Mid-air collision over Ueberlingen, Germany, July 1, 2002

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Presentation of the mid-air

- Short details
- Working arrangements in Zurich
- The technical situation
- TCAS use and procedures
- Safety nets
- Legal battle, safety improvement, and conclusion
(TU 154 Bashkirian)

BTC 3729
Flugwege und Zusammenstoß Tupolew TU 154 mit Boeing B 757
Diagramm
Collision diagramm

Zusammenstoß Tupolew TU 154 mit Boeing B 757
Interesting details

• Aircraft hit at approximately FL 350
• They collided at right angle
• TU 154 was heading 274 degrees
• B 757 was heading 004 degrees
• Both aircraft were TCAS equipped (Honeywell 2000, version 7.0)
• red color marks on the TU 154 (left side close to the two overwing emergency exits)
Interesting details

- Parts of the B757’s vertical fin found on the wings and the landing gear
- The B-757 lost only the upper part of its vertical fin
- The wreckage of the B 757 found some 8 km north of the main wreckage of the TU 154
- The first officier of the B 757 was absent (toilet) at the beginning of the collision
Accident timing (UTC time)

- 21.20.08 initial contact DHX 611 with Zurich radar, FL 260
- 21.22.54 identified, climb FL 320
- 21.26.36 climb FL 360
- 21.30.11 initial contact BTC 2937, FL 360
- 21.30.33 Squawk A 7520
- 21.34.49 BTC 2937 descent FL 350, expedite, I have crossing traffic
Accident timing (UTC time)

- 21.35.03 (repeat) BTC 2937 descend FL 350, expedite descent
- 21.35.07 readback of BTC 2937
- 21.35.13 Traffic information to BTC 2937 (position wrong)
- 21.35.19 TCAS descent reported by DHX 611 (garbeled)
- 21.35.32 Collision
Aircraft system interactions

- 21.30.11 Initial contact BTC 2937, FL 360
- 21.30.33 Squawk A 7520
- 21.34.42 Both aircraft receive a TCAS TA
- 21.34.49 BTC 2937 descent FL 350, expedite, I have crossing traffic
- 21.34.56 Both aircraft receive a TCAS RA: DHX 611 TCAS descent; TCAS climb for BTC 2937
Aircraft system interaction

- 21.35.03 (repeat) BTC 2937 descend FL 350, expedite descent
- 21.35.07 readback BTC 2937
- 21.35.10 B 757 DHL receives « increase descent »
- 21.35.13 Traffic information BTC 2937 (position wrong)
- 21.35.19 TCAS descent by DHX 611 (garbled)
Aircraft systems interactions

- 21.35.24 Tupolev receives « increase climb »
- 21.35.32 Collision
What exactly happened on the night of 1st July

Diagramm
SKYGUIDE

BLUE IS TFC INFO / PINK IS TCAS / BLACK RADAR
ATC situation

Zurich ACC
Zurich Airspace
Technical situation and working arrangements

Functions and staffing of Zurich’s ATC-system during the night of July 1, 2002
Zurich radar
Working arrangements

- Two ATCOs to cover night shift (from 23.00 to 05.30)
- Two controller assistants (CA) to assist (flight data handling, no controller training)
- Usually 1 controller and 1 assistant work at the same time during night
- (long standing arrangement, for years)
- Other team is on break on off-duty
Single man OPS (SMOP)

- Extension of SMOP procedure to day operations by service order (SO)
- FOCA (the regulator) did not disapprove (despite protests from Unions and associations)
- Many letters exchanged
Single man OPS (SMOP)

- The SMOP procedure (during day operations) had several conditions
- STCA must be on and functioning
- Nowhere it is clearly written that SMOP is not applicable at night
- The procedure was officially forbidden by the regulator on July 9, 2002
Friedrichshafen (EDNY)
Approach and departure services for EDNY

- Airport is situated below delegated zone
- Traffic is handled by Zurich ACC (overflight sector)
- At night traffic at this airport is very rare
- Different frequency 119.920 MHz and different radar scope, different settings
- at a certain distance
Degraded Operations

• On July 1, 2002 at Zurich ACC, maintenance work on the main radar system (a new software release must be loaded).

• Radar services with the RDPS in « fallback mode » (stand-by system)
Radar separation applicable

• The horizontal separation minima had been increased from 5 to 7 nm. According to this, the horizontal distance between aeroplanes flying at the same altitude must be at least 7 nm, which corresponds to a flight time of approximately one minute.

» Source German BFU, accident investigation board »
The STCA (Short Term Conflict Alert) is switched off.

The Swiss STCA triggers two alerts:
1) optical alarms
2) acoustic alarms

The optical alarm was off (not on the fall-back system)

Acoustic alarm was possibly on.
Telephone system

• The main telephone system was switched off
• The back-up telephone system was available (less performant and flexible)
• Number stored for EDNY-TWR not correct
• Karlsruhe Radar could not reach Zurich (several attempts)
Factors that have contributed to the mid-air collision

TCAS
TCAS Implications
Use of TCAS

• OPERATION OF ACAS EQUIPMENT:
  «Nothing shall prevent pilots-in-command from exercising their best judgement and full authority in the choice of the best course of action to resolve a conflict »
  » ICAO PANS-OPS (DOC 8168) »
TCAS co-ordination

- « Contrary pilot response »
- Manœuvres opposite to the sense of an RA may result in a reduction in vertical separation with the threat aircraft and therefore must be avoided. This is particularly true in the case of an ACAS-ACAS co-ordinated encounter »

» Annex 10-Aeronautical Telecommunications »
TCAS considerations

- Once an aircraft departs from its clearance in compliance with a resolution advisory, the controller ceases to be responsible for providing separation between that aircraft and any other aircraft affected as a direct consequence of the manoeuvre induced by the Resolution advisory.

» Source Doc 4444 (PANS-ATM, 15.6.3.3) »
The safety nets and how they failed

Source Jane’s Airport Review
September 2002, vol 14, issue 7
Safety net 1

• Direct controller surveillance
• -single controller (single man OPS)
• -two frequencies and two radar scopes
Safety net 2

• The surveillance system

• The radar was operating in fallback mode requiring that radar separation values were increased from 5 nm to 7 nm
Safety net 3

• The STCA (short term conflict alert)

• The short term conflict alert was switched off for maintainance
Safety net 4

- Indirect controller surveillance/telecommunication system
- DFS, the German ATSP has stated that controllers at its Karlsruhe facility noted the emerging conflict two minutes before collision
- The main telephone line was switched off, but the backup (by-pass) line was available
- Karlsruhe tried to alert Zurich via telephone using the priority facility but heard only the ringing or busy tone
Safety net 5

• The on-board collision avoidance system
• Both aircraft were properly equipped with TCAS
• Both airlines had received training packages for TCAS use
• Neither system appears to have failed
• The Tu-154, appears, however, to have ignored the TCAS command to climb
Legal battle and considerations

• Bashikirian Airlines intended legal actions against SKGUIDE, Honeywell and DHL requesting millions of dollars
• DHL is expected to intend similar legal actions (or has already done so)
Legal battle and considerations

- The Swiss general prosecutor (in Zurich) has opened an official investigation
- The second controller (on break) is witness only for the time being
- In Germany (Konstanz) a preliminary investigation (against unknown) was opened
Legal battle and considerations

• In both cases (Zurich and Konstanz) is trying a case for manslaughter by negligence in 71 cases, and endangering of public transport

• Civil court cases: (where the families of the victims might receive compensation)
Legal battle and compensation

- This battle must be fought in Germany (due to legislation and airspace delegation)
- The German government must proof that they are not responsible
- SKYGUIDE must only pay if they acted deliberately
- The Russian Tupolev was not insured
Legal battle and considerations

- There are talks on going for out of court settlement (civil case)
- SKYGUIDE has an insurance
- For the penal court case in Switzerland, the «causal factor» was determined (jurisprudence)
Legal battle and considerations

• All that happened 44 seconds or before, is considered as « contributing factors »
• In this particular case, with TCAS, the chain of events was broken by the system (manoeuvre of DHL following the RA)
• Legal outlook is not very bad for the ATCOs
TCAS considerations

• Once an aircraft departs from its clearance in complicity with a resolution advisory, the controller ceases to be responsible for providing separation between that aircraft and any other aircraft affected as a direct consequence of the manœuvre induced by the Resolution Advisory

  » Source Doc 4444 (PANS-ATM, 15.6.3.3) »
  » ATMM of Switzerland »
The controller?

- He has received intensive CISM (especially by Danish ATCOs and specialists) and psychological support afterwards
- He is receiving full legal counseling and legal assistance from the employer and the unions
- He currently works as trainer in the OJT-simulator of SKYGUIDE in Zurich
Conclusions and Thanks

Thanks
Acknowledgement
Excuses
Contrails