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Aircraft accident investigation bureau

Final Report Nr. 1872 of the Aircraft Accident Investigation Bureau

concerning the incident (Airprox)

between HB-SCO and ISK210

on 17 December 2003

TMA Zurich, 5NM East Willisau VOR/DME

FINAL REPORT

AIR TRAFFIC INCIDENT REPORT (ATIR)

AIRPROX (NEAR MISS)

This report has been prepared solely for the purpose of accident/incident prevention. The legal assessment of accident/incident causes and circumstances is no concern of the incident investigation (Art. 24 of the Air Navigation Law). The masculine form is used in this report regardless of gender for reasons of data protection.

PLACE/DATE/TIME

TMA Zurich, 5NM East Willisau (WIL) VOR/DME,
17 December 2003 at 11:57 UTC

AIRCRAFT

HB-SCO DV20 (Katana),
Horizon Swiss Flight Academy LTD
Grenchen (LSZG) – Samedan (LSZS)

ISK210 De Havilland Canada DHC Dash 8 D-BLEJ
InterSky Luftfahrt GmbH
Berne (LSZB) – Vienna (LOWW)

ATC UNIT AIR TRAFFIC CONTROLLERS

Zurich Departure Control (DEP)
DEP (Coach)
DEP (Trainee)

Zurich Area Control Centre (ACC)
RE-S/W
RP-S/W (Coach)
RP-S/W (Trainee)

Berne Tower (TWR)
ATCO TWR

AIRSPACE

C

HISTORY

ISK210

On Wednesday 17 December 2003, the crew of ISK210 were making a scheduled flight from Berne to Vienna with 30 passengers on board. The aircraft took off from runway 14 at 11:48. The flight crew were cleared to fly departure route BERSU 5 SIERRA, to climb to FL100 and to set transponder code A2747.

Two minutes after take-off, the aircraft passed 4700 ft and the crew were instructed to switch to Zurich Sector West frequency 135.675 MHz.

At the time of the incident, Sectors South and West were combined into Sector South/West.

At 11:50:56, the First Officer (FO), acting as pilot non flying (PNF), contacted Radar Executive Zurich Sector South/West (RE-S/W) and informed him that they would be passing FL50. One minute later, ISK210 passed FL60 and RE-S/W instructed the crew to continue climbing to FL140 at a maximum rate of climb of 1500 ft/min. According to the radar recording, the aircraft subsequently climbed at an average rate of climb of 650 ft/min for the subsequent four minutes.

A little later, the crew received clearance to fly direct heading direction BAMUR after passing FL110.

At 11:55:31, RE-S/W issued traffic information to the crew concerning an unknown aircraft, direction 11 o'clock, at a distance of 2 NM, which was displayed on his radar monitor at FL90. At the time, ISK210 had just passed waypoint BERSU and was at FL83 and climbing. The FO replied to the traffic information from RE-S/W: *"Yeah we have it in sight and on TCAS, ISK210 merci"*.

According to his statements, the Commander (CMD) then continued to climb maintaining continuous visual contact with the other aircraft and one minute later convergence occurred between the two aircraft.

According to the radar recording, at 11:56:45 ISK210 crossed just in front of the flight path of the other aircraft. The lateral separation at the time, according to the radar recording, was approximately 150-200 m and the altitude difference was 200 ft.

HB-SCO

On this day, the pilot of HB-SCO planned a private visual flight from Grenchen to Samedan and back to Grenchen. The aircraft took off in Grenchen at 11:38. According to his flight log, the pilot wanted to fly to Samedan via radio beacon Willisau (WIL VOR) – Walensee – Chur – Albula.

Weather conditions in the Swiss Mittelland were good. There was a light mist but good visual conditions with a few high banks of cloud.

According to his statements, the pilot prepared the flight using his personal flight log. In addition, he had studied the necessary weather information and the military hazard chart (KOSIF).

At 11:53:41, on an easterly heading, HB-SCO passed radio beacon WIL VOR at FL85, climbing. Shortly thereafter, the aircraft entered the Zurich terminal control area (TMA). The encounter with ISK210 took place there at 11:56:45 at approximately FL90; the pilot noticed it only when he had already crossed this aircraft.

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After he had ascertained that the clouds were thickening towards the Alps, he decided to abort the planned flight to Samedan in the Walensee region.

He turned his aircraft north and then made contact with Zurich flight information centre (FIC) to inform it of his changed route. He informed FIC that he intended to fly back to Grenchen via Schaffhausen – Waldshut. HB-SCO finally landed again in Grenchen at 13:36.

FINDINGS

- The incident occurred in class C airspace in the Zurich TMA within the Zurich Departure area of competency.
- ISK210 was in contact with Swiss Radar Area East, Sector South/West and was flying according to instrument flight rules (IFR).
- Sector South/West was working with frequencies 128.050 MHz and 135.675 MHz in coupling mode.
- HB-SCO was flying according to visual flight rules (VFR) and at the time of the incident was not in contact with any air traffic control unit.
- At DEP, an ATCO was working together with a trainee. At workstation RP-S/W, an ATCO was carrying out a check with a trainee.
- The volume of traffic was average.
- Three crew members and 30 passengers were on board ISK210.
- The pilot of HB-SCO was alone on board.
- Up to the day of the incident, the flying hours of the pilot of HB-SCO totalled 77 hours 37 minutes. On the aircraft type: 27 hours 14 minutes.
- Entry of aircraft flying according to visual flight rules into class C airspace requires authorisation from the responsible air traffic control unit as well as continuous radio contact with the latter.
- HB-SCO did not have authorisation to fly into the Zurich TMA.
- At 11:52:01, ISK210 was instructed by RE-S/W to climb to FL140 at a maximum rate of climb of 1500 ft/min. The crew subsequently climbed at an average rate of climb of 650 ft/min, according to the radar recording.
- According to an agreement between Zurich and Berne, departures from Berne via BERSU – KUDES in principle had to be able to pass waypoint BERSU at FL120 or higher, in order to avoid Zurich Departure airspace.
- The airspace allocated to Berne from ground to FL105 is a permanent short term conflict alert (STCA) suppression area, in which STCA alerts are suppressed by technical means.
- According to the ATCOs' statements, the radar monitors in Sector S/W were set for the altitude range FL105-FL245.
- According to the ATCO and the trainee, the radar image at DEP was set so that the entire DEP airspace was visible. The western limit was set at approximately 2-3 NM west of WIL VOR.
- RE-S/W had coordinated the reduced climb of ISK210 and the resulting entry into Zurich Departure airspace with this unit.

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- At 11:49, according to the radar recording, the pilot of HB-SCO set transponder code A7000 approximately 6 NM west of WIL VOR. The aircraft was at FL72 and climbing.
- At 11:55:00, HB-SCO entered the Zurich TMA on an easterly heading. The aircraft passed FL88, climbing. After the encounter with ISK210, the pilot realised his mistake and left the TMA at 11:57:55 in a south-easterly direction. On leaving the TMA, the flight level was FL93.
- According to his statements, the pilot of HB-SCO had seen the Dash 8 only when it had already crossed his flight path. He further stated: *"I first saw it on my left side. Although I was continuously monitoring the airspace, my attention was primarily directed towards the mountains, in order to observe the weather conditions. Since my aircraft is a low-wing aircraft, it is possible that my view of the Dash 8 was obscured by the right wing."*
- According to their statements, the two ATCOs and the trainee in Sector South/West first became aware of HB-SCO when the short term conflict alert (STCA) system was triggered at 11:55:28. At the time, the two aircraft had a lateral separation of 3.5 NM and an altitude difference of 800 ft. Then, at 11:55:31, RE-S/W immediately issued traffic information to ISK210 with a reference to an unidentified aircraft which was at 11 o'clock and at a distance of 2 NM. On his radar monitor, this aircraft indicated an altitude of FL90.
The FO answered: *"Yeah, we have it in sight and on TCAS, ISK210, merci"*.
- RE-S/W stated that after issuing the traffic information he would have carried out avoiding action if the pilot had not established visual contact with the other aircraft.
- RE-S/W was of the opinion that a conflict between two aircraft which takes place in or starts in Berne or Zurich DEP airspace in principle falls within the responsibility of these units, even if one of the aircraft is on another frequency.
- The coach at DEP stated: *"I was concentrating entirely on my coaching activity and monitored my trainee practically continuously. The radar monitor was also included in my scanning as part of my coaching."*
- According to their statements, the ATCO and the trainee at DEP had not noticed HB-SCO's entry into the Zurich TMA. They first became aware of the aircraft when they were informed of it by colleagues in Sector South-West.
- According to the radar recording, HB-SCO was visible on the DEP radar monitor for approximately 4½ minutes or 7.5 NM prior to the point of closest approach.
- The coach at DEP made the following statement: *"In my opinion it is questionable whether clear responsibility can be assigned in this case, because the VFR traffic was not known to anyone."*
- According to statements by the flight crew of ISK210, weather conditions were good, with good visibility.
- The flight crew of ISK210 indicated that throughout the crossing manoeuvre they had observed HB-SCO on their TCAS unit and maintained visual contact.
- ISK210 received a traffic advisory (TCAS-TA) and a resolution advisory (TCAS-RA) with an instruction to descend. According to his statements, on the basis of visual contact with HB-SCO the CMD interrupted the climb for a short time, as he was approximately 1000 ft below the light aircraft. His intention was apparently to cross the flight path of the other aircraft to the side and below it.

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The CMD also added that even if the VFR pilot had suddenly decided to descend again, no danger would have arisen because of the lateral separation from his own aircraft.

- The CMD further stated that the two aircraft had crossed at a lateral separation of approximately 1 km and an altitude difference of approximately 500 ft. It was therefore not possible for him to read the registration of the other aircraft.
- According to the radar recording, the two aircraft crossed at a lateral separation of approximately 150-200 m and an altitude difference of 200 ft.
- The ATCOs involved classified the incident as high risk.
- The flight crew of ISK210 basically assessed the incident as dangerous.
- The pilots and ATCOs involved were in possession of the necessary licences.
- Weather according to Meteoswiss:

General weather situation:

The centre of an extended high-pressure area was located over central Europe. In a north-westerly upper air current, banks of cloud were drawing a weakened warm front over Switzerland.

Weather conditions in the area of the incident:

Cloud: In places, extended altocumulus banks, in the Basel-Grenchen area the cloud cover was 2-5 eighths and in the central Mittelland (Berne-Altdorf-Zurich) it was 5-7 eighths
The cloud layer was between 11'000 and 13'000 ft/AMSL.

Visibility: In the eastern and central Mittelland, ground visibility (meteorological visibility) was between 10 and 20 km, in the area around Berne visibility was about 30 km.
Above the ground layer, visibility was above 30 km.

Precipitation None

Hazards: None

Evolution of the weather up to midnight: Cloud thinning in the evening, then mostly clear.

QAM according to Skyguide

LSZG 08:50 UTC 17.12.2003

Wind: 050°, 6 knots

Ground visibility: above 10 KM

Cloud: SCT 15'000 FT/GND

Temperature -01°C, dewpoint -04°C

QNH 1027 hPa NOSIG

TAF (Aerodrome forecast)

LSZG 09:00 UTC 17.12.2003

Valid 10:00 until 19:00 UTC

Wind: 050°, 8 knots

Ground visibility: above 10 KM

Cloud: SCT 6'000 FT/GND

- Military firing area LS-D12 SIHLTAL was active from 0800-2300 LT from the ground up to 9850 ft AMSL.

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- At 12:35:09, the pilot of HB-SCO made contact over Gossau SG with Zurich flight information centre (FIC) and transmitted his intended route change via Kreuzlingen – Schaffhausen – Trasadingen – Aarau back to Grenchen.

ANALYSIS

Pilot HB-SCO

At the time of the incident the pilot of HB-SCO was training with Horizon Swiss Flight Academy Ltd to be a commercial pilot (ATPL). However, before he could start IFR training, he had to acquire additional flying hours. On 17.12.03 he therefore planned a flight in HB-SCO from Grenchen to Samedan. He chose Grenchen as his departure point because he was acquainted with the aerodrome, as he had completed his previous training there.

To date, his flying experience from Grenchen in an easterly direction was restricted solely to the Grenchen-Pragelpass route to Wangen Lachen. He had not yet flown any further to the east.

The pilot knew that he would need clearance from air traffic control for a flight into the Zurich TMA. In order to avoid this, he had planned his flight via WIL VOR – Rotkreuz – Arth - Pragelpass – Walensee – Chur – Albula to Samedan, wishing to pass WIL VOR at 5500 ft and consequently fly below the south-western part of the Zurich TMA.

When he passed 7000 ft to the west of WIL VOR and activated the transponder, according to his statement he was not aware that he was already flying higher than he had originally planned. Up to the encounter with ISK210 he had apparently looked at his altimeter several times, though clearly without perceiving the displayed values.

He also stated: *"I can't say why I climbed higher than I intended. My aim was to gain sufficient altitude before reaching the mountains."*

On his customary route towards Pragelpass, he additionally realised that military firing area LS-D12 SIHLTAL was active up to 9850 ft.

This fact had apparently additionally led him to climb earlier than planned, as he knew that his aircraft had poor climbing characteristics and he wanted to fly above the LS-D12 hazard area.

When he encountered ISK210, he realised that something might be wrong. He subsequently became aware that he was already in the Zurich TMA. He then immediately turned his aircraft right in order to leave the TMA as quickly as possible.

Clearly his attention was concentrated so much on the low-lying cloud along the approaching mountains and the still distant military firing area LS-D12 SIHLTAL that he was not able adequately to perform his other tasks such as observing the airspace, monitoring the instruments, etc. His situational awareness was no longer sufficient to detect the airspace violation.

The fact that his aircraft was a low-wing aircraft may have contributed to his view of ISK210 approaching from the right and from below being obstructed by the right wing.

Flight crew ISK210

The FO of ISK210 had already detected another aircraft on his TCAS system at an early stage, though without knowing anything about its flight path. Only after the crew had received traffic information from RE-S/W were they able to verify the location of the aircraft

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(termed an 'intruder' in TCAS terminology) on the TCAS system. The pilots managed to establish visual contact with this aircraft at almost the same time.

The crew of ISK210 estimated that at this point the other aircraft was flying 3000-4000 ft higher and was at a distance of approximately 8 km. According to the radar recording, at this time the DV20 was only approximately 3 NM away from ISK210 and 700 ft higher.

The CMD stated that from this point in time he was able to monitor the flight path of the intruder continuously with visual contact, while the FO continuously checked its flight level on his TCAS unit. As the crew of ISK210 had no further information about the flight path of the other aircraft, the CMD decided to continue climbing to identify the intruder, if this was possible.

This subsequently led to a continuous convergence of the two aircraft.

When ISK210's TCAS system generated a TCAS-TA and shortly after a TCAS-RA with the instruction to descend (RA – descend, descend), the CMD did not obey this instruction. Analysis of the available data showed that the CMD only interrupted the climb shortly before crossing HB-SCO, about 15 seconds after the initial RA, and carried out the impending crossing manoeuvre whilst maintaining visual contact.

According to his statements, the FO lost visual contact with the other aircraft shortly after the TCAS-TA alert. Once the TCAS-RA had sounded shortly after this, however, the CMD kept him constantly informed about the intruder's position. The FO, who was able to follow the crossing manoeuvre only on his TCAS system, relied on the CMD maintaining adequate separation from the other aircraft visually.

The CMD of ISK210 did not manage to determine the registration of the other aircraft, as according to his statements he was primarily concerned with constantly maintaining adequate separation from the other aircraft. He further stated that even if the VFR pilot had suddenly decided to descend further, no danger could have arisen for their aircraft.

However, both pilots asserted in retrospect that if they should ever find themselves in a similar situation, they would definitely try next time to maintain greater separation from the intruder for reasons of safety.

Air traffic control

Berne departure procedures via BERSU

Under an agreement between Berne TWR and Zurich ACC, departures from Berne via BERSU, with a requested cruising altitude of FL120 or higher, were cleared by Berne TWR to FL100 initially. The hand-over to Zurich WEST Sector took place without a hand-over message, provided no further separation problems arose with other traffic in Berne's area of responsibility, but at the boundary of Berne's area of responsibility at the latest.

As far as the ATCOs at Zurich WEST Sector were concerned, these aircraft, which they expected to be climbing, were automatically released for further climb after making contact.

Moreover, it had been agreed between Berne TWR and Zurich ACC in principle to avoid the area of responsibility of Zurich APP/DEP for aircraft climbing with a requested cruising altitude of FL120 and higher on the BERSU – KUDS route. The Zurich WEST Sector ATCOs therefore had to ensure that aircraft passed BERSU waypoint at FL120 or higher. If this was not possible, they had to coordinate these flights with Zurich DEP.

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Berne ATCOs

Berne provides air traffic control service as well as flight information service and alerting service at FL105 and below within a clearly defined airspace between Berne and WIL VOR. This airspace extends north-west as far as Porrentruy and also includes Grenchen CTR. Outside Berne TMA and Grenchen CTR, this region is classified as class E airspace. Air traffic control does not have to provide separation between IFR and VFR flights in class E airspace. However, it is obliged, as far as possible, to issue traffic information.

After leaving Grenchen CTR and until it entered the Zurich TMA, HB-SCO was within this class E airspace delegated to Berne. According to his statements, the ATCO in Berne was not sure whether he had ever seen the VFR aircraft between Grenchen and WIL VOR after the transponder had been activated. He was also of the opinion that after ISK210 had been handed over to Zurich this unit was responsible for any traffic information.

The ATCO had the possibility, as part of his radar scanning, of issuing traffic information to ISK210 until it had definitively left his airspace.

However, the ATCO was on his own in the control tower and had to handle arrivals and departures as well as performing the other duties in the control tower (aerodrome control, ground control, duty manager, weather observer, etc.).

On the basis of the scope of these tasks, it is apparent that a single ATCO cannot carry out supervision of air traffic on his radar monitor with the same intensity as when the work in the control tower is being carried out by 2 ATCOs.

Nor was an STCA alert available to the ATCO, as Berne airspace from the ground to FL105 is permanently classified as an "STCA suppression area".

STCA suppression areas are airspaces in which the triggering of STCA alerts is suppressed by technical means, temporarily or permanently.

Zurich Sector South/West ATCOs

Because of their area of responsibility, the ATCOs in Sector S/W had set up their radar monitor by default so that they were able to see all information (aircraft call signs/altitude, etc.) on aircraft with activated transponders in the altitude range between FL105 and FL245. Known aircraft from other airspaces which wished to enter their area (e.g. ISK210) were also fully visible on the basis of addressing.

Aircraft outside their area with activated transponders (e.g. HB-SCO) were shown on the radar monitor only as an aircraft symbol, but without any further information. Such aircraft symbols (above all of VFR flights) are often present in large numbers in the area between Zurich and Berne.

The ATCO is able to display the data on these aircraft on his radar monitor using the quicklook key.

RE-S/W had a Saab2000 to Palma de Mallorca on the frequency; it had taken off shortly before from Zurich and was flying direction Berne. The ATCO instructed this crew to climb to FL230 and to maintain a rate of climb of 2000 ft/min or more until they had passed FL150. RE instructed ISK210, which had taken off from Berne, to climb to FL140 and to maintain a rate of climb of max. 1500 ft/min. These measures allowed RE-S/W to ensure that vertical separation was permanently maintained between the two aircraft which were climbing in opposite directions.

According to the radar recording, it was apparent that in the subsequent few minutes ISK210 maintained an average rate of climb of 650 ft/min.

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RE-S/W realised that at this rate of climb ISK210 would not reach the required altitude of FL120 at the boundary with Zurich DEP airspace. He then coordinated with DEP-ATCO. The latter approved ISK210's climb through his airspace.

HB-SCO, which was flying from Grenchen direction WIL VOR and which activated transponder code A7000 at 11:49, was visible to RE-S/W on his radar monitor as a symbol in the form of a "U". However, according to RE's statements, he did not attribute great importance to U-shaped symbols at FL105 and lower, as he was of the opinion that any impending conflict inside this airspace would fall within the responsibility of Berne or Zurich DEP respectively, even if one of the aircraft was on his frequency.

According to their statements, both RE-S/W and RP-S/W and his trainee had first noticed HB-SCO when they received an STCA alert. RE then immediately issued ISK210 with traffic information.

RE-S/W also stated that he would have carried out avoiding action with ISK210 if the crew had only had TCAS information, without visual contact with the other aircraft.

Zurich Departure ATCOs

The coach at the DEP workstation was having to handle an average volume of traffic with his trainee. The coach stated that he had been devoting his entire attention to his coaching activity.

According to his statements, the radar image was set up to that the entire DEP airspace was visible. As a rule, the setting was performed individually. At the time, it corresponded to the trainee's needs. The latter also stated that the range of altitudes between 2000 ft and FL180 had been set and that the western limit of the image setting was approximately 2-3 NM to the west of WIL VOR.

The ATCO and the trainee stated that they had never seen HB-SCO on their radar monitor. Apparently they had first become aware of this aircraft after the Sector S/W coach had informed them of the incident after it had taken place.

On the basis of the DEP image setting, HB-SCO, up to the point at which it crossed ISK210, must have been visible on the DEP radar monitor for approximately 4½ minutes or 7.5 NM with its activated transponder.

Radar was available without any limitations. The ATCO and the trainee stated that the technical systems were functioning normally.

It must therefore be assumed that the way both the DEP ATCO and the trainee divided their attention as part of normal radar scanning was deficient and that this is why they were not aware of the incident which was obviously taking place at the edge of the radar image they had set.

The coach also stated that he was basically of the opinion that the DEP airspace occupied by ISK210, once coordination had taken place, was delegated to Sector S/W. In addition, he said it was questionable in the present case, given that the VFR aircraft was unknown, whether clear responsibility could be attributed.

In this context, it should be noted that the DEP ATCO only cleared ISK210 to fly through his airspace for the ATCO at Sector S/W, but had not delegated the entire airspace. Consequently, DEP, even after coordination had taken place, continued to be responsible for the conflict-free passage of ISK210 through his airspace, until the climbing aircraft had left the area for which he was responsible.

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ACAS II /TCAS II

In document ACAS II SARPS (Standards And Recommended Practices), the ICAO (International Civil Aviation Organisation) has laid down the requirements for an on-board collision avoidance system functioning between the aircraft concerned. The TCAS II Version 7 installation (hereinafter designated 'TCAS') is the only one capable of the performance required in the above-mentioned document. The operation of TCAS is based on a calculation of the time remaining until the so-called closest point of approach (CPA). The time up to the closest point of approach is termed 'tau' (time-to-go to the closest point of approach). In the course of a convergence, a traffic advisory (TA) is generally issued first; it informs the crew of possible impending avoiding action and allows them to prepare accordingly. In a second phase, a resolution advisory (avoiding instruction, RA) is issued; a distinction is made between preventive RAs and corrective RAs, depending on the magnitude of the calculated vertical separation at the CPA. Minimum separations to be achieved after complying with TCAS advisories are laid down by means of different sensitivity levels for 7 altitude ranges. Both TAs and RAs are communicated to the crew both acoustically and visually by an amber display for TAs or a red display of the intruder for RAs. Once every second, the TCAS computers recalculate the current progress of the approach and the effectiveness of the avoiding action; there is the possibility, depending on crew reactions, that an advisory will be strengthened (strengthening RA), weakened (weakening RA) or even that its avoiding action will be reversed (reversal RA).

The case of the incident reconstructed below is one involving one aircraft equipped with TCAS II and one equipped with only a Mode C transponder. The TCAS of ISK210 was at sensitivity level 5 (altitude range from 5'000 ft to 10'000 ft, above the hysteresis/buffering limit of 5'500 ft), which respectively required a minimum altitude difference of 600 ft (ZTRH) for a preventive RA and a minimum altitude difference of 350 ft (ALIM) for a corrective RA.

A reconstruction of the warnings and avoiding actions issued by the TCAS produced the following results:

- The TCAS on board ISK210 issued a traffic advisory (TA) at 11:56:05, i.e. 40 seconds before the calculated closest point of approach. This traffic advisory was communicated to the pilots as an acoustic warning in the cockpit with the call-out '*traffic traffic*', accompanied by an amber display of the intruder on the TCAS display.
- At 11:56:20, i.e. 25 seconds before the closest point of approach, climbing at a rate of climb of approximately 800 ft/min, still 400 ft below HB-SCO, the TCAS issued the avoiding action instruction '*descend descend*'.
- Since the crew of ISK210 did not comply with this instruction and continued to climb, a few seconds later the TCAS computer must have issued a strengthening RA: '*increase descend, increase descend*'.
- This resolution advisory was then issued without interruption for about 20 seconds, both acoustically and visually on ISK210's TCAS display.
- After the two aircraft had crossed at 11:56:45 and ISK210's TCAS had detected an increasing separation both laterally and vertically, '*clear of conflict*' was issued by the TCAS as a conclusion to the procedure.

The TCAS had performed its function and warned the crew of ISK210 in good time by means of a traffic advisory and shortly afterwards by a resolution advisory, so that safe vertical avoiding action by ISK210 would have been possible. It is a key component of the TCAS philosophy that a resolution advisory must be obeyed immediately in every case, even if there is visual contact with the intruder. If there is visual contact, such as that maintained by

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the crew of ISK210, it is not always certain whether the visually observed aircraft is the one which is triggering the TCAS instruction or whether it is in fact another aircraft not detected by TCAS because it is not equipped with an activated transponder. A resolution advisory must be obeyed in all cases until the TCAS computer signals, by means of the clear of conflict message, an increasing separation between the aircraft and hence an amelioration in the situation. Deliberate non-compliance with a resolution advisory until the clear of conflict message, as occurred in this case, is a violation of the principle of conflict avoidance.

CAUSE

The incident is attributable to the fact that:

- the pilot of HB-SCO entered the Zurich TMA without clearance.

The following factors contributed to this:

- air traffic control was late in noticing the convergence of the two aircraft in their airspace.
- the crew of ISK210, after recognising the conflict situation, continued to approach the other aircraft in a dangerous manner with the aim of determining its registration.

SAFETY RECOMMENDATIONS

Safety deficit

On 17 December 2003, aircraft HB-SCO took off under visual flight rules from Grenchen aerodrome and flew east. At the same time a scheduled flight, ISK210, which had taken off in Berne, was climbing in a north-easterly direction. The two aircraft converged dangerously in the Zurich TMA, so that the STCA of the ATCO's radar in Zurich ACC's Sector S/W triggered an alert. Despite a TCAS-RA, the scheduled flight continued to approach HB-SCO, in order to determine its registration.

- After leaving Grenchen CTR up to entering the Zurich TMA, HB-SCO was within class E airspace delegated to Berne. According to his statements, the ATCO in Berne was not sure whether he had ever seen the VFR aircraft between Grenchen and WIL VOR after the transponder had been activated. He was also of the opinion that after ISK210 had been handed over to Zurich this unit was responsible for any traffic information.
- HB-SCO, which was flying from Grenchen direction WIL VOR and which activated transponder code A7000 at 11:49, was visible to the Zurich ATCO (RE-S/W) on his radar monitor as a symbol in the form of a "U". However, according to his statements, he did not attribute great importance to U-shaped symbols at FL105 and lower, as he was of the opinion that any conflict which threatened inside this airspace would fall within the responsibility of Berne or Zurich DEP respectively, even if one of the aircraft was on his frequency.
- The Zurich Departure coach stated that he was basically of the opinion that the departure airspace occupied by ISK210, once coordination had taken place, was delegated to Zurich Sector S/W. In addition, he said it was questionable in the present case, given that the VFR aircraft was unknown, whether clear responsibility could be attributed.

As the statements made by the ATCOs indicate, they were not clear about the allocation of tasks and responsibilities.

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Safety recommendation No. 370

The Federal Office for Civil Aviation should verify:

- whether the allocation of tasks and the responsibilities of ATCOs in Switzerland are defined uniformly and so as to exclude any doubt.
- whether the training and further training of ATCOs is being implemented in sufficient detail in this regard.

Safety deficit

On 17 December 2003, aircraft HB-SCO took off under visual flight rules from Grenchen aerodrome and flew east. At the same time a scheduled flight, ISK210, which had taken off in Berne, was climbing in a north-easterly direction. The two aircraft converged dangerously inside the Zurich TMA, so the STCA of the ATCO's radar in Zurich ACC's Sector S/W triggered an alert.

When ISK210's TCAS system triggered a TCAS-TA and shortly after a TCAS-RA with the instruction to descend (RA – descend, descend), the CMD did not obey this instruction. Analysis of the available data showed that the CMD only interrupted the climb shortly before crossing HB-SCO, about 15 seconds after the initial RA, and conducted the impending crossing manoeuvre with visual contact.

During several AAIB investigations it has become apparent that pilots' knowledge of TCAS is deficient.

Safety recommendation No. 371

The Federal Office of Civil Aviation should ensure that pilots' training and knowledge of TCAS meets the requirements.

Berne, 9 March 2006

Aircraft Accident Investigation Bureau

This report has been prepared solely for the purpose of accident/incident prevention. The legal assessment of accident/incident causes and circumstances is no concern of the incident investigation (Art. 24 of the Air Navigation Law). The masculine form is used in this report regardless of gender for reasons of data protection

All times in this report follow the UTC format (local time –1 hour)

Responsibility and division of air traffic control Zurich

Area control centre (ACC) Zurich and approach control office (APP) Zurich/Berne/Basle are responsible for the airspace of air traffic control Zurich.

The airspace of ACC Zurich from the lower boundary up to FL245 is subdivided into four geographically defined lower sectors:

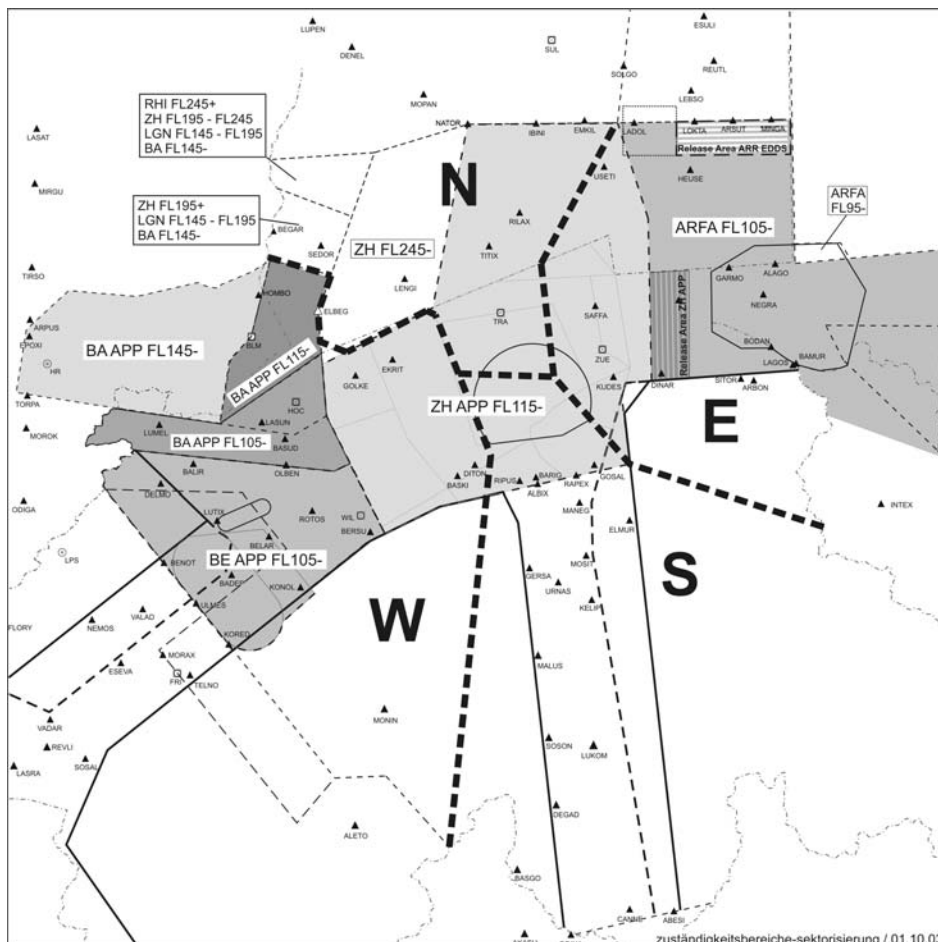
Sectors	SOUTH (S)	NORTH (N)
	EAST (E)	WEST (W)

The lower limit of these sectors above the airspace of Zurich approach is determined at FL115, above the airspace of Berne APP at FL105 and above the airspace of Basle APP at FL105 or FL115, respectively at FL145.

The sector ARFA with an upper limit of FL105 is situated within the sector EAST.

Depending of the expected traffic amount the responsibility of one or more sectors can be delegated or taken on other sectors.

Map showing areas of responsibility ACC Zurich – lower sectors and approach control office Zurich/Berne/Basle



**TRANSCRIPT OF TELEPHONY
OR RADIOTELEPHONY COMMUNICATION TAPE-RECORDINGS**

Investigation into the **incident** that occurred on **17.12.2003**

- Subject of transcript:	HB-SCO / ISK210
- Centre concerned:	Swiss Radar Area East
- Designation of unit:	Radar Lower Sector West/South
- Frequency / Channel:	135.675 MHz
- Date and period (UTC) covered by attached extract:	17.12.2003 11:50 - 12:11 UTC
- Date of transcript:	30th December 2003
- Name of official in charge of transcription:	Claudio DI PALMA

- Certificate by official in charge of transcription:

I hereby certify:

- That the accompanying transcript of the telephony or radiotelephony communication tape-recordings, retained at the present time in the premises of the Analysis Department, has been made, examined and checked by me.
- That no changes have been made to the entries in columns 2, 3 and 4, which contain only clearly understood indications in their original form.

Zürich, 30th December 2003

Claudio DI PALMA

Abbreviations

Sector Designation of sector

W RE - Radar Lower Sector West/South
 T W RE - Telephone Executive Controller Lower Sector West/South
 T W RP - Telephone Radar Planner Lower Sector West/South
 T APW - Telephone Executive Controller Arrival Sector West
 T DEP - Telephone Executive Controller Departures
 T CAP - Telephone Approach Co-ordinator

<u>Aircraft</u>	-	<u>Callsign</u>		<u>Type of acft</u>	<u>Flight rules</u>	<u>ADEP</u>	-	<u>ADES</u>
210	-	ISK210	Intersky	DH8C	IFR	LSZB	-	LOWW
215B	-	SWR215B	Swiss	SB20	IFR	LSZH	-	LEPA
400	-	SWR400	Swiss	RJ1H	IFR	LSZH	-	EIDW
4477	-	IBE4477	Iberia	MD87	IFR	LSZH	-	LEBL
74AY	-	SWR74AY	Swiss	A320	IFR	LSGG	-	LSZH
K41	-	OVAK41	Aero Nova	SW4	IFR	EKCH	-	LFLS
054D	-	SWR054D	Swiss	A319	IFR	LSZH	-	LEBL

OZEO-dc / 30th December 2003

TRANSCRIPT SHEET

Occurrence: HB-SCO / ISK210 of 17.12.2003



To	From	Time	Communications	Observations
<u>Col.1</u>	<u>Col.2</u>	<u>Col.3</u>	<u>Col.4</u>	<u>Col.5</u>

Coupled Frequencies: 135.675 MHz Radar Lower Sector West/South

W RE	210	11:50:56	Swiss Radar "schöne guete Mittag mitenand" Intersky two one zero, five zero climbing one hundred on course RAMOK	
210	W RE	11:51:03	Intersky two one zero Swiss Radar "guete Mittag" identified, I call you for higher short	
W RE	215B	:39	Radar good morning Swiss two one five Bravo climbing flight level one two zero	
215B	W RE	:43	Swiss two one five Bravo Swiss Radar good morning identified climb to level two three zero keep a rate of two thousand or more until out of one five zero please	
W RE	215B	:52	Recleared flight level two three zero, two thousand or more until one five zero Swiss two one five Bravo	
210	W RE	11:52:01	Intersky two one zero climb to level one four zero maximum rate äh... of climb one thousand five hundred	
W RE	210	:08	Intersky two one zero climbing level one four zero and the maximum rate is fifteen hundred or less	
400	W RE	:26	Swiss four hundred climb to level two four zero	
W RE	400	:29	Climb level two four zero Swiss four hundred	
4477	W RE	:33	Iberia four four seven seven contact Swiss Radar one two eight decimal niner bye-bye	
W RE	4477	:38	One two eight decimal nine Iberia four four seven seven bye-bye	
400	W RE	11:53:02	Swiss four hundred fly direct to Rolampont	
W RE	400	:04	Direct Rolampont Swiss four hundred "danke"	
210	W RE	:17	Intersky two one zero when passing level one one zero fly direct to BAMUR	
W RE	210	:22	When passing level one hundred direct BAMUR Intersky two one zero "merci"	
210	W RE	:26	When passing one one zero	

Signature of person
in charge of transcription :

TRANSCRIPT SHEET

Occurence: HB-SCO / ISK210 of 17.12.2003



To <u>Col.1</u>	From <u>Col.2</u>	Time <u>Col.3</u>	Communications <u>Col.4</u>	Observations <u>Col.5</u>
W RE	210	11:53:28	Ah okay one one zero Intersky two one zero	
W RE	74AY	:31	"Radar guete Tag" Swiss seven four Alfa Yankee level one six zero	
74AY	W RE	:36	????? station calling say again	unreadable, could be "last"
W RE	74AY	:39	Swiss seven four Alfa Yankee level one six zero	
74AY	W RE	:42	Seven four Alfa Yankee Swiss Radar "guete Tag" identified follow BERSU three Echo arrival, high speed approved	
W RE	74AY	:47	"Dankeschön" BERSU three Echo arrival Swiss seven four Alfa Yankee	
400	W RE	11:54:21	Swiss four hundred contact Reims one three four decimal four	
W RE	400	:24	One three four four "schöne Mittag" Swiss four hundred	
400	W RE	:27	"Merci gliichfalls"	
215B	W RE	:42	Swiss two one five Bravo rate of climb now at own convenience	
W RE	215B	:46	Roger two one five Bravo	
K41	W RE	:56	Oscar Victor Alfa Kilo four one fly direct to BENOT descend to level one seven zero	
W RE	K41	11:55:01	XXXXXX and level descending flight level one seven zero XXXXX four one	unreadable
W RE	054D	:08	"Züri Radar" Swiss zero five four Delta "grüessech" level one zero eight climbing level one two zero	
054D	W RE	:15	Swiss five four Delta Swiss Radar "guete Morge" identified climb to level one six zero	
W RE	054D	:20	Climb level one six zero Swiss zero five four Delta	
210	W RE	:31	Intersky two one zero I've unidentified äh... traffic at your eleven o'clock distance two miles at I'm reading level niner zero	

Signature of person
in charge of transcription :

TRANSCRIPT SHEET

Occurrence: HB-SCO / ISK210 of 17.12.2003



To <u>Col.1</u>	From <u>Col.2</u>	Time <u>Col.3</u>	Communications <u>Col.4</u>	Observations <u>Col.5</u>
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W RE	210	11:55:40	Yeah we have it in sight and on TCAS Intersky two one zero "merci"	
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210	W RE	:44	Roger	
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- end -

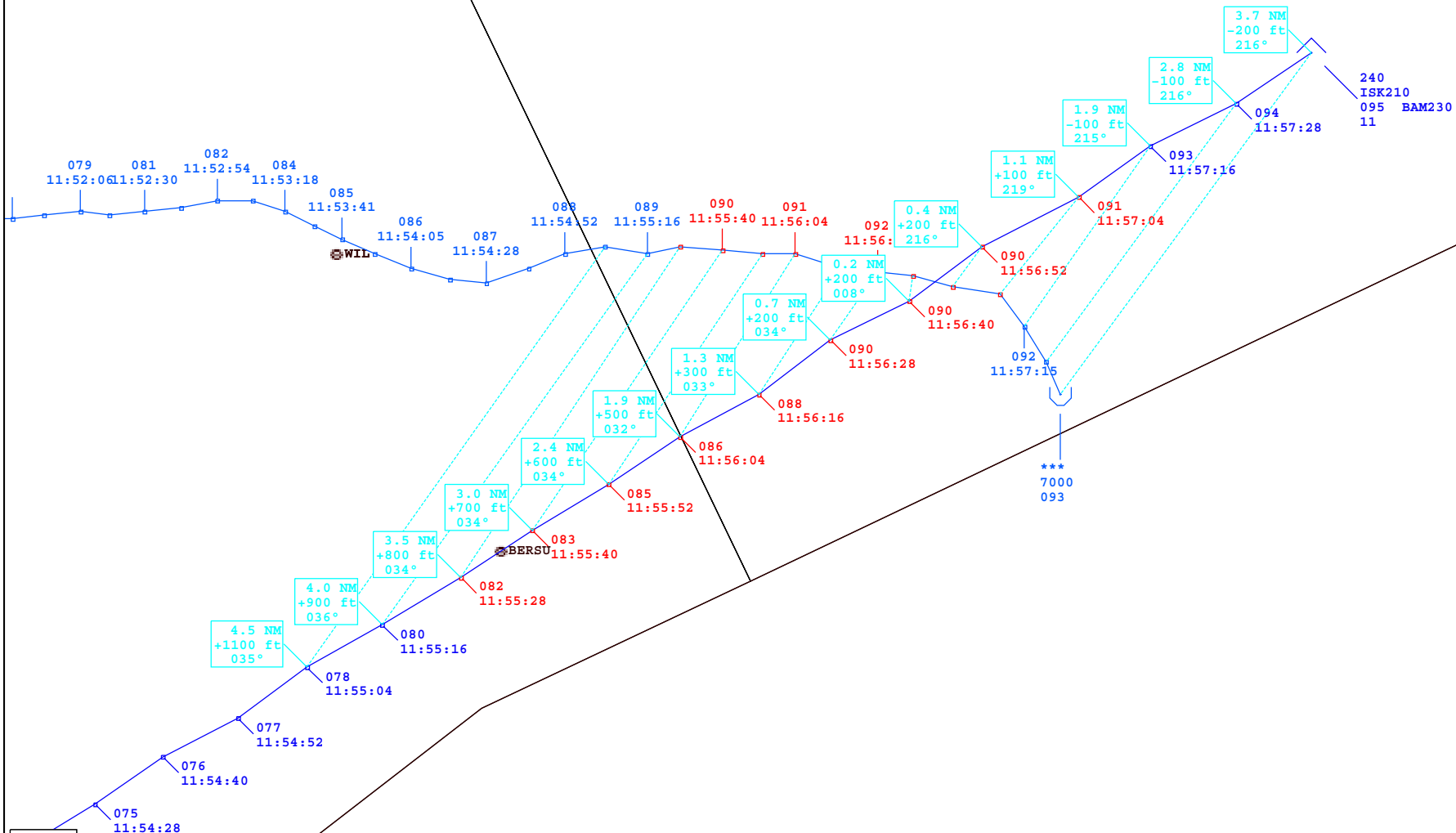
Signature of person
in charge of transcription :

Src
ACN

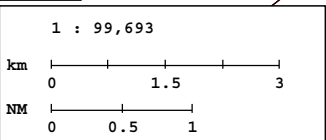
Analysis: airprox HB-SO / ISK210 Time [UTC]: 17.12.2003 11:57:47



TRIENGEN



7000
093



Name: Claudio Di Palma OZEO-dc Eval Date: 18.12.2003