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Swiss Accident Investigation Board SAIB

Aviation Division

Final Report no. 2211 of the Swiss Accident Investigation Board SAIB

concerning the serious incident (Airprox)

involving the Boeing B737-800 aircraft, EI-ENK
operated by Ryanair
under flight number RYR 3595

and the Airbus A319-111 aircraft, CS-TT
operated by Air Portugal
under flight number TAP 706

on 12 April 2013

20 NM south-east of Zurich Airport

General information on this report

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

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

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

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

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

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

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Final Report

Synopsis

RZR 3595

Owner	Ryanair Ltd., Dublin, Ireland
Operator	Ryanair Ltd., Dublin, Ireland
Manufacturer	The Boeing Company, USA
Aircraft type	B737-800
Country of registration	Ireland
Registration	EI-ENK
Flight number	RZR 3595
Radio callsign	Ryanair three five niner five
Flight rules	Instrument flight rules (IFR)
Type of operation	Scheduled flight
Departure point	Pisa (LIRP)
Destination point	Lübeck (EDHL)

TAP 706

Owner	International Lease Finance Corporation (ILFC), USA
Operator	TAP Air Portugal, Portugal
Manufacturer	Airbus S.A.S., Toulouse, France
Aircraft type	A319-111
Country of registration	Portugal
Registration	CS-TTD
Flight number	TAP 706
Radio callsign	Air Portugal seven zero six
Flight rules	Instrument flight rules (IFR)
Type of operation	Scheduled flight
Departure point	Lisbon (LPPT)
Destination point	Prague (LKPR)
Location	20 NM south-east of Zurich Airport Swiss sovereign territory, FL 366
Date and time	12 April 2013, 16:11:49 UTC
ATS units	Zurich Area Control Centre (ACC), Control Sector M4
Airspace class	C
Closest point of approach between the two aircraft	0.8 NM horizontally and 650 ft vertically
AIRPROX category	ICAO Category A - high risk of collision
Minimum separation	5 NM horizontally or 1000 ft vertically

Investigation

The serious incident occurred on 12 April 2013 at 16:11 UTC. The notification was received on 16 April 2013 at 13:12 UTC. After the usual preliminary investigations for this type of serious incidents, the investigation was opened by the SAIB on 23 April 2013.

The SAIB notified the serious incident to the Irish, Portuguese and German authorities, each of which nominated an authorised representative who assisted with the investigation.

The final report is published by the SAIB.

Summary

On 12 April 2013, the two commercial aircraft with the flight numbers TAP 706 and RYR 3595 were cruising in Swiss airspace under the control of the Zurich Area Control Centre (ACC). At 16:00:53 UTC, while at FL 370, the crew of TAP 706, with the radio callsign "*Air Portugal seven zero six*", an A319 on a scheduled flight from Lisbon (LPPT) to Prague (LKPR), reported to the Zurich ACC Upper Sector M4 air traffic controller (ATCO). The crew of RYR 3595, with the radio callsign "*Ryanair three five niner five*", (a B737 on a scheduled flight from Pisa (LIRP) to Lübeck (EDHL) also reported to the ATCO just a short time later at 16:01:11 UTC, while at FL 360.

At 16:10:43 UTC the crew of RYR 3595 requested clearance to climb to FL 380 due to expected turbulence; though without mention of their radio callsign. The ATCO replied as follows: "*Six Delta Whiskey, climb three eight zero*". This was the radio callsign for flight RYR 6DW, an aircraft belonging to the same aviation operator reporting to the sector shortly before. The crew of flight RYR 3595 responded to the clearance for flight RYR 6DW as follows: "*Flight level three eight zero, Ryanair three five niner five*" and initiated a climb. Neither the ATCO nor the crew of RYR 6DW did respond to this readback of RYR 3595.

At 16:11:37 UTC the ground-based short-term conflict alert for Sector M4 reported an impending conflict between TAP 706 and RYR 3595. After the crew of RYR 3595 answered in the negative to the ATCO's immediate query as to whether they were at FL 360, he instructed them to descend immediately.

The traffic alert and collision avoidance system on both aircraft generated resolution advisories (RAs) shortly afterwards; these were immediately followed by both crews.

At 16:11:49 UTC, the closest point of approach between the two aircraft was reached: 0.8 NM horizontally and 650 ft vertically.

Causes

The serious incident is attributable to the fact that the crew of a commercial aircraft initiated a climb without clearance, which led to a dangerous convergence with another commercial aircraft.

The following factors were identified as the cause of the serious incident:

- The crew initiated the climb on the basis of a clearance which had been issued to another commercial aircraft belonging to the same aviation operator.
- The air traffic controller did not realise that the clearance issued was not read back by the crew for which it had been intended.

The following was identified as a contributing factor to the serious incident:

- A request by a flight crew for clearance to a higher flight level without specification of their radio callsign;
- The issue of altitude clearance by air traffic control without verification of the crew which had made the request;
- Absent reaction of another crew to whom the clearance was addressed to;
- Insufficient attention was given to the prevailing weather conditions when the decision to combine sectors was made.

1 Factual information

1.1 Pre-history and history of the serious incident

1.1.1 General

The recordings of the radiotelephony, radar data and the data transmitted to the ground radar stations via the Mode S downlink from the traffic alert and collision avoidance system (TCAS) were used for the following description of the flight preparations and history of the flight. The recorded data of the ground-based short-term conflict alert (STCA) and the statements of crew members and air traffic controllers were also used.

Onboard flight RYR 3595 the commander was pilot flying (PF) and the co-pilot was pilot not flying (PNF). Onboard TAP 706 the co-pilot was PF and the commander was PNF. These functions did not alter during the serious incident. Both flights took place under instrument flight rules.

There were no operational or technical restrictions.

1.1.2 Pre-history

In terms of air traffic control, Sectors M4, M5 and M6 of the Zurich Area Control Centre (ACC) were involved. According to the statements of the two duty supervisors (SPVRs) at the time of the serious incident, the low volume of traffic meant that these three sectors had been combined into one sector at the Control Sector M4 working position. The Radar Executive (RE) air traffic controller was responsible for tasks including radiotelephony traffic and the Radar Planner (RP) air traffic controller was responsible for planning and coordination tasks. According to their statements the sector capacity was appropriate to the prevailing conditions: *"Wir waren gefordert, aber nicht überfordert; wir hatten einfach genug zu tun."* ["It was demanding, but we were not overwhelmed; we simply had enough to do."] In the two operational internal reports (OIRs) written by the two ATCOs after the incident, they described the volume of traffic as *"sehr hoch"* ["very high"].

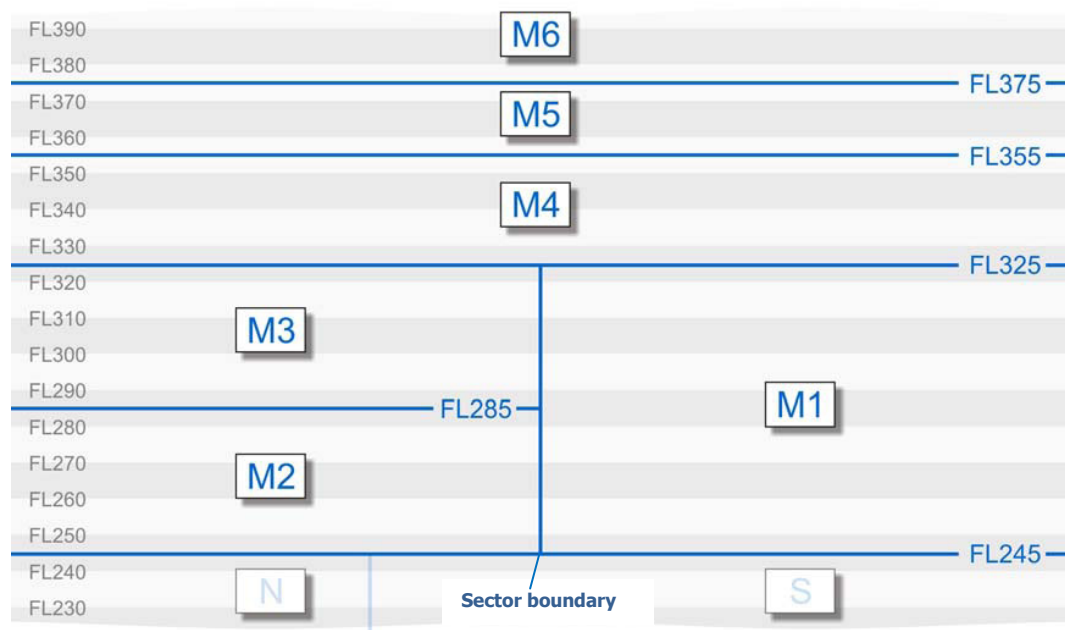


Figure 1: Division of the upper airspace of the Zurich ACC in terms of altitude

Between 16:00 UTC and the time of the incident, 19 other aircraft were in contact with the RE air traffic controller, including four other Ryanair aircraft. These aircraft were identified as follows: flight plan callsign RYR 6DW with the radio callsign "Ryanair six delta whiskey", RYR 4492 with the radio callsign "Ryanair four four niner two", RYR 7792 with the radio callsign "Ryanair seven seven niner two" and RYR 5012 with the radio callsign "Ryanair five zero one two" (cf. Annex 1).

1.1.3 History of the serious incident

At 13:45 UTC, the Airbus A319 aircraft, registration CS-TTD, with the flight number TAP 706 and the radio callsign "*Air Portugal seven zero six*" took off from Lisbon (LPPT) on a scheduled flight to Prague (LKPR). At 16:00:53 UTC the crew reported to the Zurich ACC Upper Sector M4 unit as follows: "*Swiss radar good afternoon, Air Portugal seven zero six, approaching FL three seven zero.*" The air traffic controller (ATCO) acknowledged the call as follows: "*Air Portugal seven zero six, identified.*"

At 15:35 UTC the Boeing B737-800 aircraft, registration EI-ENK, with the flight number RYR 3595 and the radio callsign "Ryanair three five niner five", took off from Pisa (LIRP) on a scheduled flight to Lübeck (EDHL). At 16:01:11 UTC the crew reported to the Upper Sector M4 ATCO as follows: "*Radar good afternoon, uh three five niner five, flight level three six zero to ABESI.*" The ATCO replied, "*Ryanair three five niner five, squawk seven five two seven*", which the crew immediately acknowledged.

The ATCO subsequently had radio conversations with six other crews; one of the crews requested a change of course for meteorological reasons; this was cleared by the ATCO.

At 16:03:53 UTC the crew of TAP 706 reported to the ATCO as follows: "*Radar, Air Portugal seven zero six*". The ATCO did not respond to this call; instead he gave RYR 3595 the following clearance at 16:03:56 UTC: "*Ryanair three five niner five, direct LOKTA*". The crew of RYR 3595 immediately acknowledged this clearance. The crew of TAP 706 then called the ATCO again and at 16:04:08 UTC made the following request after his "*go ahead*": "*Uh we are expecting some turbulence uh seven zero miles ahead of us, is there any chance you could give us a route to the left to intercept a point maybe MEBEK, BIBAG.*" The ATCO replied as follows at 16:04:23 UTC: "*Uh..left turn to MEBEK is approved, Air Portugal seven zero six.*" The crew acknowledged this clearance and thanked the ATCO.

The ATCO subsequently had radio conversations with eleven other crews, two of which reported that they were "*clear of weather*". At 16:09:36 UTC, RYR 6DW reported to the ATCO as follows: "*Swiss radar, good day Ryanair six delta whiskey climbing to flight level three two zero to LOKTA*". At 16:09:41 the ATCO replied, "*Ryanair six delta whiskey, identified, climb flight level three four zero*", which the crew immediately read back.

At 16:10:17 UTC the crew of RYR 3595 reported to the ATCO as follows: "*Ryanair three five niner five request*". After the ATCO had given the "*go*" the crew asked the following question: "*Any reported turbulence at flight level three eight zero on our route?*" The ATCO answered in the negative. Shortly afterwards, RYR 4492 reported to the ATCO as follows: "*Ryanair four four niner two [incomprehensible] light turbulence passing the Alps.*" The crew of RYR 3595 then immediately reported as follows at 16:10:43 UTC, though without mentioning their radio callsign: "*Report turbulence now that we are requesting climb flight level three eight zero.*"

At 16:10:47 UTC the ATCO replied to this request as follows: *"Six Delta Whiskey roger, climb three eight zero"*. The clearance to FL 380 issued to RYP 6DW was not answered by this crew, but by the crew of RYP 3595 as follows at 16:10:51 UTC: *"Flight level three eight zero, Ryanair three five niner five, thank you"*. They then initiated a climb. Neither the ATCO nor the crew of RYP 6DW responded to this clearance readback. At 16:10:54 UTC the ATCO issued another aircraft with clearance to climb to FL 360.

A short time later, at 16:11:17 UTC, the ATCO requested the crew of TAP 706 to report to the German Rhine Radar air traffic control unit. The crew acknowledged this request and signed off.

At 16:11:37 UTC the Sector M4 short-term conflict alert (STCA) (cf. Section 1.7.2 and Annex 2) triggered an alert in relation to the impending conflict between TAP 706 and RYP 3595. At 16:11:43 UTC the ATCO called the crew of RYP 3595 with the following query: *"Ryanair three five niner five confirm maintaining three six zero?"* The crew answered in the negative, whereupon the ATCO immediately gave them the following instruction at 16:11:49 UTC: *"Descend immediately, traffic three seven zero above."* The crew immediately acknowledged this as follows: *"Descending, Ryanair three five niner five."*

At this time both crews had received a resolution advisory (RA): the crew of TAP 706 had received an RA to climb, while the crew of RYP 3595 had received an RA to descend.

At 16:11:48 UTC the crew of TAP 706, who had in the meantime reported their cruising altitude of FL 370 to the Rhine Radar ATCO reported to him as follows: *"TCAS RA Air Portugal seven zero six TCAS RA."* At 16:12:03 the ATCO replied as follows: *"Roger Air Portugal seven zero six, ah I see a traffic below you passing flight level three five seven it's ah same position and ahm Boeing seven three seven eight hundred."* A few seconds later the crew replied, *"Roger we have an ah resolution advisory we ah act (...) accordingly"*, which the ATCO acknowledged with *"Roger"*.

At 16:12:10 UTC the crew of RYP 3595 reported, *"Ryanair three five niner five going back flight level three six zero"*, to which the ATCO immediately answered *"Ryanair three five niner five, three six zero."*

At 16:12:38 UTC the crew of RYP 3595 informed the ATCO as follows: *"Ryanair three five niner five, we are sorry we had a TCAS RA."* The ATCO replied as follows: *"Ryanair three five niner five, yeah I wa..I thought there was a company traffic climbing, now clear of traffic, climb flight level three seven zero."* The crew immediately acknowledged these instructions.

Both aircraft subsequently continued to their destination points.

1.1.4 Location of the serious incident

Position	20 NM south-east of Zurich Airport
Date and time	12 April 2013, 16:11:49 UTC
Lighting conditions	Daylight
Altitude	FL 366

1.2 Personnel information

1.2.1 Crew of RYP 3595

1.2.1.1 Commander

1.2.1.1.1 General

Person	French citizen, born 1980
Licence	Airline transport pilot licence aeroplane – ATPL(A) according to Joint Aviation Requirements (JAR)
Training on TCAS ¹	5 January 2013 (<i>refresher</i>)

All available evidence suggests that the commander started duty well-rested and in good health.

1.2.1.1.2 Flying experience

Total	6052 hours
of which as commander	3835 hours
on the type involved in the incident	2700 hours
during the last 90 days	170 hours
of which on the type involved in the incident	170 hours

1.2.1.2 Co-pilot

1.2.1.2.1 General

Person	Spanish citizen, born 1986
Licence	Commercial pilot licence aeroplane (CPL(A)) according to JAR
Training on TCAS	16 February 2013 (<i>refresher</i>)

All available evidence suggests that the co-pilot started duty well-rested and in good health.

1.2.1.2.2 Flying experience

Total	972:57 hours
on the type involved in the incident	767:00 hours
during the last 90 days	150:38 hours
of which on the type involved in the incident	150:38 hours

¹ The basic concept of this collision avoidance system is known as an airborne collision avoidance system (ACAS). The International Civil Aviation Organization (ICAO) uses this term when drawing up the standards with which the system must comply. The traffic alert and collision avoidance system (TCAS) is a concrete implementation of this concept.

1.2.2 Crew of TAP 706

1.2.2.1 Commander

1.2.2.1.1 General

Person	Portuguese citizen, born 1960
Licence	Airline transport pilot licence aeroplane (ATPL(A)) according to JAR
Training on TCAS	9 December 2012 (<i>refresher</i>)

All available evidence suggests that the commander started duty well-rested and in good health.

1.2.2.1.2 Flying experience

Total	10 562:42 hours
of which as commander	5325:00 hours
on the type involved in the incident	8765:03 hours
during the last 90 days	116:20 hours
of which on the type involved in the incident	116:20 hours

1.2.2.2 Co-pilot

1.2.2.2.1 General

Person	Mozambican citizen, born 1977
Licence	Commercial pilot licence aeroplane (CPL(A)) according to JAR
Training on TCAS	7 December 2012 (<i>refresher</i>)

All available evidence suggests that the co-pilot started duty well-rested and in good health.

1.2.2.2.2 Flying experience

Total	2993:23 hours
on the type involved in the incident	2993:23 hours
during the last 90 days	148:53 hours
of which on the type involved in the incident	148:53 hours

1.2.3 Air traffic control personnel

1.2.3.1 RE air traffic controller

Function	Radar Executive (RE), Sector M4
Person	Swiss citizen, born 1979
Licence	Air traffic controller licence based on European Community Directive 2006/23, issued by the Federal Office of Civil Aviation (FOCA)

All available evidence suggests that the air traffic controller started duty well-rested and in good health.

1.2.3.2 RP air traffic controller

Function	Radar Planner (RP), Sector M4
Person	German citizen, born 1988
Licence	Air traffic controller licence based on European Community Directive 2006/23, issued by the FOCA

All available evidence suggests that the air traffic controller started duty well-rested and in good health.

1.2.3.3 Supervisor 1

Function	Duty Manager Tour 4 (start of duty 14:30 UTC, Supervisor)
Person	Swiss citizen, born 1968
Licence	Air traffic controller licence based on European Community Directive 2006/23, issued by the FOCA

All available evidence suggests that the supervisor started duty well-rested and in good health.

1.2.3.4 Supervisor 2

Function	Duty Manager Tour 3 (start of duty 11:30 UTC, Supervisor)
Person	Swiss citizen, born 1971
Licence	Air traffic controller licence based on European Community Directive 2006/23, issued by the FOCA

All available evidence suggests that the supervisor started duty well-rested and in good health.

1.3 Aircraft information

1.3.1 RYP 3595

Registration	EI-ENK
Aircraft type	B737-800
Characteristics	Twin-jet commercial aircraft
Manufacturer	The Boeing Company, USA
Owner	Ryanair Ltd., Dublin, Ireland
Operator	Ryanair Ltd., Dublin, Ireland
Relevant equipment	Honeywell TCAS II, Version 7.0

1.3.2	TAP 706	
	Registration	CS-TTD
	Aircraft type	A319-111
	Characteristics	Twin-jet commercial aircraft
	Manufacturer	Airbus S.A.S., Toulouse, France
	Owner	International Lease Finance Corporation (ILFC), USA
	Operator	TAP Air Portugal, Portugal
	Relevant equipment	Honeywell TCAS II, Version 7.0

1.4 Meteorological information

1.4.1 General meteorological situation

A shortwave trough was moving eastwards over Central Europe. The Alpine region was at the southern end of this trough, near a jetstream segment which stretched from the Massif Central to the Po Valley.

1.4.2 Weather for the Walensee and surrounding area

Humid air was being conveyed into eastern Switzerland in an active westerly air-flow. The Payerne radiosonde showed unstable stratification up to approximately 21,000 ft above mean sea level (AMSL). Isolated thunderstorm cells were developing in front of and along a convergence line, which at 16:00 UTC was located over the Swiss plateau and the foothills of the Alps. One cluster of cells extended from Lake Lucerne to the Arlberg. The Walensee area was directly below this cluster. According to satellite measurements, the surface temperature of individual cloud towers fell to just below minus 50 °C, which corresponds to a height of approximately 31,000 ft AMSL.

1.4.3 Weather at FL 366 at the time of the serious incident

The atmosphere at FL 366 in the area surrounding the Walensee was cloudless. Analysis of the Payerne radiosonde indicates that there was strong wind shear above FL 340, which was a potential cause of clear air turbulence (CAT).

According to analysis of the radiosonde ascent, the mean equilibrium height of the convective cloud was between 19,300 and 20,700 ft AMSL. Measurement of cloud surface temperatures by Meteosat 10 indicated that individual CB were climbing towards the tropopause at approximately 32,000 ft.

Cloud	No clouds
Visibility	Over 70 km
Wind	245° / 47 kt
Temperature/dewpoint	-51 °C / -73 °C
Hazards	CAT due to wind shear

1.4.4 Astronomical information

Position of the sun	Azimuth: 262°	Elevation: 19°
Lighting conditions	Daylight	

1.4.5 Satellite and webcam images

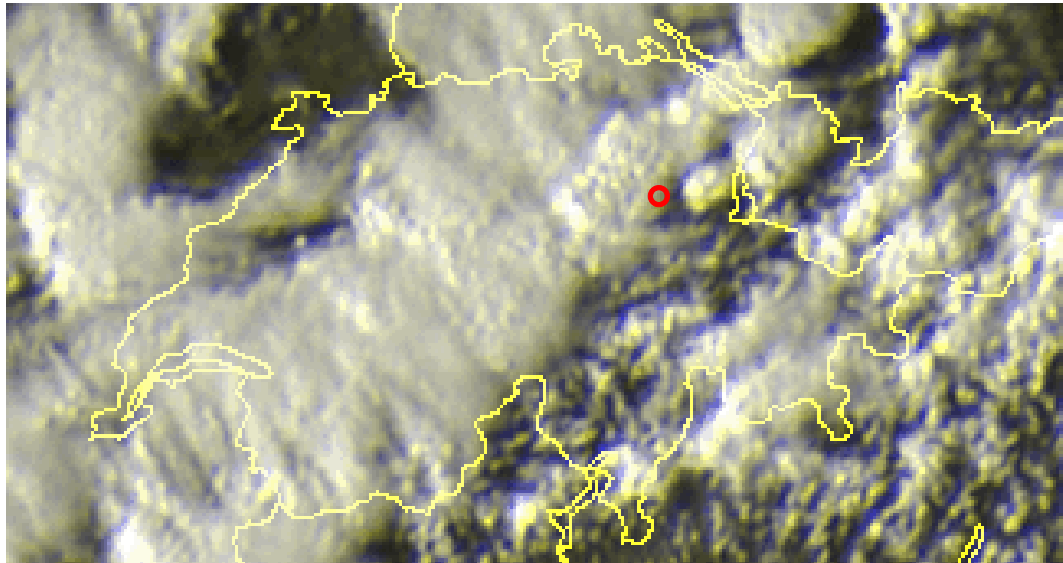


Figure 2: MET10, VIS image of 12 April 2013, 16:00 UTC (<http://www.sat24.com>) (● Location of the serious incident) maximum cloud ceiling approximately FL 295 - FL 320.

1.5 Communications

Radio communication between the crews and the air traffic control units involved (Zurich Upper Sector M4 and Rhine Radar) took place in the English language and without any technical problems.

1.6 Airspace information

1.6.1 Control sector management

Each of the six control sectors (M1 - M6) in the upper airspace (FL 245 - FL 600) of the Zurich Area Control Centre (ACC) has three working positions for air traffic controllers:

- One working position for the Radar Executive (RE) air traffic controller
- One working position for the Radar Planner (RP) air traffic controller
- One working position which can be occupied by a Radar Coordinator (RC) if necessary (high volume of traffic, special weather situations, incidents and emergencies), or a monitoring on-the-job training instructor (OJTI) for training purposes.

According to the statements of the two duty supervisors, the low volume of traffic at the time of the serious incident meant that the Zurich ACC Control Sectors M4, M5 and M6 had been combined into one sector (M4) (cf. Section 1.1.2, Figure 1). The serious incident took place in Class C airspace in the Control Sector M5 altitude band.

1.6.2 Tasks of the Radar Executive (RE) air traffic controller

The general description of the tasks of the RE in the Air Traffic Management Manual (ATMM) - ZURICH ACC – Volume 2, Section 1.1 is as follows:

"The Radar Executive [air traffic control officer] ATCO (RE) is responsible for the provision of radar services in a specified sector. He is assisted by the Radar Planner ATCO (RP)."

1.6.3 Tasks of the Radar Planning (RP) air traffic controller

The general description of the tasks of the RP in the Air Traffic Management Manual (ATMM) - ZURICH ACC – Volume 2, Section 2.1 is as follows:

"Within a specified sector, the Radar Planning ATCO (RP) is responsible for the analysis of the traffic situation and the planning of the traffic in close cooperation with the RE of his sector. He shall perform the necessary coordination. His main duty is to support the Radar Executive ATCO (RE) of his sector."

1.7 Warning systems

1.7.1 Onboard warning systems

Both commercial aircraft involved in the serious incident were equipped with a traffic alert and collision avoidance system (TCAS II, version 7.0).

The system is independent of ground-based systems. It transmits signals and on the basis of the radar response signals from the transponders of other aircraft determines their relative positions and motion vectors. From this it calculates the closest point of approach (CPA). In the case of convergence with another aircraft which is capable of communicating using the system in the manner described, an initial aural and visual traffic advisory (TA) is generated and, in the case of more impending, dangerous convergences, an aural and visual resolution advisory (RA).

The thresholds for triggering the traffic advisories and resolution advisories depend on the respective heights above ground of the two aircraft. If one of the two aircraft suddenly alters its motion vector, it may also directly trigger a resolution advisory.

The TCAS on both aircraft generated resolution advisories. The TCAS onboard TAP 706, which was at FL 370, generated the RA *"Climb, climb!"* The TCAS onboard RYR 3595, which had just left FL 360 to climb, generated the RA *"Descend, descend!"*

1.7.2 Ground-based warning systems

Zurich Air Traffic Control is equipped amongst others with a short-term conflict alert (STCA). This is based on the available radar data and generates a visual and aural warning when two aircraft violate the safe separation minimum defined in the system within a certain time period.

The STCA therefore gives an adequate warning time, which is designed to leave the ATCO sufficient time for an appropriate response.

In the present case, the STCA generated a warning at 16:11:37 UTC; this continued to be displayed until 16:12:01 UTC (cf. Annex 2).

1.8 Flight recorders

The flight data recorder (FDR) and cockpit voice recorder (CVR) on board both aircraft had in the meantime been overwritten and were no longer available for the investigation.

1.9 Organisational and management information

1.9.1 Aviation operators

Both aviation companies' OM A operations manuals specify procedures for the conduct of the crew when a resolution advisory (RA) is triggered.

The following excerpt from Section 8.3.6 of the OM A applies to the crew of RYR 3595, a B737-800:

"8.3.6 Policy and Procedures for the Use of TCAS/ACAS

TCAS is fitted to all Ryanair aircraft. The operating policy and procedures are presented in FCOM Vol. 2 for system description and QRH non-normal manoeuvres. ATC shall be advised of the TCAS commanded manoeuvres with the call "TCAS RA". After the 'Clear of Conflict' Resolution Advisory aural call out is received and a return to the previous ATC clearance or instruction is initiated, ATC shall be advised using the phrase "Clear of Conflict, returning to (assigned clearance)".

If an ATC clearance or instruction contradictory to the TCAS RA is received, the Flight Crew shall follow the RA and inform ATC directly: "Unable, TCAS RA". A SAIR shall be filed for all TCAS RAs."

Furthermore, under "Maneuvers - Non-Normal Maneuvers" the Boeing 737 Flight Crew Operations Manual (FCOM) specifies the following as regards reacting to an RA:

Pilot Flying	Pilot Monitoring
<p><i>If maneuvering is required, disengage the autopilot and autothrottle.</i></p> <p><i>Smoothly adjust pitch and thrust to satisfy the RA command. Follow the planned lateral flight path unless visual contact with the conflicting traffic requires other action.</i></p>	
<p><i>Attempt to establish visual contact. Call out any conflicting traffic</i></p>	

The following excerpt from Section 8.3.6 of the OM A applies to the crew of TAP 706, an A319-111:

"8.3.6 TCAS / ACAS II

POLICY AND PROCEDURES FOR THE USE OF TCAS / ACAS II

When Traffic and Collision Avoidance System (TCAS) / Airborne Collision Avoidance System (ACAS) is serviceable, it shall be used in flight in a mode that enables Resolution Advisories (RA) to be produced unless to do so would not be appropriate for conditions existing at the time. When undue proximity to another aeroplane (RA) is detected by TCAS / ACAS II, the commander or the pilot to whom conduct of the flight has been delegated must ensure that any corrective action indicated by the RA is initiated immediately, unless doing so would jeopardize the safety of the aeroplane.

When TCAS II / ACAS II generates an RA, pilots shall:

- immediately conform to the indications of the RA indication, even if this conflicts with an air traffic control (ATC) instruction, unless doing so would jeopardize the safety of the aircraft, and*
- as soon as permitted by workload, notify the appropriate ATC unit of any RA which requires a deviation from the current ATC instruction or clearance using the ICAO standard phraseology:"*

Furthermore, under "Abnormal and Emergency Procedures" the FCOM specifies the following in relation to reacting to an RA:

TCAS WARNINGS	
Applicable to: ALL	
<p>■ Traffic advisory: "TRAFFIC" messages: Do not perform a maneuver based on a TA alone.</p>	
<p>■ Resolution advisory: All "CLIMB" and "DESCEND" or "MAINTAIN VERTICAL SPEED MAINTAIN" or "ADJUST VERTICAL SPEED ADJUST" or "MONITOR VERTICAL SPEED" type messages: AP (if engaged).....OFF BOTH FDs..... OFF Respond promptly and smoothly to an RA by adjusting or maintaining the pitch, as required, to reach the green area and/or avoid the red area of the vertical speed scale.</p>	
<p><i>Note:</i> Avoid excessive maneuvers while aiming to keep the vertical speed just outside the red area of the VSI, and within the green area. If necessary, use the full speed range between V_{max} and VMAX.</p>	
<p>Respect stall, GPWS, or windshear warning. Notify ATC.</p>	
<p>● GO AROUND procedure must be performed when an RA "CLIMB" or "INCREASE CLIMB" is triggered on final approach:</p>	
<p><i>Note:</i> Resolution Advisories (RA) are inhibited below 900 ft.</p>	
<p>■ When "CLEAR OF CONFLICT" is announced Resume normal navigation in accordance with ATC clearance. AP/FD can be re-engaged as desired.</p>	

Figure 3: Copy from the OM B Part 2, FCOM

1.9.2 Air navigation services company skyguide

1.9.2.1 General service operation organisation

In Switzerland, the supervisor (SPVR) is always responsible for organising the service operation of an air traffic control unit.

The ATMM Switzerland specifies the following in this respect:

"2.8 WATCH SUPERVISION

2.8.1 GENERAL RESPONSIBILITY OF THE SPVR

The SPVR is a generic term for the person responsible for the operation of an ATM unit at a given time. He is in charge of organizing, managing and supervising ATM operations in order to ensure safe, efficient and expeditious services.

The functions of the SPVR may be transferred to any operator qualified to work in the concerned unit, who has received appropriate supervision training (...)

2.8.3 SPECIFIC DUTIES OF THE SPVR

When acting as SPVR, you are responsible for:

- *managing air traffic within your area of responsibility;*
- *ensuring that operating positions are occupied by qualified personnel; (...)*
- *ensuring that a sufficient number of working positions or sectors are manned to face the anticipated load of traffic, based on traffic forecasts and other information of which you are aware;*
- *opening additional working positions or sectors when the actual traffic load exceeds traffic forecasts (...)"*

1.9.2.2 Service operation organisation for the Zurich Area Control Centre

The supervisor (SPVR) is responsible for service operation organisation in the Zurich ACC. He decides when to open and close control sectors on the basis of the expected volume of traffic.

The most important tasks of the Zurich ACC SPVR are stated as follows in the ATMM - ZURICH ACC - Volume 2:

"4 Tasks SPVR-ACC

4.1 General Job Description

SPVR-ACC is the representative of OZ and therefore the SPOC (single point of contact) within the CIR

He shall manage and organize the operational services of ZURICH ACC

He is assisted by SMC and SPVR ANSE

CAP is responsible for the operational services of ZURICH APP

4.2 List of Duties / Tasks

- (...)
- *Planning of the sector configuration according to ...*
- *traffic demand*
- *Staff availability*
- *Other relevant factors (such as weather, airspace available, etc.)*
- (...)
- *Decision on flow measures*
- (...)"

1.9.2.3 Combining sectors

As the aforementioned tasks of the supervisor specify, he is responsible for deciding when to open and close control sectors on the basis of the expected volume of traffic. According to the operational internal report (OIR) of the ATCOs involved on the combined sector M4/M5/M6 and the radio recording, the workload in this sector at the time of the serious incident was very high.

According to the statements of the two duty supervisors, the low volume of traffic meant that the Zurich ACC Control Sectors M4, M5 and M6 had been combined into one sector (M4) at the time of the serious incident (cf. Section 1.1.2, Figure 1).

1.9.2.4 Air traffic capacity analysis

The air navigation services company skyguide analysed the air traffic capacity at the time of the serious incident on behalf of the SAIB. The analysis report produced by the Air Traffic Flow Capacity Management (ATFCM) department specifies the following:

- The full sector capacity of 43 flights per hour was available in the combined sector.
- The figures for the predicted traffic, which were within the sector capacity, meant that it was possible to combine Control Sectors M4, M5 and M6 into a single sector.
- The traffic movements which were subsequently established indicate that numerous changes for the combined Sector M4/M5/M6 occurred at a very late stage and therefore could not be foreseen.

- Between 15:40 UTC and 16:40 UTC, there were 11 additional flights, i.e. a total of 54 flights entered the combined sector. 22 of these occurred between 16:00 UTC and 16:20 UTC alone (equivalent to 66 flights per hour; the number planned for this time period had been 14, equivalent to 42 flights per hour).
- In the ATFCM analysis, skyguide came to the conclusion that the decision to combine the sectors mentioned was correct and in accordance with procedures.
- A few minutes before the serious incident, the volume of traffic increased significantly; this was not foreseeable because the deviations from the forecasts took place at a very late stage.

2 Analysis

2.1 Technical aspects

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

2.2 Human and operational aspects

2.2.1 Crews

When the crew of RZR 3595 asked the Zurich Area Control Centre (ACC) Upper Sector M4 air traffic controller (ATCO) about turbulence on their route, they acted with foresight. After RZR 4492 reported turbulence over the Alps, the crew of RZR 3595 requested clearance to climb as follows: *"Report turbulence now that we are requesting climb flight level three eight zero."* It should be noted that the crew of RZR 3595 failed to mention their radio callsign during this radiocommunication; this deviated from standard phraseology and left the ATCO uncertain as to who had effectively requested clearance to FL 380. This contributed to the occurrence of the dangerous convergence.

The fact that the crew of RZR 3595 acknowledged the clearance to FL 380 issued to RZR 6DW might be attributable to the expectations of the former. It should be noted that the crew of RZR 6DW should have intervened when the clearance to FL 380 issued to them was read back by the crew of RZR 3595. The reason why they did not do so must be left unanswered. Possibly the crew firstly did not expect any clearance because they were already established at their flight level filed in their flightplan, secondly they might have been in doubt whether the clearance was meant for them. Possible doubts were dispelled the moment another crew acknowledged the clearance without any delay and ATC did not intervene.

The fact that the ATCO did not respond to the altitude clearance readback by the crew of RZR 3595 confirmed their assumption that the clearance had been intended for them. The climb that was initiated was the logical conclusion under these conditions and helped cause the occurrence of the dangerous convergence.

Both crews reacted to the visual and aural resolution advisories (RAs) of their traffic alert and collision avoidance systems (TCASs) without delay and in accordance with the procedures prescribed by their aviation operators. Their actions were safety-conscious and helped to defuse the dangerous situation.

2.2.2 Air traffic control

The skyguide analysis report on air traffic capacity at the time of the serious incident (cf. Section 1.9.2.4) was verified and indicates that it is possible for there to be a substantial deviation between the predicted flight movements for a control sector in the Zurich ACC and the actual flight movements subsequently recorded for the same control sector.

The predicted flight movements meant that the decision of the supervisor (SPVR) to combine sectors M4, M5 and M6 into one control sector was in accordance with common practice. In reality, considerably more flight movements took place than had been predicted. Between 16:00 and 16:20 UTC there were 22 flight movements (the number predicted for this time period had been 14). This is attributable to the fact that many additional flights were allowed into the combined sector. The reason for these additional flights was partly due to the fact crews requested unplanned changes in altitude due to the prevailing weather, especially

the prevailing turbulence, and received clearance for this from air traffic control. It is possible to draw the conclusion that too little attention was paid to the prevailing weather conditions when the decision to combine sectors was made.

The combination of sectors M4, M5 and M6 led to high frequency occupation. It is possible that standard phraseology could not be consistently applied due to the high frequency occupation. When the crew of RYP 3595 reported to the ATCO *"Report turbulence now that we are requesting climb flight level three eight zero"*, the ATCO assigned this request to the RYP 6DW. The clearance subsequently issued to RYP 6DW, which had not explicitly requested an altitude clearance, was based purely on assumption. The ATCO also failed to inquire as to who had made the request, which contributed to the occurrence of the dangerous convergence. It is obvious that the ATCO did not realise that the clearance had been read back by the crew of RYP 3595 and not by the crew of RYP 6DW. This can be explained by his expectations: he assumed only the crew he had called would respond. Such expectations (those that do not match actual conditions) are known as expectation errors. In the present case this led to the fact that the crew of RYP 3595 initiated a climb without clearance, thus creating the conditions for a dangerous convergence.

The fact that there were five Ryanair aircraft on the ATCO's frequency at the same time may have complicated the situation. However, the radio callsigns were so different that aural confusion seems to be rather unlikely, particularly as the radio callsign of RYP 6DW was the only one to contain letters.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- Both aircraft were licensed for IFR traffic.
- The investigation produced no indications of any pre-existing technical faults which might have caused or influenced the incident.
- Both commercial aircraft were equipped with a traffic alert and collision avoidance system (TCAS); each system generated a resolution advisory (RA).
- The ground-based short-term conflict alert (STCA) generated a warning.

3.1.2 Crews

- The pilots were in possession of the necessary licences for the flight.
- There are no indications of health conditions which would impair the ability of the pilots to perform their duties during the flight, involved in the serious incident.

3.1.3 Air traffic control personnel

- The air traffic controllers were in possession of the licences necessary to exercise their activities.
- There are no indications of health conditions which would impair the ability of the air traffic controllers to perform their duties at the time of the serious incident.

3.1.4 History of the flight

- At 16:00:53 UTC, shortly before reaching FL 370, the crew of TAP 706 reported to the Zurich ACC Sector M4 air traffic controller (ATCO).
- At 16:01:11 UTC the crew of RYR 3595 reported to the Sector M4 ATCO while at FL 360.
- At 16:03:53 UTC the crew of TAP 706 called the ATCO who did not respond to that call. Instead he gave a heading change to the crew of RYR 3595.
- The crew of TAP 706 called again and requested a heading change with the intention of flying around the turbulence on their planned heading.
- The ATCO subsequently had radio conversations with eleven other crews. Two of them reported that they were *"clear of weather"*.
- At 16:10:20 UTC the crew of RYR 3595 reported to the ATCO and asked if turbulence had been reported on their planned route at FL 380. The ATCO answered this question in the negative.
- Shortly afterwards the crew of RYR 4492 reported turbulence over the Alps to the ATCO.
- At 16:10:43 UTC the crew of RYR 3595 reported to the ATCO as follows: *"Report turbulence now that we are requesting climb flight level three eight zero."*
- At 16:10:47 UTC the ATCO replied as follows: *"Six Delta Whiskey roger, climb three eight zero"*.
- The crew of RYR 3595, and not the crew of RYR 6DW, responded as follows at 16:10:51 UTC: *"Flight level three eight zero, Ryanair three five niner five, thank you"*.

- Neither the crew of RZR 6DW nor the ATCO responded to this clearance readback by the crew of RZR 3595. Three seconds later the ATCO issued another aircraft with clearance to climb to FL 360.
- At 16:11:17 UTC the ATCO requested the crew of TAP 706 to report to the Rhine Radar air traffic control unit, which they did immediately.
- At 16:11:37 UTC, Zurich ACC/APP air traffic control's STCA reported an impending conflict between TAP 706 and RZR 3595.
- The ATCO immediately requested the crew of RZR 3595 to confirm that they were still at FL 360.
- When the crew answered in the negative, the ATCO gave the following instruction two seconds later, at 16:11:49 UTC: *"Descend immediately, traffic three seven zero above"*; this was immediately acknowledged.
- At 16:11:48 UTC, the crew of TAP 706 informed the Rhine Radar air traffic controller that they had received a resolution advisory (RA) from their TCAS.
- At 16:12:38 UTC the crew of RZR 3595 also informed the Zurich ACC Sector M4 ATCO that they had received an RA from their TCAS.
- The ATCO replied as follows: *"Ryanair three five niner five, yeah I wa..I thought there was a company traffic climbing, now clear of traffic, climb flight level three seven zero."*
- Both RZR 3595 and TAP 706 subsequently continued to their destination points.

3.1.5 General conditions

- The air traffic control unit had combined the three sectors M4, M5 and M6 on the basis of the predicted volume of traffic.
- Between 16:00 UTC and 16:20 UTC there were 22 flight movements (the number predicted for this time period had been 14).
- The prevailing weather conditions meant that flight crews increasingly requested changes from their intended course and altitude.

3.2 Causes

The serious incident is attributable to the fact that the crew of a commercial aircraft initiated a climb without clearance, which led to a dangerous convergence with another commercial aircraft.

The following factors were identified as the cause of the serious incident:

- The crew initiated the climb on the basis of a clearance which had been issued to another commercial aircraft belonging to the same aviation operator.
- The air traffic controller did not realise that the clearance issued was not read back by the crew for which it had been intended.

The following was identified as a contributing factor to the serious incident:

- A request by a flight crew for clearance to a higher flight level without specification of their radio callsign;
- The issue of altitude clearance by air traffic control without verification of the crew which had made the request;
- Absent reaction of another crew to whom the clearance was addressed to;
- Insufficient attention was given to the prevailing weather conditions when the decision to combine sectors was made.

4 Safety recommendations and measures taken since the serious incident

4.1 Safety recommendations

None.

4.2 Measures taken since the serious incident

4.2.1 Aviation operator Ryanair

The aviation operator Ryanair informed in a writing of 12 May 2014 that amongst others the following measures have been taken:

- *"Developed robust Standard Operating Procedures in level bust prevention (...).*
- *(...)*
- *Mid Air Collision (MAC) has been identified as one of our 10 Key Operational Risk Areas in our Corporate Safety Strategy. All MAC events are tracked and analysed by the Flight Safety Office to identify adverse trends both strategically and tactically. Each event is risk classified using the Aviation Risk Management Solutions (ARMS).*
- *The Flight Safety Office has developed a Bowtie Risk Assessment model for MAC and all TCAS RA events are analysed in conjunction with the Bowtie model to identify weaknesses and strengths both within the protective and recovery barriers.*
- *This threat was highlighted and communicated to all our flight crews during the 2013/2014 Flight Safety Roadshow under Level Bust Prevention, Top Ten Causal Factors (all airlines) – Correct read back by incorrect aircraft. This threat is very difficult to mitigate against unless ATC or other aircraft identify the mistake.*
- *The Flight Safety Roadshow also highlighted the threat of multiple Ryanair aircraft operating on the same frequency, the report also identified the threat of multiple aircraft of the same operator in the same sector and the threat that the ATC controller did not identify that the clearance was read back by the incorrect aircraft.*
- *The report also identifies the escalation factor that the prevailing weather conditions, upper level turbulence, contributed to the event. This factor has been included in the Ryanair MAC Bowtie as an escalation factor following this investigation.*
- *(...). The report will be made available on the flight crew website once it is published."*

4.2.2 Air navigation services company skyguide

The air navigation services company skyguide informed in a writing of 24 April 2014 that, as of 10 December 2013, the following system was put into operation in the area control centre (ACC) of Zurich under the project name 'operational deployment of enhanced mode-S (EHS)':

"Mit stripless step 2 wurde das enhanced mode-S cleared level adherence monitoring-tool (EHS CLAM) in Betrieb genommen. Dabei wird die freigegebene Höhe nach Eingabe im skyvisu mit der im Flugzeug eingestellten Höhe (selected altitude) abgeglichen. Einer Diskrepanz folgt eine sofortige, visuelle Warnung."

[With stripless step 2, the enhanced mode-S cleared level adherence monitoring-tool (EHS CLAM) was put into operation. Therein, the cleared altitude, after being

inserted into skyvisu, is compared with the selected altitude on board the aircraft. In case of discrepancy, an immediate visual warning is issued.]

Furthermore, skyguide informed in that writing the following:

"Das Thema 'importance of read-backs' wird im ACC-Simulator fresh-up behandelt. Die Simulatortage, welche jeder ACC FVL durchlaufen muss, finden vom 24. März bis 10. April 2014 statt."

[The subject 'importance of read-backs' is part of the ACC-simulator fresh-up. The simulator days, every ACC ATCO has to pass through, take place from 24 March 2014 till 10 April 2014.]

Payerne, 24 September 2014

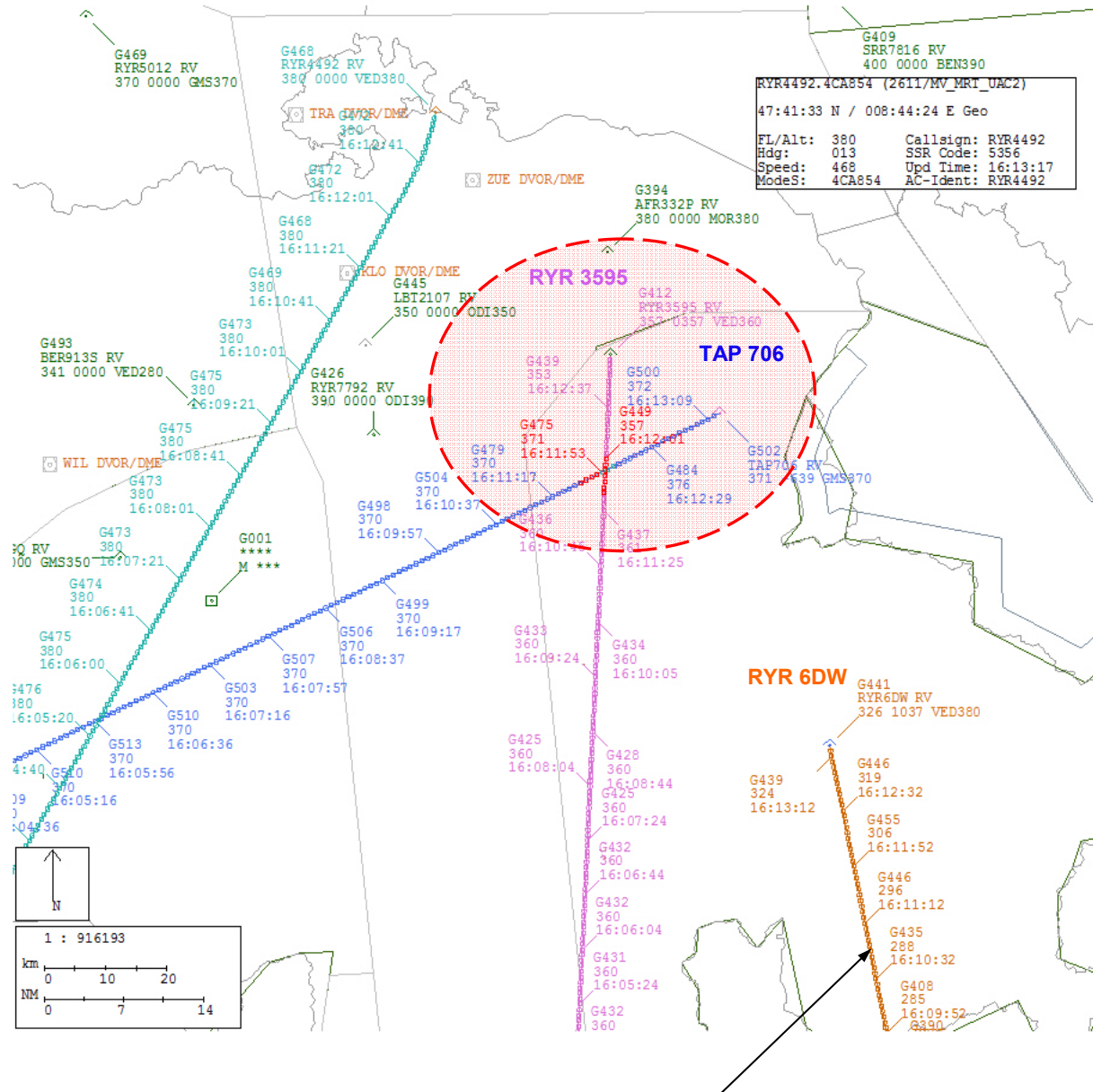
Swiss Accident Investigation Board

This final report was approved by the management of the Swiss Accident Investigation Board SAIB (Art. 3 para. 4g of the Ordinance on the Organisation of the Swiss Accident Investigation Board of 23 March 2011).

Berne, 9 October 2014

Annexes

Annex 1: Radar plot of the traffic situation



Legend:

- G435 Ground speed: 435 knots
- 288 Altitude in hundreds of feet
- 16:10:32 Time (UTC)

Annex 2: Radar plot at the time of the STCA-alert

