50% is added to this speed, as is usual, for example, for the calculation of $V_{pattern}$, for civil aircraft flying a holding pattern, then the resulting TAS of 420 km/h (corresponding to approximately 200 KIAS) is sufficient to enable safe manoeuvrability. From this point of view, it is therefore quite possible to operate this aircraft type at 250 KIAS below flight level 100.

Operators of such high-performance aircraft also pointed out that a higher airspeed up to approximately 400 KIAS is desirable in lower altitude airspace in order to have a reserve of energy available in the event of an engine failure. On the one hand this would make it possible to attempt to restart the engine for a longer time or to control the aircraft over an unpopulated area before using the ejector seat.

As the investigation established, the United Kingdom supervisory authority, for example, allows operation of a comparable Hunter fighter aircraft at airspeeds up to 400 KIAS even below FL 100 (see Annex 2). However, a whole series of requirements are associated with this permit. These flights, for example, have to be authorised by an air traffic control unit and monitored by radar. In this context an assessment was also made as to how much these or other risks were established in the past by operators or by the supervisory authority in connection with the operation of high-performance aircraft. In recent years, both the operators and the FOCA have been increasingly faced with complaints about low-level flights at high speeds. Helicopter aviation operators in particular had criticized the sudden appearance of civil registered fighter aircraft. The FOCA subsequently suggested a number of measures on a voluntary basis and the operators of civil registered fighter aircraft concerned opened a dialogue with the helicopter aviation operators concerned. According to information from the FOCA, notifications of such events subsequently fell significantly. Even though the efforts of the supervisory authority and the operator of high-performance aircraft are to be commended in this respect, the following points are raised which appear noteworthy in terms of handling the risks associated with the operation of this category of aircraft.

- Civil registered fighter aircraft have been operated in Switzerland since 1988, and the Hawker Hunter type since 1995. The FOCA takes the standpoint that the requirement of flying at a speed of maximum 250 KIAS below FL 100 would also be binding for this aircraft type and relied on the compliance with this regulation. The operator of the civil registered fighter aircraft on the contrary arbitrary ignored this requirement and flew systematically at higher speeds. A joint and careful investigation respectively a cautious exemption regarding the necessity to fly such aircraft types at speeds higher than 250 KIAS below FL 100 did however not take place.
- It is not comprehensible why the need to operate such aircraft types below flight level 100 at airspeeds higher than 250 KIAS was for 20 years not thoroughly clarified and vigilantly regulated either by the operators or the supervisory authority.
- In its preliminary risk assessment dated 28 December 2010, the FOCA assessed the probability of a collision between a civil registered fighter aircraft and a general aviation aircraft as unlikely. At the same time, however, it noted that such an event would have catastrophic consequences. For this reason, various measures such as, for example, the operation of high-performance aircraft on defined flight routes or the publication of a NOTAM with precise in-

formation on the flight paths or training areas were proposed. However, these proposals have been implemented to date only partially.

In summary, the Swiss Accident Investigation Board concludes that with regard to the operation of civil high-performance aircraft, in particular former fighter aircraft, the risks have so far been inadequately analysed, by both operators and the supervisory authority. Where risks were identified, there was a failure to jointly work out and implement appropriate improvements.

The flight involved in this serious incident was a so-called 'flight with examiner'. Moreover, the pilot in the left-hand seat did not have the minimum training required for carrying passengers: three landings in the last 90 days on the Hunter aircraft type. Thus the examiner in the right-hand was effectively acting as an instructor. It is not surprising that he did not intervene in this function when the maximum permissible speed of 250 kt below FL 100 was exceeded, because he believed, mistakenly, that he was authorised to do so on the basis of the flight plan which had been submitted. A flight plan does in no way release a pilot from complying with the required maximum speed of 250 KIAS below FL 100, stated in the VVR.

It was clear to the crew of HB-RVP that they were operating in Class E airspace, in which the 'see and avoid' separation principle applied. An essential prerequisite for maintaining the necessary safety margins in terms of both time and space is therefore the restricted top speed of 250 knots below FL 100. Significantly exceeding this maximum airspeed increases the risk of a collision. The two pilots of the civil registered fighter aircraft HB-RVP, as former military pilots, had a distinct capability and awareness with regard to surveillance of the airspace. However, the present case clearly shows that the high airspeed of the HB-RVP led to time-related circumstances that no longer permitted even such pilots with above-average skills to acquire visual contact with OPJ 700.

Also, the high speed of the Hawker Hunter contributed to the fact that possible coordination by the air traffic controllers at the Zurich Delta workstation was practically impossible, for time-related reasons.

2.2.3 Procedures

2.2.3.1 Operating regulations and departure procedures

Since 2002, Buochs aerodrome has had operating regulations which were actually applied though which had only a provisional status. The standard instrument departure route (SID) WIL 1A could not be published because of the provisional operating regulations, but was nevertheless issued to local pilots and used by them. It is therefore not surprising that there was ambiguity and uncertainty among the different parties in relation to the departure route. All these circumstances indicated an uncommon process regarding the publication and distribution of this procedure and thus pose a certain potential danger.

As described in chapter 1.9.2.2, since 12 March 2009 reciprocal agreements and arrangements (letters of agreement - LoA) regulated coordinations and the handover procedures for aircraft, between Buochs and Emmen, among other things. These also covered departure from Buochs under instrument flight rules, where a distinction is made depending on whether Emmen approach control is active or not (Emmen on / Emmen off). Although Emmen approach control was not active in the present case due to the weather conditions, the Buochs control tower ATCO informed the Emmen aerodrome control officer about the impending departure. This action was prudent but could not prevent the serious incident. Regardless of the fact that depending on the status of Emmen, coordination of IFR departures from Buochs had to take place, there was no exchange of information with the Zurich Delta air traffic control unit. Therefore the question arises whether

the procedures relating to IFR departures from Buochs and departures from Emmen are appropriate.

The fact that the two aircraft were in radio contact with two different air traffic control units without these being aware of the presence of the other aircraft created an essential pre-condition for the occurrence of the serious incident.

2.2.3.2 Flight approval and special approval

The 'Operating rules for flights by historical jet aircraft (in Switzerland)' drawn up by the 'Verein Fliegermuseum Altenrhein' were approved by the FOCA in May 1997. With regard to aviation law and the applicable ordinances, the rights and obligations of the commander, the use of oxygen and compliance with minimum flying altitudes were mentioned, among other things. Reference was also made to specific articles of the DETEC Ordinance on the Rules of the Air (VVR). It is, however, clear that there was no reference to Article 9 of the Ordinance, which regulates the maximum airspeed for flights below FL 100, and nor was corresponding action regulated within the framework of the above-mentioned operating regulations. At the time of the serious incident, no authorisations existed to allow the flying of former military aircraft in the Special Category, Subcategory Historical, faster than 460 km/h (250 kt) at flight altitudes below FL 100.

The ATC flight plans in practice submitted with 360 knots are not mentioned in the operating permit. Exceeding the maximum allowable airspeed below FL 100 increases the risk of a collision.

2.2.3.3 Handling of previous incidents

When one considers the dangerous convergences listed in chapter 1.11 which have occurred between civil registered fighter aircraft and air force aircraft, it is striking that not in all cases a specific analysis was carried out to prevent such events. In particular, the near-collision over Leuk, in which the pilot involved in the serious incident currently under investigation was also involved, indicates that the investigation of such an event cannot be left to either of the two parties involved, since they can be concentrated to one side on their own interest and an investigation can therefore be made either biased or even inhibited. Only an investigation by an independent entity can ensure that the necessary lessons can be drawn from such a situation in an impartial manner and that particular interests are not suddenly brought to the fore.

In the investigation of this serious incident as well as in other cases, the Swiss Accident Investigation Board has determined that a considerable number of dangerous convergences involving civil and military aircraft occur which are reported incorrectly or not at all. This means that such safety-critical events can neither be analysed nor can lessons be learned or improvements made. For this reason, the Swiss Accident Investigation Board has decided to conduct a broad-based study on reporting and on the areas of risk which can remain concealed as a result of incorrect or non-existent reporting.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft OPJ 700 was licensed for VFR/IFR transport.
- The aircraft HB-RVP was licensed for VFR operation.
- The investigation did not produce any indications of pre-existing technical faults on the aircraft involved which might have caused or influenced the serious incident.
- The investigation did not produce any indications of any pre-existing technical faults on the ground-based air traffic control systems.

3.1.2 Crews

- The pilots were in possession of the necessary licences for the flight.
- There are no indications of the pilots suffering health problems during the flight involved in the serious incident.

3.1.3 Air traffic control personnel

- The air traffic control officers were in possession of the licences necessary to exercise their activities.
- There are no indications of the air traffic control officers suffering health problems at the time of the serious incident.

3.1.4 History of the serious incident

- At 11:59:12 UTC the aerodrome control officer in Buochs gave the crew of OPJ 700 the air traffic control (ATC) clearance which included the standard instrument departure (SID) WIL 1A, the cleared flight level (FL) 100 and a transponder code.
- At 12:00:31 UTC the air traffic control officer (ATCO) in the aerodrome control tower (TWR) of Buochs gave the crew of OPJ 700 clearance to take off from runway 25.
- Approximately two and a half minutes later, at 12:03:02 UTC, the Buochs TWR air traffic control officer instructed the crew of OPJ 700 to make contact with Bern approach control.
- At 12:03:44 UTC, the Hawker Hunter HB-RVP received clearance to take off from runway 04 for a flight under visual flight rules from the Emmen military airbase aerodrome control officer.
- One minute after the take-off clearance, the aerodrome controller in Emmen revised his first given altitude clearance from 4000 ft to 3500 ft QNH for traffic-related reasons. After this, no explicit altitude clearance was given for the remainder of this flight.
- During the communication with the crew of HB-RVP, no traffic information was provided by the aerodrome control officer in Emmen regarding the Falcon 2000 which had taken off from Buochs.
- According to the radar recordings, OPJ 700 reached the cleared altitude of FL 100 at 12:05:08 UTC.

- The crew of OPJ 700 reported at 12:07:09 UTC on the frequency of the West/South Sector.
- At that time, the crew of HB-RVP reported to the Zurich Delta ATS unit and inquired at 12:07:06 UTC about a training area for the performance of its aerobatics programme.
- At this time, the Hawker Hunter was climbing with a ground speed (GS) of 390 kt at 12:07:12 UTC, which increased in the subsequent 30 seconds to 426 kt.
- At 12:07:16 UTC, the ground-based short term conflict alert (STCA) system was triggered at the Sector West/South and Delta workstations of ACC Zurich.
- From 12:07:18 UTC to 12:07:33 UTC five more radio conversations took place on the frequency of the ACC West/South Sector, two of them with OPJ 700 and three with a commercial aircraft.
- The radar executive (RE) air traffic control officer in the ACC West/South Sector asked the crew of OPJ 700 about their flight status at 12:07:46 UTC: "Operajet seven hundred, just for my confirmation, you are still ah VFR?"
- The crew of OPJ 700 then replied at 12:07:54 UTC: "still VFR; ah we are ah, ah ready for IFR", whereupon the air traffic control officer answered: "Roger, I call you back in two minutes, we have opposite traffic, and, ah, yes."
- At the same time, at 12:07:54 UTC, the traffic alert and collision avoidance system (TCAS) on board OPJ 700 generated the resolution advisory (RA) "descend, descend".
- The crew obeyed immediately and since they had established visual contact with HB-RVP shortly before, they also initiated a left turn.
- According to the radar recordings, HB-RVP reached flight level 100 at 12:08:12 UTC.
- At 12:08:14 UTC, HB-RVP and OPJ 700 crossed with a lateral distance of 0.9 NM and an altitude difference of 400 ft, approx. 15 NM south-southeast of radio beacon WIL.
- At the time of the closest approach, the GS of OPJ 700 was 247 kt and that of HB-RVP was 372 kt.
- The crew of HB-RVP were never aware of OPJ 700 as the aircraft converged.

3.1.5 General conditions

- The serious incident took place in Class E airspace, in which the separation principle 'see and avoid' applies in relation to separation of flights under visual flight rules and flights under instrument flight rules.
- The operating regulations of Buochs aerodrome had a 'provisional' status, which is why the SID WIL 1A could not be published officially.
- Visual flight rules applied, with no relevant restrictions due to cloud or visibility.

3.2 Causes

The serious incident is attributable to the dangerous convergence of a business jet aircraft in instrument flight and a civil registered fighter aircraft flying under visual flight rules; it was able to occur because of a combination of the following factors:

- With regard to flight operations by civil high-performance aircraft, in particular former fighter aircraft, the supervisory authority requested to adhere to speed limitations and the operator did systematically not comply with because they were convinced that higher speeds were a necessity.
- The measures taken by the supervisory authority after having done a risk assessment were only partially put into practice.
- The high airspeed of the civil registered fighter aircraft increased the closing speed remarkable and reduced the time for traffic information from the air traffic control units involved and made it more difficult for the crews to carry out a visual search and establish visual contact with the other aircraft.
- The two aircraft were not in contact with the same ATC unit.
- The alert from the ground-based conflict alert system was in fact noted by the air traffic control officers involved. Appropriate traffic information to the crew of the business jet was given, but it was too late and imprecise.
- Traffic information to the crew of the civil registered fighter aircraft did not take place.

The serious incident was facilitated by the fact that the standard instrument departure route (SID) WIL 1A from Buochs aerodrome was never published. This led to the following contributory factors:

- Two air traffic control units and the crew of the business jet aircraft were unclear about the flight rules governing an aircraft on this SID. This led to discussions on the radio and hence to delayed traffic information.
- The crew of the civil registered fighter aircraft were unaware of the existence of the standard instrument departure route.

4 Safety recommendations, safety advices and measures taken since the serious incident

Safety recommendations

According to the provisions of Annex 13 of the International Civil Aviation Organization (ICAO) and Article 17 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, all safety recommendations listed in this report are intended for the supervisory authority of the competent state, which must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, any establishment and any individual is invited to strive to improve aviation safety in the spirit of the safety recommendations pronounced.

Swiss legislation provides for the following regulation regarding implementation in the Ordinance on the Safety Investigation of Transport Incidents (OSITI):

„Art. 48 Safety recommendations

[1] The STSB shall submit the safety recommendations to the competent federal office and notify the competent department of the recommendations. In the case of urgent safety issues, it shall notify the competent department immediately. It may send comments to the competent department on the implementation reports issued by the federal office.

[2] The federal offices shall report to the STSB and the competent department periodically on the implementation of the recommendations or on the reasons why they have decided not to take measures.

[3] The competent department may apply to the competent federal office to implement recommendations."

The STSB shall publish the answers of the relevant Federal Office or foreign supervisory authorities at www.stsb.admin.ch in order to provide an overview of the current implementation status of the relevant safety recommendation.

Safety advices

The STSB may publish safety advices in response to any safety deficit identified during the investigation. Safety advices shall be formulated if a safety recommendation in accordance with Regulation (EU) No. 996/2010 does not appear to be appropriate, is not formally possible, or if the less prescriptive form of a safety advices is likely to have a greater effect. The legal basis for STSB safety advices can be found in Article 56 of the OSITI:

"Art. 56 Information on accident prevention

The STSB may prepare and publish general information on accident prevention."

4.1 Safety recommendations

4.1.1 Analysis and risk reduction in the operation of civil high-performance aircraft

4.1.1.1 Safety deficit

On 14 June 2012, at 12:00:31 UTC, a Falcon 2000 aircraft, flight plan call sign OPJ 700, received take-off clearance from aerodrome control at Buochs aerodrome. After take-off, OPJ 700 followed its previously assigned standard instrument departure route (SID) WIL 1A and climbed to the cleared flight level 100. Approximately three minutes later, the Hawker Hunter aircraft registration HB-RVP received clearance to take off from runway 04 for a flight under visual flight

rules from the aerodrome control officer in the control tower of the Emmen military airbase. After take-off, HB-RVP turned left onto a south-south-westerly heading and continued to accelerate during its climb.

At 12:07:16 UTC the ground-based short term conflict alert (STCA) system in air traffic control triggered. Shortly afterwards, the traffic alert and collision avoidance system (TCAS) on the Falcon 2000 generated a traffic advisory, followed at 12:07:54 UTC by a resolution advisory which the crew of OPJ 700 obeyed immediately. The two aircraft were flying in opposing directions and crossed at 12:08:14 UTC approximately 15 NM south-southeast of radio beacon WIL at flight level 100 with a lateral distance of 0.9 NM and an altitude difference of 400 ft. At this time, the ground speed of OPJ 700 was 247 knots and that of HB-RVP was 372 knots.

Visual flight rules applied, with no relevant restrictions due to cloud or reduced visibility. The crew of the Hunter were not aware of the dangerous convergence. With the help of the TCAS the crew of OPJ 700 were able to establish visual contact with the other aircraft just before they crossed.

The investigation has shown that, among other factors, the high airspeed of the civil registered fighter aircraft made a warning to the two crews and a visual search and detection of the respective other aircraft more difficult.

As data from the aircraft flight manual for the Hawker Hunter aircraft type proves, it is technically quite possible to operate this aircraft type at 250 KIAS below flight level 100. However, operators of this aircraft type pointed out that a higher airspeed, up to approximately 400 KIAS, is desirable in lower airspace in order to have a reserve of energy available in the event of an engine failure. On the one hand this would make it possible to try to restart the engine for a longer time or to control the aircraft over an unpopulated area before using the ejector seat.

As the investigation established, the United Kingdom supervisory authority, for example, allows operation of a comparable Hunter fighter aircraft at airspeeds up to 400 KIAS even below FL 100. However, a whole series of requirements are associated with this permit. These flights, for example, have to be authorised by an air traffic control unit and must be monitored by radar.

In this context, an assessment was also made as to how much these or other risks were established in the past by operators or by the supervisory authority in connection with the operation of high-performance aircraft. In recent years, both the operators and the FOCA have been increasingly faced with complaints about low-level flights at high speeds. Helicopter aviation operators in particular had criticized incidents involving sudden encounters with civil registered fighter aircraft. The FOCA subsequently suggested a number of measures on a voluntary basis and the operators of civil registered fighter aircraft concerned opened a dialogue with the helicopter aviation operators concerned. According to information from the FOCA, notifications of such events subsequently fell significantly. Even though the efforts of the supervisory authority and the operator of high-performance aircraft are to be commended in this respect, the following points are raised which appear noteworthy in terms of handling the risks associated with the operation of this category of aircraft.

- Civil registered fighter aircraft have been operated in Switzerland since 1988, and the Hawker Hunter type since 1995. It is not comprehensible why the need to operate such aircraft types below flight level 100 at airspeeds higher than 250 KIAS was for 20 years not thoroughly clarified and vigilantly regulated either by the operators or the supervisory authority.

- In its preliminary risk assessment dated 28 December 2010, the FOCA assessed the probability of a collision between a civil registered fighter aircraft and a general aviation aircraft as unlikely. At the same time, however, it noted that such an event would have catastrophic consequences. For this reason, various measures such as, for example, the operation of high-performance aircraft on defined flight routes or the publication of a NOTAM with precise information on the flight paths or training areas were proposed. However, these proposals have not been implemented to date.

In summary, the Swiss Accident Investigation Board concludes that with regard to the operation of civil high-performance aircraft, in particular former fighter aircraft, the risks have so far been inadequately analysed, by both operators and the supervisory authority. Where risks were identified, there was a failure to jointly work out and implement appropriate improvements. For these reasons, the Swiss Accident Investigation Board sees an urgent need for action to ensure safe operation of such high-performance aircraft in the future.

4.1.1.2 Safety recommendation no.494

"Das Bundesamt für Zivilluftfahrt (BAZL) sollte in Zusammenarbeit mit den Betreibern von zivilen Hochleistungsflugzeugen, insbesondere ehemaligen Kampfflugzeugen, Rahmenbedingungen und Betriebsregeln festlegen, welche einerseits einen sicheren Betrieb dieser Luftfahrzeuge ermöglichen und andererseits die Sicherheitsbedürfnisse der übrigen Luftraumbenützer berücksichtigen."

[The Federal Office of Civil Aviation (FOCA), in collaboration with the operators of civil high-performance aircraft, especially former fighter aircraft, should lay down basic conditions and operating rules which on the one hand allow safe operation of these aircraft and on the other hand take into account the safety-related requirements of other airspace users.]

4.2 Safety advices

None

4.3 Measures taken since the serious incident

4.3.1 Federal Office of Civil Aviation

The Federal Office of Civil Aviation (FOCA) reported in a letter of 31 March 2014 the following measures taken:

„Das BAZL hat auf jede ihm bekannte Regelverletzung sofort und entschieden reagiert. Seit dem schweren Vorfall vom 14. Juni 2012 wurden folgende sichernden Massnahmen im Zusammenhang mit dem Betrieb der Hawker Hunter getroffen:

- *Nach dem Vorfall vom 14. Juni 2012, bei welchem mit einer Höchstgeschwindigkeit von 370 KIAS auf FL 92 geflogen wurde und es zu einem Airprox kam, hat das BAZL den beiden Piloten die Lizenz warnungsweise während 1 resp. während 3 Monaten (mit Auferlegung eines Flugverbotes im schweizerischen Luftraum) entzogen. Beide Piloten haben diesen Lizenzentzug angefochten. Beide Verfahren sind zur Zeit vor Bundesverwaltungsgericht hängig.*
- *Geschwindigkeitsüberschreitungen in der Zeit vom 18. und 19. Juni 2013: drei Hunterflüge mit Höchstgeschwindigkeiten von 286, 304, 328 KIAS unter FL 100. Dem Piloten wurde das Hunterrating sicherungsweise mit sofortiger Wirkung auf unbestimmte Zeit entzogen.*

- *Vorfall vom 18. Juni 2013: Verletzung des italienischen Luftraumes und Geschwindigkeitsüberschreitung (369 KIAS auf FL 96). Dem Piloten wurde die Lizenz sicherungsweise mit sofortiger Wirkung entzogen, und für die Wiedererlangung der Lizenz hat der Pilot den Nachweis über die durchgeführte Schulung betreffend die gesetzlichen Bestimmungen der VVR und der Flugplanung sowie eines positiven verkehrspsychologisch-psychiatrischen Gutachtens betreffend seiner charakterlichen Eignung zu erbringen. Diese Anordnungen wurden vom Piloten angefochten und sind zur Zeit vor Bundesverwaltungsgericht hängig.*
- *In der Folge des Entwurfs der SUST zum Untersuchungsbericht Airprox vom 14. Juni 2012 hat das BAZL am 10. März 2014 alle Halter von zivil in der Schweiz immatrikulierten Hawker Hunter Flugzeugen zur Vereinbarung von dringenden Sofortmassnahmen gegen das festgestellte Risiko sowie zur Besprechung der mittel- und langfristigen Bereinigung der Situation eingeladen. Es konnte ein klares Bekenntnis zur Einhaltung der Höchstgeschwindigkeiten im unkontrollierten Luftraum unter FL 100 vereinbart werden. Die Einhaltung wird mittels Logging-Geräten auf jedem Flug aufgezeichnet. Bis zum Beginn der Trainingssaison 2014 ab Mitte Mai wird zudem mit den militärischen Stellen und dem Aeroclub nach einer längerfristigen Lösung mit Radarbegleitung, Separation und Einsatzführung durch die Flugsicherung gesucht werden.*
- *Teilweise Suspendierung der SID WIL 1A am 10. März 2014 (kann nur noch durch Pilatus Piloten geflogen werden)“*

Das BAZL wird in den genannten Fällen selbstverständlich auch strafrechtliche Massnahmen an die Hand nehmen, sobald über die sichernden Massnahmen rechtskräftig im Sinne des Amts entschieden ist.“

[Translation]: The FOCA has responded immediately and decisively to any breach of the rules it has been made aware of. Since the serious incident on 14 June 2012 the following safety measures have been taken in connection with the operation of the Hawker Hunter:

- After the incident on 14 June 2012, during which a top speed of 370 KIAS was flown at FL 92, leading to an Airprox, the FOCA revoked the licenses of the two pilots for 1 and 3 months respectively (with a flight ban in Swiss airspace) as a warning. Both pilots challenged the revocations. Both cases are currently pending before the Federal Administrative Court.
- Exceeding the speed limit in the period from 18 to 19 June 2013: three Hunter flights with top speeds of 286, 304 and 328 KIAS below FL 100. The pilot's Hunter rating was revoked with immediate effect for an indefinite period in the interests of safety.
- Incident on 18 June 2013: Violation of Italian airspace and exceeding the speed limit (369 KIAS at FL 96). The pilot's license was revoked with immediate effect in the interests of safety. In order to regain his license, the pilot must provide proof of training relating to the statutory provisions of the WR and flight planning, as well as a positive traffic psychological-psychiatric expertise regarding his character suitability. These arrangements were challenged by the pilot and are currently pending before the Federal Administrative Court.
- As a result of the SAIB draft investigation report (Airprox) of 14 June 2012, on 10 March 2014 the FOCA invited all civil operators of Hawker Hunter aircraft registered in Switzerland to agree on urgent measures against the identified risk, as well as to discuss a medium- and long-term solution to rectify the situation. It was possible to agree upon a clear commitment to observe speed lim-

its in uncontrolled airspace below FL 100. Compliance will be recorded by means of logging equipment on each flight. Until the beginning of the 2014 training season from mid-May, the FOCA, together with the military authorities and the Aeroclub, will attempt to find a longer-term solution involving radar assistance, separation and operational command by air traffic control.

- Partial suspension of SID WIL 1A on 10.03.2014 (can only be flown by Pilatus pilots).

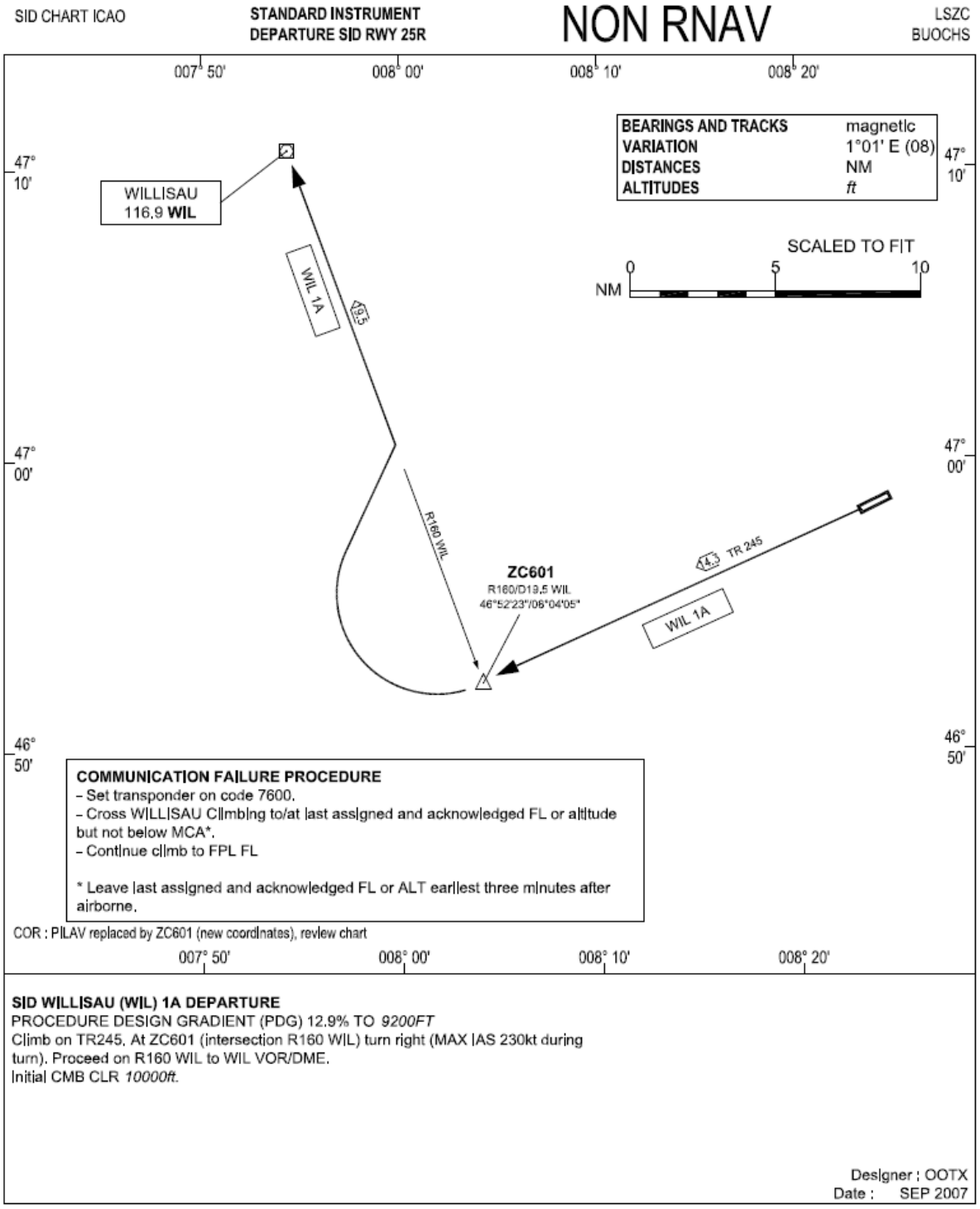
In the above cases, the FOCA will of course also take measures under criminal law as soon as a legal decision on the safety measures is made in accordance with the wishes of the Office.

Payerne, 29 June 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

Berne, 16 June 2015

Annex 1: Standard instrument departure (SID) Willisau (WIL) 1A from Buochs aerodrome (LSZC)



Annex 2: Civil Aviation Authority Rules of the Air Regulations 2007

CIVIL AVIATION AUTHORITY
Rules of the Air Regulations 2007

Civil Aviation Authority

PERMISSION

1. The Civil Aviation Authority, pursuant to Rule 21(3) of the Rules of the Air Regulations 2007, hereby permits Hawker Hunter Mk58A G-PSST, (the said aircraft), operated by Heritage Aviation Developments Ltd to fly at a speed which according to the airspeed indicator is more than 250 knots, below Flight Level 100, in so far as is necessary to enable the aircraft to fly for the purposes of:

Display practice, Display Flying,Training and Transit.

2. This Permission is granted subject to the following conditions:

(a) the said flights shall only be made in Class D, E, F and G airspace within the UK FIR: however, flight pursuant to this Permission in Class D and E airspace must also be cleared by the relevant Air Traffic Control authority

(b) the pilot in command of the aircraft on the said flights shall be any pilot briefed and authorised by the Chief Pilot;

(c) the said flights shall only be made in weather conditions which enable the aircraft to remain at least 3 kilometres horizontally and 1000 feet vertically away from cloud and in a flight visibility of at least 10 kilometres;

(d) on the said flights the aircraft shall not fly unless it is in receipt of a radar service, except when it is flying within an Aerodrome Traffic Zone (ATZ);

(e) the operator of the aircraft shall keep a record of any flights made pursuant to this Permission for two years for inspection by the Authority upon request.

(f) the said aircraft shall not exceed 400 knots IAS during transit flying.

3. This Permission shall have effect from the date hereof until **25 June 2013** unless previously revoked, varied or suspended.

for Civil Aviation Authority
G DUNCAN

Date: 15 May 2012
Reference: 20120615PAndE6341
Flight Operations Inspectorate
General Aviation
01293 573510

Distribution: Heritage Aviation Developments Ltd(07802 202222),AUS, LACC-Swanwick, LJAO(MASOR), Scottish ATCC, Controlled Airspace Section, DAP
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