



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Büro für Flugunfalluntersuchungen BFU
Bureau d'enquête sur les accidents d'aviation BEAA
Ufficio d'inchiesta sugli infortuni aeronautici UIIA
Uffizi d'investigaziun per accidents d'aviatica UIAA
Aircraft accident investigation bureau AAIB

Final Report No. 1926

by the Aircraft Accident Investigation Bureau

concerning the serious incident (Airprox)

involving Tupolev 154M

and Airbus 319

on 14 February 2005

4 NM S/E RILAX Intersection

The incident occurred within German airspace. The two aircraft concerned were under control of air traffic control Zürich. Therefore the investigation has been delegated from the [German Federal Bureau of Aircraft Accidents Investigation](#) to the [Swiss Aircraft Accident Investigation Bureau](#).

When developing this investigation report German legislation has been applied.

Final report

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	Zurich Arrival 4 NM S/E RILAX Intersection, 14 February 2005, 07:00 UTC
------------------------	--

Aircraft	Tu-154M
	Warsaw/Okecie (EPWA) – Zurich (LSZH)
	A319
	Cologne/Bonn (EDDK) – Zurich (LSZH)

Crews	Tu-154M	CMDR
		FO
		NAV (Navigator)
		FE (Flight Eng.)
	A319	CMDR
		FO

ATC unit	Approach control Zurich
-----------------	-------------------------

Air traffic controller	Approach controller east (APE)
-------------------------------	--------------------------------

Airspace	C
-----------------	---

1. History

1.1 History of the flight

On the morning of 14 February 2005, a Tu-154M was flying a ferry flight from Warsaw to Zurich. The aircraft entered Zurich air traffic control airspace from the north east over TGO - EMKIL - RILAX and made contact for the first time at 06:52 UTC with Sector North area control centre on frequency 136.150 MHz: *"Swiss radar Papa Lima Foxtrot one zero one good morning proceeding EMKIL descending level one seven zero."*

The air traffic controller (ATCO) instructed the crew after reaching FL 170 to remain at this altitude and to maintain a speed of 240 KIAS.

At 06:53:11 UTC, the crew of an A319, which was flying from the north over SUL VOR direction RILAX, made contact with Sector North: *"Swiss radar good morning (A319) is approaching level one six zero inbound Sierra Uniform Lima, speed is two four zero."*

The ATCO cleared the A319 to descend further to FL 150.

A little later, the A319 was instructed to continue its descent to FL 130 and to switch to the approach control frequency.

Approximately 30 seconds later, the Sector North ATCO cleared the Tu-154M to descend to FL 150 and also instructed the crew to make contact with approach control.

After making contact with approach control east (APE), at 06:57:14 UTC the APE ATCO instructed the A319 to fly a heading of 180°: *"Grüezi (A319) arrival fly heading one eight zero vectors ILS one four"*. According to his statements, the ATCO intended to guide both the A319 and the following Tu-154M onto the runway 14 instrument landing system (ILS) using a long approach and radar vectoring.

At 06:57:59 UTC, the crew of the Tu-154M made contact with the approach control east ATCO: *"Zurich arrival (Tu-154M) good morning, er ... approaching RILAX descending level one five zero, information India"*.

The ATCO instructed the crew to turn left onto a heading of 150° and to reduce speed to 210 KIAS. The instruction was correctly acknowledged.

A short time later, the crew of the A319 was also instructed to reduce its speed to 210 KIAS.

The commander of the Tu-154M indicated that, during this phase, the entire crew noticed on the traffic alert and collision avoidance system (TCAS) an aircraft in front of them flying in the same direction. It had flown not far in front of them and was approximately 2,000 ft below them slightly to the right. They were able to establish visual contact with this aircraft

According to the radar recording, the A319 reached FL 130 and was already stabilised on a 180° heading some 1.5 NM north-east of RILAX. At the same time, the Tu-154M was located approximately 0.7 NM behind the A319, passing FL 149 in descent and executing a left turn in order to attain the 150° heading as instructed by the APE ATCO.

Approximately half a minute later, as the crew had stabilised their aircraft on a heading of 150°, the Tu-154M passed FL 140.

Having issued the radar heading and speed reduction to the A319 and the Tu-154M, according to his statements, the APE ATCO turned his attention to the other aircraft flying in front, as he knew the two aircraft had vertical separation. He also stated: *"I was again made aware of the two aircraft when I received the STCA alert. I noticed that the (Tu-154M), which had been authorised to descend to FL 150, was continuing to descend. I stopped the (Tu-154M) immediately and gave the crew traffic information about the (A319) which was at FL 130. The crew informed me that they had seen the (A319). I then cleared the (Tu-154M) to climb to FL 140."*

The crew of the A319 stated that they had received a traffic advisory (TCAS-TA) on their TCAS. They could observe on the display that the other aircraft was descending and closed to within 300 ft, at which point it eventually turned away. They were also able to establish visual contact. The crew also indicated they were continuing their flight normally and mentioned that air traffic control was very busy at the time of the incident.

According to the radar recording, the Tu-154M passed FL 137 at 06:59:19 UTC, when the crew were requested by APE ATCO to stop their descent. The ATCO informed them that they had only been cleared to descend to FL 150.

The commander (CMDR) of the Tu-154M stated that, after making contact with approach control, the crew received a heading instruction of 150° from the APE ATCO and clearance to descend to FL 110. A crew member had read back this instruction. This read back was at the same time a check that the entire crew had understood the instruction correctly.

At 06:59:52 UTC, the APE ATCO instructed the crew of the Tu-154M to climb back to FL 140 and at 07:01:07 UTC the aircraft was stabilised at FL 140.

According to the radar recording, the two aircraft had closed to an altitude difference of 300 ft and a lateral separation of 1.5 NM.

1.2 Weather

Weather according INFONET Data of air traffic control:

ATIS ZURICH

INFO INDIA

LDG RWY 14 ILS APCH, DEP RWY 28

QAM LSZH 0650Z 14.02.2005

230 DEG, 4 KT

VIS 18 KM

CLOUD FEW 1000 FT, SCT 3000 FT

-01°C / -03°C

QNH 1005 ZERO FIVE

QFE THR 14 955

QFE THR 16 955

QFE THR 28 954

NOSIG

GEN DEICING PROC IN OPS

TRL 75 DAY 0605 NGT 1725 QNH TICINO 0540Z: 997 HPA

TROPO: 25400FT, MS53

RWY-REPORT NR. 261 0520

RWY 14

FULL LEN 30 M WIDE WET AND DEICED AND 10 % OR LESS PATCHES OF WET SNOW UP TO 2 MM

BA UNREL

EDGES COVERED WITH WET SNOW

RWY 16 AND 28

FULL LEN 30 M WIDE WET AND DEICED AND 11 % TO 25 % PATCHES OF WET SNOW UP TO 3 MM

BA UNREL

EDGES COVERED WITH WET SNOW

APRON AND TWY PATCHES OF ICE AND WET SNOW

RWY 14 CLSD DUE TO SNOW CLEARING FROM 0430 TIL 0530

AIRMET 2. VALID BTN 0400 AND 0800

SWITZERLAND FIR LOC MOD ICE OBS AND FCST N OF ALPS AND ALPS BLW FL 100 STNR INTENSITY NO CHANGE

2. Analysis

2.1 Traffic handling

As the two flight crews made contact with the Zurich area control centre (ACC), both aircraft were flying in the direction of RILAX on converging courses, where they would have met at about the same time. Before being handed over to approach control, the crew of the A319 was instructed by the ACC ATCO to descend to FL 130. The crew of the Tu-154M was cleared to descend to FL 150, a flight level through which the A319 had already passed.

There was a high volume of traffic in approach control. The APE ATCO envisaged implementing a long approach with the A319 and the Tu-154M, in order to create a gap for aircraft ready for take-off. After making contact, he allocated a radar heading to both crews.

When the APE ATCO was warned by his short term conflict alert (STCA) system at 06:59:15 UTC that the two aircraft were converging, the Tu-154M had already passed FL 138.

The APE ATCO immediately requested the crew of the Tu-154M to stop their descent and issued traffic information regarding the A319 which was flying to its right. A little later, the instruction was given to climb back to FL 140.

According to the radar recording, the Tu-154M continued to descend to FL 133 before the aircraft began to climb again.

It must remain open as to why the crew of the Tu-154M was of the opinion it had received an instruction to descend to FL 110. According to the radio recording, they

had at no time received clearance to descend to this flight level. All instructions issued to the crew had been confirmed by them correctly.

According to the recording, comprehensibility on this frequency was good. Confusion with an instruction to another crew can be excluded, because at the time in question, no aircraft on this frequency had received clearance to descend to FL 110.

A possible explanation can, however, be derived from the first call from the Tu-154M to APE and the response at 06:58:06 UTC, combined with the instruction *"Hello (Tu-154M) Zurich Arrival turn left heading one five zero vectors one four speed two one zero"*. This instruction, which includes several times the number "one", was indeed correctly acknowledged by the crew. However, given the many "ones", during execution it could subsequently have caused the crew to erroneously continue its descent to FL 110.

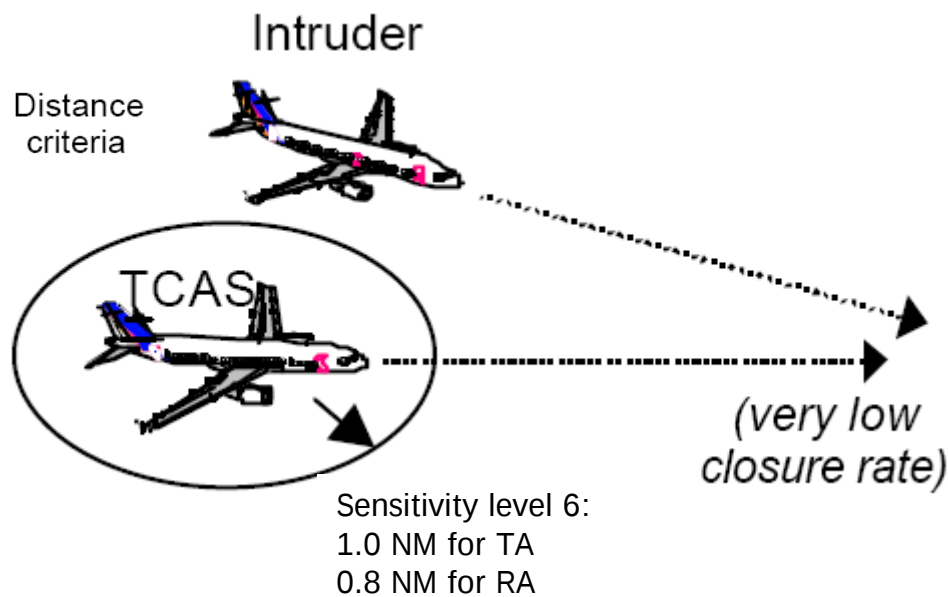
During its later take-off from Zurich, it could be observed that the crew of the Tu-154M again had problems in maintaining the allocated speed and authorised flight level.

2.2 Crew resource management/CRM

According to current knowledge about crew resource management and crew cooperation, in multi-crew cockpits the concepts of 'silent cockpit' and 'closed loop' are applied. This means that below a specific flight level or from the initiation of a descent, the only conversation carried out in the cockpit is that which is directly concerned with controlling the aircraft. This should avoid any distractions. In addition, within the context of this 'closed loop' principle, every action of a crew member is checked by the other crew member(s). On the basis of the statements of the crew of Tu-154M, it is not possible to deduce what led them to deviate from these recognised working techniques, eventually leading to passing the authorised flight level. Inappropriate crew resource management can be assumed.

2.3 TCAS

The A319 was in level flight at FL 130, whereas the Tu-154M was descending. At the time of the closest lateral convergence of the two aircraft at 06:58:52 UTC, the altitude difference was some 1,600 ft. The A319 was at this time already at FL 130 in level flight, and the rate of descent of the Tu-154M was approximately 1,500 ft/min. These values did not yet fulfil the requirements for triggering a traffic advisory. From this point in time, the lateral separation between the two aircraft began to increase again, until about 06:59:04 UTC, but at such a slow rate that an extrapolation of the flight path would have resulted in a convergence of less than 1.0 NM by the time they reached the same altitude (co-altitude). As the lateral separation between the aircraft was continuing to increase from 06:58:52 UTC, a special function of the TCAS logic was triggered. This function is provided for situations in which the horizontal closure rate is very low or the aircraft are even diverging, but the TCAS computer indicates that at the time when they reach the same altitude (co-altitude), a set lateral separation minima will be violated.



For the altitude band between 10,000 and 20,000 ft (sensitivity level 6) in which the incident took place this set lateral separation minima corresponds to 1.0 NM for the triggering of a TA (traffic advisory) and 0.8 NM for the triggering of an RA (resolution advisory).

According to TCAS logic, in the corresponding altitude band between 10,000 and 20,000 ft (sensitivity level 6) a traffic advisory (TA) is issued if the following two conditions are fulfilled simultaneously:

1. If the time to reach 'co-altitude', i.e. until the two aircraft are at the same altitude, is 45 seconds (TAU_TA).
2. If the distance calculated by both TCAS on the basis of the current flight paths on reaching this co-altitude is 1.0 NM or less.

Because of the geometry of this serious incident, these conditions were fulfilled at the time at which the Tu-154M was executing a left turn onto a heading of 150°. Shortly thereafter, the flight paths of the two aircraft were again diverging as a result of this turn, which prevented further intensification of the conflict and the issuing of a resolution advisory.

3. Conclusions

3.1 Findings

- Both aircraft were flying according to instrument flight rules (IFR) in category C airspace and were in uninterrupted radio contact with approach control.
- Flight Tu-154M from Warsaw to Zurich was a ferry flight. According to the statements of the crew, they had previously flown to Zurich on a number of occasions.
- There was a high volume of traffic in the area of responsibility of approach control east.
- The air traffic controllers were in possession of the necessary licences to perform their duties.

- The approach air traffic controller had to ensure minimum separation between the two aircraft of 1,000 ft vertically and 5 NM laterally.
- Both crews had received a TCAS-TA alert and were able to establish visual contact with the other aircraft
- According to information from the flight crew, the Tu-154M was equipped with an FMS Universal Avionics UNS-1D and a TCAS II Version 7.0.
- The crew of the Tu-154M was instructed by air traffic control to descend to FL 150.
- The crew of the Tu-154M continued their descent below FL 150, as they were of the opinion that they had received clearance to descend to FL 110. According to the radio recording, this was not the case.
- The approach air traffic controller was made aware of the separation violation by the STCA system.
- The Tu-154M descended to FL 133 and then climbed back to FL 140 in accordance with the instruction from the air traffic controller.
- According to the radar recording, the two aircraft converged to an altitude difference of 300 ft and a lateral separation of 1.5 NM, or an altitude difference of 800 ft and a lateral separation of 1 NM.

3.2 Cause

This incident is attributable to the fact that the crew of the Tu-154M did not follow the instruction of air traffic control to descend to FL 150 and continued its descent for reasons unknown.

Berne, 6 June 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.