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Aircraft Accident Investigation Bureau AAIB

Final Report No. 1976 by the Aircraft Accident Investigation Bureau

concerning the serious incident (near collision/AIRPROX)
between the Boeing 737-436 aircraft, registration G-DOCE
operated by British Airways under flight number BAW 2751
and the Boeing 737-330 aircraft, registration D-ABXO
operated by Lufthansa under flight number DLH 87A

on 28.03.2006

13 NM SW DVOR HOC

General information on this report

This report contains the AAIB's conclusions on the circumstances and causes of the accident/serious incident which is the subject of the investigation.

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident 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 prevention, due consideration shall be given to this circumstance.

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

All times mentioned in this report, unless otherwise indicated, follow the coordinated universal time (UTC) format. At the time of the accident, Central European Summer Time (CEST) applied as standard time (local time – LT) for the region of Switzerland. The relation between LT, CEST and UTC is: $LT = CEST = UTC + 2 \text{ h}$.

For reasons of protection of privacy, the masculine form is used in this report for all natural persons, regardless of their gender.

Final Report

Aircraft	BAW 2751, G-DOCE, Boeing 737-436 British Airways, plc
	Zurich (LSZH) – London Gatwick (EGKK)
	Type of operation: IFR, scheduled flight
	DLH 87A, D-ABXO, Boeing 737-330 Deutsche Lufthansa AG
	Frankfurt (EDDF) – Bilbao (LEBB)
	Type of operation: IFR, scheduled flight

Crews	BAW 2751 CMDR FO
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	DLH 87A CMDR FO
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Location	13 NM SW DVOR HOC
Date and time	28.03.2006, 09:46 UTC

ATC unit	Upper Area Control Centre (UAC) Switzerland UAC East, Sector M2
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Air traffic controllers	Radar Executive M2 (RE-M2) Radar Planner M2 (RP-M2)
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Airspace	C
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1 History

1.1 History of the flight

On the morning of 28 March 2006 a British Airways B737-436, callsign BAW 2751, took off from Zurich on a scheduled flight to London Gatwick. The planned departure route was via VEBIT – LASUN – LUMEL – TORPA. The desired flight level was specified in the ATC flight plan as FL 360.

At 09:39:49 UTC, the crew of BAW 2751 reported to Zurich Lower Sector West. At this time the aircraft was approximately 10 NM south-west of Zurich airport and was approaching the cleared flight level of FL 120. The Radar Executive West (RE-W) air traffic controller (ATCO) cleared the crew to climb to FL 240 on condition that they maintained a rate of climb of at least 2500 ft/min. Flight level FL 240 and the TORPA transfer point were coordinated with Reims air traffic control (ATC) after the aircraft took off.

In view of BAW 2751's high rate of climb, the Radar Planner West (RP-W) coordinated a further climb to FL 280 with Reims ATC. After the ATCO in Reims had accepted this flight level, the RP-W also obtained the agreement of Zurich Sector Upper (U), which was responsible for flight levels between FL 246 and FL 285.

At 09:40:29 UTC, the RE-W cleared the crew of BAW 2751 to climb to FL 280 and shortly afterwards cleared them direct to waypoint TORPA. After passing waypoint VEBIT, the crew were informed at 09:42:05 UTC with the words "*Rate of climb is yours*" that the condition for the rate of climb had been cancelled. They were then instructed to contact Reims ATC on the frequency 134.400 MHz.

The Lufthansa Boeing 737, callsign DLH 87A, was on a scheduled flight from Frankfurt to Bilbao. ATC had assigned to the flight the secondary surveillance radar (SSR) code 6002. In the ATC flight plan, the crew had specified the route HERBI - Y164 - OLBEN - UN869 - MILPA for the transit flight through UAC Switzerland. At 09:34:35 UTC, the crew reported at FL 310 to Zurich Sector M2, which was responsible for the flight levels between FL 285 and FL 325. The Radar Executive (RE-M2) ATCO cleared the crew for the route OLBEN – BENOT and about four minutes later cleared them direct to BENOT. At this time, the aircraft was approximately 35 NM of DVOR HOC. When the aircraft was approximately 6 NM west of HOC, the RE-M2 instructed the crew of DLH 87A to contact Geneva ATC on the frequency 132.315 MHz.

At 09:44:21 UTC, the crew of DLH 87A reported to UAC West Upper Sector K2 in Geneva and were cleared direct to waypoint MEBAK.

At 09:42:16 UTC, the crew of BAW 2751 reported to Reims Sector UH: "*Reims, bonjour, BAW 2751 climbing level 280, direct TORPA*". At this time, Sector UH was coupled with Sector UX and occupied by a radar controller, a trainee on radar and a planning controller.

Shortly afterwards, at 09:43:26, Reims issued the following clearance: "*BAW 2751, continue present heading, climb level 320 initially*". The crew of BAW 2751 confirmed the clearance and the heading of 275°. At this time the aircraft was

still within the area of responsibility of Zurich ATC, passing FL 225 and some 16 NM from the Line of Responsibility (LoR) between Zurich ATC and Reims ATC. According to the radar recording, the rate of climb was approximately 3000 ft/min.

Shortly after BAW 2751's call, the Reims ATC air traffic controller enquired by telephone of the Zurich RP-U whether he could give BAW 2751 clearance for a direct flight to beacon RLP. At the same time he also asked whether BAW 2751 was cleared to continue its climb. The RP-U ATCO in Zurich gave his agreement for the direct flight to RLP and confirmed the flight level of FL 280 which had already been coordinated, without dealing with the question relating to the continued climb.

The RE-M2 ATCO later stated that shortly after he had handed DLH 87A over to Geneva he had seen BAW 2751, indicating FL 293, below it. He stressed that Sector M2 had not issued any clearance for this aircraft to climb. *"On the basis of virtually daily events of this kind, I relied on the aircraft flying a level-off at FL 300"*, explained the RE-M2 ATCO. Shortly afterwards, he realised that BAW 2751 was continuing to climb and was passing FL 300.

In summary, the statement by the CMDR of BAW 2751 concerning the history of the flight can be reiterated as follows:

After the hand-over to Reims ATC the crew received clearance to climb to FL 320. Since the B737 was relatively light, the rate of climb was 4000 ft/min; this would have been maintained until FL 320 was reached. Approximately when passing FL 280, the TCAS reported a traffic alert (TA) and the FO, who was pilot flying, immediately reduced the rate of climb to 500 ft/min. According to the crew's statement, the visibility conditions were good and they realised that DLH 87A was at FL 310 and would cross their flight path from right to left. When BAW 2751 was approaching FL 300, the crew reduced the rate of climb to 100 ft/min. The CMDR also stated: *"The other aircraft passed directly overhead as we passed FL 300. The vertical clearance was probably around eight hundred feet, maybe slightly more. The horizontal clearance was nil"*. After the aircraft crossed, the crew of BAW 2751 asked Reims ATC about the cleared flight level. Reims ATC confirmed the clearance for a climb to FL 320.

The comments of the FO corresponded to those of the CMDR.

The radar recording showed the two aircraft at the same altitude after they had crossed, with a lateral separation of 3.5 NM.

On an enquiry from the Geneva Upper Sector K2 ATCO, on whose frequency DLH 87A was at this time, the crew, according to the radio recording, reported a TA and confirmed visual contact with the aircraft concerned.

The crew of DLH 87A later recalled no irregularities at the time of the serious incident.

1.2 Weather analysis according to MeteoSwiss

General weather situation

An active cold front had reached Switzerland in the night. The perturbation moved south-east only slowly and determined the weather over all of Switzerland, with humid and gradually colder air masses. In the course of the day, further cold air at altitude reached the Alps, triggering further showers.

Conclusion

On the basis of the available information, it is possible to conclude that the weather conditions at the time of the serious incident were as follows:

Cloud: The cloud ceiling in this region would have been at approximately FL 160. Isolated cumulus with high tops cannot be excluded.

Weather: -

Visibility: over 30 km

*Wind FL 240, approx. 220 degrees at 60 kt
FL 310, approx. 230 degrees at 75 kt*

*Temp./dewpoint: FL 240, -38°C / -52°C
FL 310, -55°C / -66°C*

METAR Zurich according to MeteoSwiss

LSZH280950z 19009KT -RA FEW009 SCT018 BKN032 07/06 Q1010 NOSIG

1.3 ATC Zurich operating regulations

The operating regulations for ATC Zurich were laid down in the ATMM ZC Volume 2 ATC MANUAL. The following regulations and procedures were applicable to this serious incident.

1.3.1 Procedures adjacent centres / Reims

According to point 1 of these regulations, the Line of Responsibility (LoR) between Zurich ATC and Reims ATC for a take-off from Zurich on the LASUN – TORPA route was 11 NM W HOC. (See Annex 1)

Flights departing Zurich and landing UK (United Kingdom) were listed under point 6.2 and were cleared on the LASUN – TORPA (UT10) route.

Normally, flights departing Zurich were cleared to FL 240.

The transfer of aircraft was regulated under point 9. For flight BAW 2741 via G4/UG42 the transfer had to take place 19 NM W HOC at the latest.

1.3.2 Area of responsibility and sectorisation

In this section, the responsibilities of the ATC sectors were listed under point 3 and point 4:

Sector West: up to FL 245
Sector U: from FL 246 to FL 285
Sector M2: from FL 286 to FL 325

(for chart see Annex 1)

1.3.3 Procedures adjacent centres / Geneva

The transfer of aircraft was regulated under point 9:

Transfer of Communication

The transfer of communication to the adjacent centre shall be made as early as practicable but not later than the line of responsibility.

1.3.4 Procedures adjacent centres / RHINE

In section 8 Radar Procedures, Pt. 8.2 included also the application of SSR Codes:

SSR codes

The use of ORCAM codes is compulsory

1.3.5 ATS Route Network (ARN)

Point 3 of this section lists the routes for those flights which were in transit through the Zurich ATC area of responsibility. It was a requirement that flights be equipped with RNAV.

The following routing applied to flight DLH 87A:

NATOR - UN869 - OLBEN - BENOT - VEROX

2 Analysis

2.1 Transfer of Communication und Transfer of Responsibility

After the frequency change, both DLH 87A and BAW 87A were given clearances by the ATC units which were taking over, even though the two aircraft were not yet in the airspace of their area of responsibility.

The transfer of an aircraft to the frequency of the next control unit must not be equated with a simultaneous clearance for changes in altitude or heading to the ATC unit which is taking over. In the agreements between air traffic control units, a distinction is therefore made between transfer of communication and transfer of responsibility.

2.2 Flight path and coordination of DLH 87A

The RE-M2 had initially instructed DLH 87A to follow the published OLBEN – BENOT route, which was also specified in the ATC flight plan. The clearance which was subsequently issued for a direct flight to BENOT took the aircraft approximately 6 NM west of HOC, whereas routing via OLBEN would have taken it somewhat to the east of HOC. The distance to the Line of Responsibility (LoR) between Zurich ATC and Reims ATC was about 5 NM. When DLH 87A was abeam of HOC, the crew were instructed to make radio contact with ATC Geneva. This corresponded to the procedures agreed with Geneva ATC. When the Zurich Sector M2 ATCO became aware of the conflict, he no longer had the possibility of coordinating with Geneva because of a shortage of time. This meant that the crew of DLH 87A could not be made aware of the conflict.

On its first call, Upper Sector K2 in Geneva cleared DLH 87A direct to MEBAK. This resulted in a heading change of approximately 18 degrees to the right. As a result, the flight path of DLH 87A briefly approached the LoR between Reims ATC and Zurich ATC, which in this area runs 11 NM to the west of HOC and which at a point approximately 15 NM SW HOC runs in a westerly direction to the national frontier. The serious incident took place in this corner of the LoR (see Annex 1).

Geneva ATC had not obtained agreement from Zurich Sector M2 for DLH 87A's direct flight to MEBAK, even though the flight was still within Zurich ATC's area of responsibility. Consequently Zurich ATC was not able to inform Reims ATC of the flight path of DLH 87A. This would have been necessary in view of the flight path, which briefly extended as far as the boundary with the Reims ATC area of responsibility.

2.3 Flight path and coordination of BAW 2751

The flight path of BAW 2751 ran via waypoint VEBIT und then, according to the instruction from the RE-W, directly to waypoint TORPA. After the aircraft had taken off, this waypoint, as well as the flight level of FL 240, had been coordinated with Reims ATC in accordance with procedures. According to the radar recording, the high rate of climb of the Boeing 737 was visible at an early stage. About six minutes after take-off, the aircraft was already passing FL 180.

The RP-W coordinated FL 280 as a new transfer altitude with Reims ATC; this was accepted by this unit. Coordination of this flight level was appropriate.

2.4 ATC Reims aspects

The crew of BAW 2751 was instructed by Zurich ATC at an early stage, shortly after passing waypoint VEBIT, to change to the Reims ATC frequency. This corresponded to the agreement between Zurich ATC and Reims ATC, which merely states in this context the latest point at which the frequency change must take place.

According to the statement by the radar controller in Reims, the flight path of DLH 87A, with transponder code 6002, was not shown on his radar screen. Only after the crew of BAW 2751 had reported crossing DLH 87A did he select the "Autres Codes" (other codes) key, but even then he was not immediately able to locate code 6002. In any event, it would have been too late for an intervention, as at this time the two aircraft had already crossed.

In their work, the ATCOs in Reims relied mainly on the radar display.

The transponder code 6002 of DLH 87A was normally not shown on the radar display. Apparently, the controllers in Reims had been misled, as a result of the non-representation of DLH 87A, into clearing BAW 2751 for an early, continuous climb, even outside their area of responsibility. In doing so, they may possibly not have taken into account the extraordinarily high rate of climb of the aircraft.

The Reims planning controller later stated that he had relied excessively on the information from the radar display and that code 6002 was not displayed. A clearance by Zurich Sector M2 for BAW 2751's continued climb to FL 320 would have been necessary.

Assignment of SSR Codes

The Assignment of SSR-codes by ATC is made according to *ORCAM (Originating Region Code Assignment Method)*. This assignment assures that within a specified region the same code is assigned only once. To flight DLH 87A the code 6002 had been assigned by ATC. This code should not have been used for a flight from Frankfurt to Bilbao. In France are, according to ATC Reims, the code numbers 60xx reserved for flights inbound to military airfields. In order not to present unnecessary data on the radar screen in sector UH these code numbers were normally not shown. However all flights corresponding with ORCAM were displayed even outside their area of responsibility.

Only by selecting the button «Autre Codes» flights with codes numbers 60xx were displayed in sector UH.

The investigation could not find out who assigned the Code 6002 to DLH 87A.

2.5 TCAS aspects

DLH 87A was in level flight at FL 310. BAW 2751 was below the flight level of DLH 87A and climbing at a high rate of climb, at which point the two flight paths crossed.

At the time of the serious incident, the ACAS II of the two aircraft concerned were equipped with the current software version 7.0.

The TCAS trigger values for this convergence geometry were as follows:

- TA: 48 seconds before the closest point of approach (CPA) at a calculated vertical separation at the CPA of <700 ft.
- RA: 25 seconds before CPA at a calculated vertical separation at the CPA of <600 ft, if one of the two aircraft is in level flight. If both aircraft are climbing or descending, the trigger value is 35 seconds.

In the case of a convergence geometry corresponding to the present situation, the ACAS II issues a TA (traffic advisory) 48 seconds before the calculated closest point of approach (CPA). In order to prevent the premature issue of an RA (resolution advisory) and to avoid false alarms, in situations in which one aircraft is in level flight and the other is climbing or descending, the ACAS II, for the aircraft in level flight, works with a reduced time before the triggering of a resolution advisory. This reduction of the time between the triggering of the RA and the point at which the CPA is reached is intended to allow the ACAS II to detect a level-off (transition to level flight) by the aircraft which is climbing or descending 1000 ft below or above the aircraft which is in level flight without triggering an RA (topic: "*1000 ft separation level-off encounters*"). In the band between 20,000 ft and 42,000 ft, this reduced time is 25 seconds, i.e. an RA is not issued until 25 seconds before the closest point of approach.

According to the crew's statement, the ACAS II on BAW 2751 issued a TA during the climb when passing FL 280. Given a rate of climb of approximately 3500 ft/min, this would have occurred fairly precisely 48 seconds before the CPA. As a result of the rapid reduction in BAW 2751's rate of climb due to the triggered TA, the calculations of the two aircrafts' ACAS II computers, performed within one second, meant that at the closest point of approach there would be a vertical separation which corresponded to the minimum altitude difference of 600 ft (ALIM sensitivity level 7, layer 5) required by the ACAS II logic. This why no RAs were generated.

3 Conclusions

3.1 Findings

- BAW 2751 was flying according to instrument flight rules and was in contact with Sector UH in Reims on the 134.400 MHz frequency at the time of the serious incident.
- DLH 87A was flying according to instrument flight rules and was in contact with Geneva UAC Sector K2 on the 132.315 MHz frequency at the time of the serious incident.
- DLH 87A was on a transit flight through the area of responsibility of Zurich ATC at FL 310.
- According to ORCAM the SSR code 6002 should not have been used for flight DLH 87A from Frankfurt to Bilbao.
- Flight DLH 87A with SSR Code 6002 was normally not displayed on the radar screen in Reims Sector UH.
- The assigned SSR Code 6002 to DLH 87A could be displayed in the Reims sector UH by selecting the button «Autre Codes».
- The flight of DLH 87A with transponder code 6002 was not displayed on the radar screen of Sector UH in Reims.
- The flight of DLH 87A was not coordinated with Reims ATC.
- Zurich ATC had coordinated with Reims ATC for BAW 2751 to climb to FL 280.
- At 09:43:26 UTC, Reims ATC cleared BAW 2751 to climb to FL 320.
- Reims ATC had not coordinated BAW 2751's climb to FL 320 inside the Zurich ATC area of responsibility.
- The crew of BAW 2751 had established visual contact with DLH 87A after a TCAS TA, reduced the aircraft's rate of climb and crossed the flight path below DLH 87A.
- The crew of DLH 87A confirmed a TCAS TA and visual contact with BAW 2751 on the Geneva frequency, but were no longer able to recall the incident subsequently.
- Both flight crews as well as the air traffic controllers in Zurich and Reims were both in possession of the licences necessary to exercise their activity.
- The serious incident occurred at the boundary of the area of responsibility between Reims ATC and Zurich ATC.
- The radar recording, after the two aircraft crossed, showed an altitude difference of 0 ft and a lateral separation of 3.5 NM.

3.2 Cause

The serious incident is attributable to the issuing of instructions by ATC to aircraft outside its own area of responsibility.

Berne, 11 September 2008

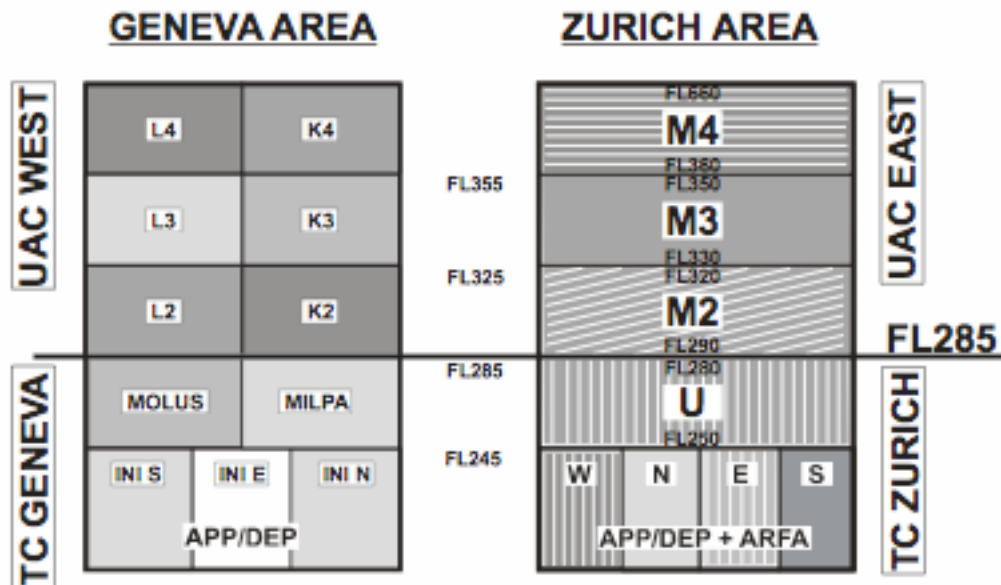
Aircraft Accident Investigation Bureau

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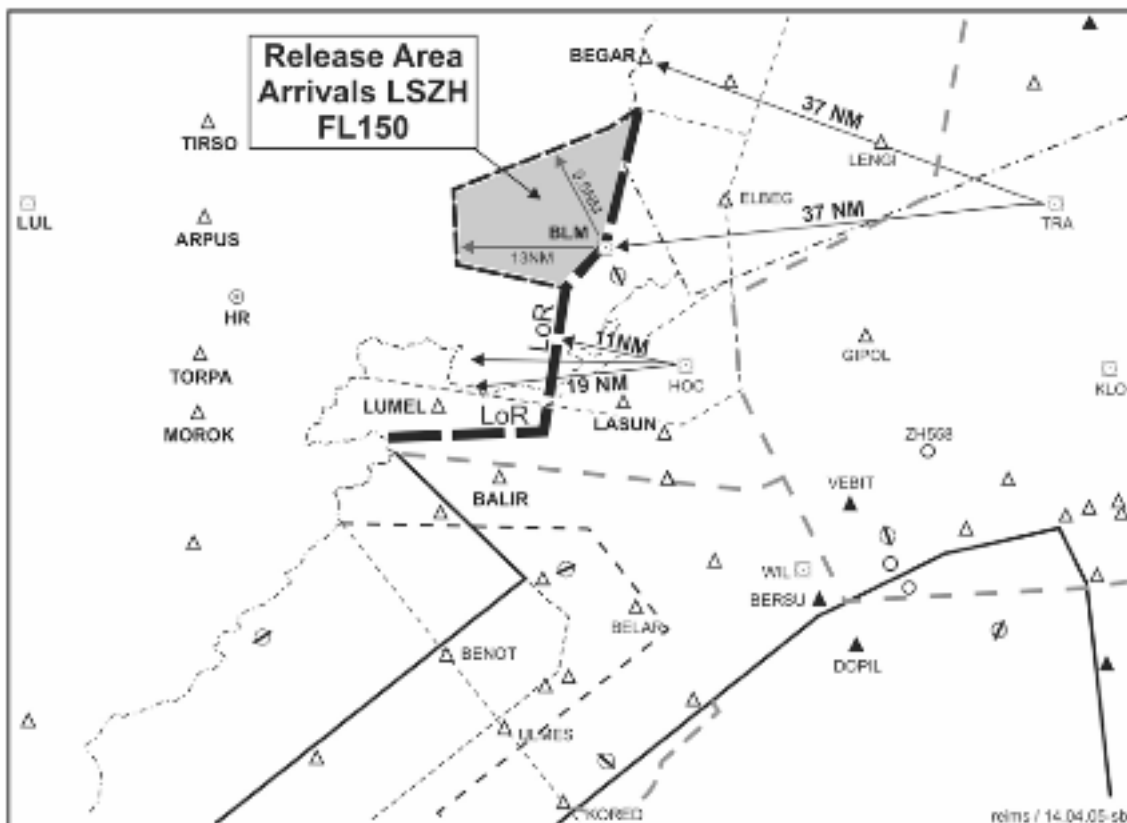
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Swiss Airspace: Areas of responsibility and ATC Sectors



Lines of Responsibility Zurich - Reims



Annex 2

Publication of a deviating statement

According to ICAO Annex 13 chapter 6.3 the AAIB Switzerland publishes the following statement of the French investigation authorities BEA involved in the investigation. This statement concerns the cause and deviates from the AAIB's opinion which is published in the investigation report. The French investigation authorities requested its publication.

„Les faits présentés et l'analyse de l'événement nous semblent justes et complets. Cependant la conclusion ne reflète pas les différents facteurs contributifs mis en évidence par l'enquête. Nous vous proposons donc de compléter le paragraphe 3.2 par la phrase suivante :

« L'allocation d'un code transpondeur non conforme aux règles de l'ORCAM et l'absence de coordination avec le secteur de Reims ATC de la route donnée au DLH87A ont été des facteurs contributifs. »

Translation:

The facts presented and the analyses of the incident seem to be correct and complete. But the conclusion does not reflect the various contributing factors identified by the investigation. We therefore propose to add to paragraph 3.2 the following sentence: "The allocation of a transponder code not complying with the rules of the ORCAM and the lack of coordination with Reims ATC in respect of the routing assigned to DLH87A were contributing factors."

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

Investigation into the **incident** that occurred on **28.03.2006**

- Subject of transcript: **BAW2751 / DLH87A**
- Centre concerned: Swiss Radar Area East
- Designation of unit: Zurich ACC West
- Frequency / Channel: 135.675 MHz
- Date and period (UTC) covered by attached extract: 28.03.2006
09:35-09:45 UTC
- Date of transcript: 25.04.2006
- Name of official in charge of transcription:

- 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, 25.04.2006

Abbreviations

<u>Sector</u>	<u>Designation of sector</u>
ACW	- ACC West
T-RPU	- ACC Upper Telephone
T-RPS	- ACC South Telephone
T-RPW	- ACC West Telephone
M2	- ACC Upper M2
T-RMS	- ACC Reims Telephone

<u>Aircraft</u>	<u>Call sign</u>	<u>Type of aircraft</u>	<u>Flight rules</u>	<u>ADEP</u>	<u>ADES</u>
BAW2751	- Speedbird	B734	IFR	LSZH	- EGKK
DLH87A	- Lufthansa	B734	IFR	EDDF	- LEBB

DMOsn / 25.04.2006

TRANSCRIPT SHEET**Occurrence: BAW2751 / DLH87A of 28.03.2006**

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>

Frequency: ACC West 135.675 MHz

ACW	2751	09:39:49	Swiss Radar, Speedbird two seven five one, climbing flight level one two zero towards VEBIT
2751	ACW	:56	Speedbird two seven five one, Swiss Radar, identified, climb to flight level two four zero, rate of climb two thousand five hundred feet of greater
ACW	2751	:40:04	Climb to flight level two four zero, rate of climb two thousand five hundred feet per minute or greater, Speedbird two seven five one
2751	ACW	:29	Speedbird two seven five one, climb to flight level two eight zero, maintain the rate until out of one seven zero
ACW	2751	:35	Flight level two eight zero, maintaining the rate until out of one seven zero, Speedbird two seven five one
2751	ACW	:41:21	Speedbird two seven five one, direct to TORPA
ACW	2751	:23	Direct TORPA , Speedbird two seven five one
2751	ACW	:42:05	Speedbird two seven five one, rate of climb is yours, contact Reims one three four decimal four, bye bye
ACW	2751	:09	Reims one three four decimal four, is it that, Speedbird two seven five one?
2751	ACW	:14	Affirm
ACW	2751	:15	bye

- end -

Channel: M2 132.315 MHz

M2	87A	09:34:35	Swiss Radar, "grüezi", Lufthansa eight seven Alfa, flight level three one zero
87A	M2	:39	Lufthansa eight seven Alfa, Swiss Radar, "guten Tag", Radar contact, cleared OLBEN BENOT, flight level three one zero for the time
M2	87A	:49	Thank you, Lufthansa eight seven Alfa, OLBEN, then

TRANSCRIPT SHEET

Occurrence: BAW2751 / DLH87A of 28.03.2006

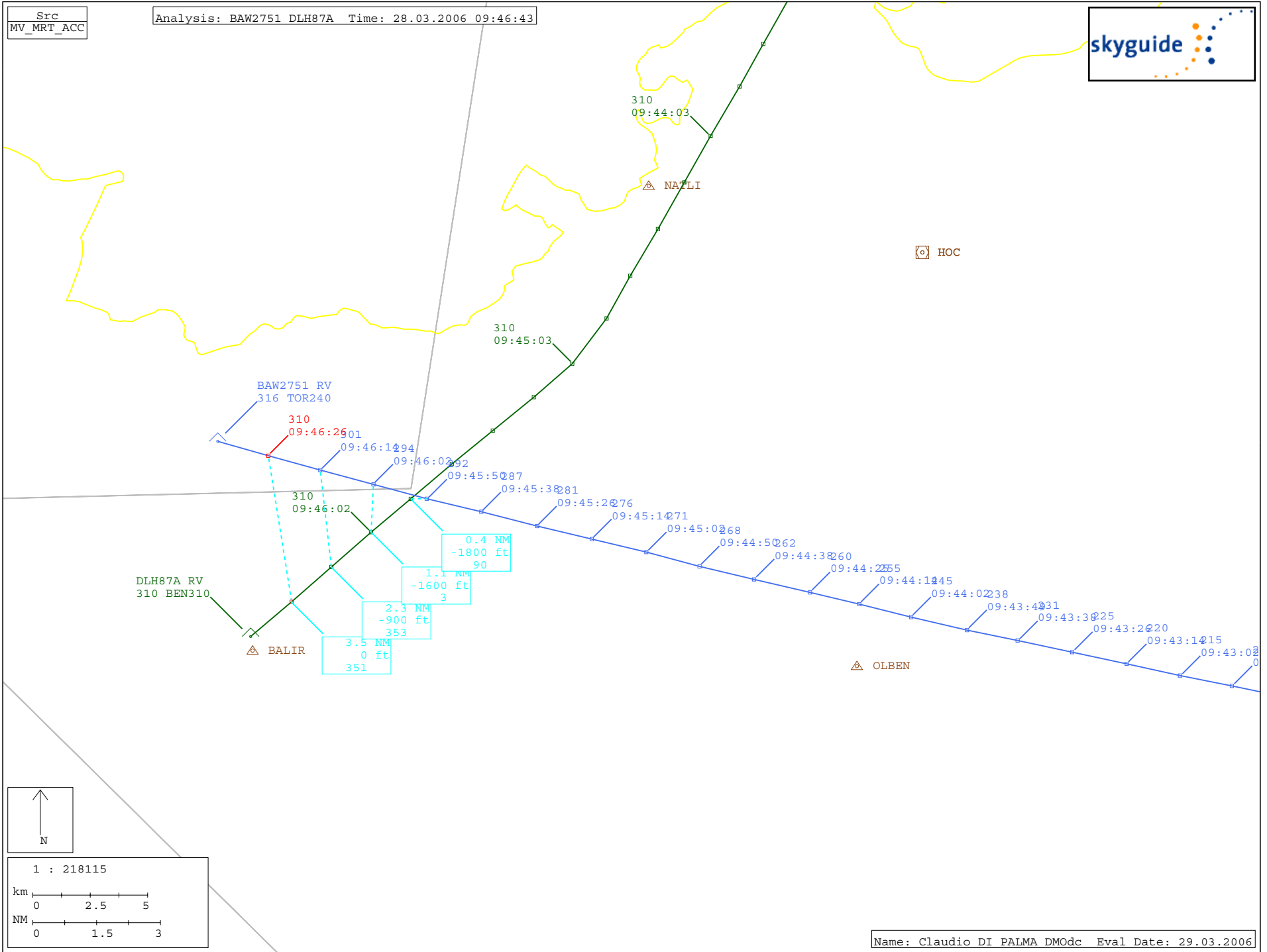


<u>To</u> <u>Col.1</u>	<u>From</u> <u>Col.2</u>	<u>Time</u> <u>Col.3</u>	<u>Communications</u> <u>Col.4</u>	<u>Observations</u> <u>Col.5</u>
			BENOT, level three one zero, and if possible, we get three one zero to cruise	
87A	M2	:55	Perfect, maintain	
M2	87A	:57	Thank you	
87A	M2	:38:30	Lufthansa eight seven Alfa, direct BENOT	
M2	87A	:32	Lufthansa eight seven Alfa, direct to BENOT	
87A	M2	:44:03	Lufthansa eight seven Alfa, contact Radar one three two decimal eight one five, "tschüss"	
M2	87A	:06	one three two decimal eight one five, Lufthansa eight seven Alfa, "tschüss"	

- end -

Src
MV_MRT_ACC

Analysis: BAW2751 DLH87A Time: 28.03.2006 09:46:43



Src
MV_MRT_ACC

Analysis: incident BAW2751 / DLH87A Time: 28.03.2006 09:50:55
of march 28, 2006

