



## Investigation report

C 10b/2002 L

# Loss of Separation in the Turku Terminal Area on October 31, 2002

OH-SAI	Avro RJ85
SE-LNV	Jetstream 32

According to Annex 13 of the Convention on International Civil Aviation, paragraph 3.1, the purpose of aircraft accident and incident investigation is the prevention of accidents. It is not the purpose of aircraft accident investigation or the investigation report to apportion blame or to assign responsibility. This basic rule is also contained in the Investigation of Accidents Act, 3 May 1985 (373/85) and European Union Directive 94/56/EC. Use of the report for reasons other than the improvement of safety should be avoided.

## SUMMARY

On Thursday 31 October 2002 at 16.37 local time there was an aircraft incident approximately 43 km west-south-west of Turku airport. An Air Botnia Oy Avro RJ85, call sign KFB662 on a scheduled passenger flight from Copenhagen to Turku, and an European Executive Express Jetstream 32, call sign EXC316 on a scheduled passenger flight from Turku to Mariehamn, passed each other at an altitude of about 2500 m with opposite headings and the separation was lost. The pilots of KFB662 noticed EXC316 on their TCAS display, aborted their descent and remained level at flight level 85. Also the pilots of EXC316 noticed the opposing traffic on their TCAS display and maintained their cleared flight level 80. The commander of KFB662 obtained visual contact with the lights of EXC316 6-7 seconds before the aircraft passed each other. The Accident Investigation Board Finland decided on 11 November 2002 to investigate the incident and appointed airline pilot Jussi Haila as the investigator-in-charge. MSc Ville Hämäläinen and air traffic controller Erkki Lepola were appointed as members of the investigation commission.

At the time of the incident the traffic was handled by an air traffic controller student of Avia College who was on an on-the-job training period. The air traffic controller on duty had moved to a distance of approximately 2-3 metres from the working position and dictated the clearances which the student relayed to the aircraft. EXC316 had received an enroute clearance from Turku to Mariehamn at flight level 80. KFB662 had received a clearance to descend to flight level 100 from Tampere Area Control Centre and contacted Turku when instructed by the ACC when approaching flight level 100 at a distance of approximately 65 km. The air traffic controller dictated to the student a clearance for KFB662 to TURKU via PERKA 3B arrival and to descend to 3200 feet on QNH 1011. The student relayed the clearance to the aircraft. The air traffic controller had forgotten the departing EXC316 and cleared KFB662 to descend through the altitude of EXC316. He did not notice the mistake before KFB662 asked about the opposite traffic the pilots had noticed on the TCAS (Traffic alert and Collision Avoidance System). The air traffic controller started to handle the traffic after the question but it took a while before the situation was under his control. The student was not in an educational situation to handle traffic in the working position nor was it permitted by Avia College guidelines. She also had no possibility to detect the conflicting clearances based on her education. The air traffic controller did not use the flight strip markings made by the student nor the radar monitor in the control tower, but operated based on his memory and the radio traffic from the loudspeakers.

The minimum vertical separation between the aircraft was 500 feet (150 m) without the required horizontal separation. KFB662 climbed back to flight level 90 before the aircraft passed each other and the vertical separation was the required 1000 feet. There was no danger of collision due to the vigilance of the KFB662 pilots.

The investigation commission recommended that the Finnish Civil Aviation Administration and Turku airport would develop an administrative model aiming to the safety of operations. The commission also recommended that the radar monitor would be more actively used and better located in Turku. It was also recommended to formulate on-the-job training guidelines and schedules and nominate on-the-job trainers in Turku. The commission recommended that Avia College would prepare a co-operation agreement with Turku airport.

The comments received for the draft report have been taken into account in the final version.

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## LIST OF ABBREVIATIONS

ACC	Area control centre
ANS	Air Navigation Services
ATC	Air traffic control
ATS	Air traffic services
FCAA	Finnish Civil Aviation Administration
COM	Communication
DME	Distance measuring equipment
FL	Flight level
FOR	Flight occurrence report
IFR	Instrument flight rules
JAR	Joint aviation requirements
METAR	Aviation routine weather report
MHz	Megahertz
MSSR	Monopulse secondary surveillance radar
NM	Nautical mile
PF	Pilot flying
PHI	Confidential reporting system
PNF	Pilot not flying
QNH	Altimeter sub-scale setting to obtain pressure altitude above mean sea level
RA	Resolution advisory
RAC	Rules of the air and air traffic services
TA	Traffic advisory
TAF	Terminal area forecast
TCAS	Traffic alert and collision avoidance system
UTC	Co-ordinated universal time
VFR	Visual flight rules
VHF	Very high frequency
VOR	VHF omnidirectional radio range
VMC	Visual meteorological conditions



## **1 FACTUAL INFORMATION**

### **1.1 Sequence of events**

#### **1.1.1 Flights involved in the incident**

The incident took place on Thursday, October 31, 2002, at 14.37 in the Turku terminal area at a distance of about 23 NM west-southwest from VOR/DME RUSKO between flight levels 80 and 90 (about 2600 m). EXC316 was flying at FL 80 (2450 m) in accordance with the Turku air traffic control clearance and KFB662 was descending in opposite direction to the altitude of 3200 ft (975 m) cleared by the Turku air traffic control at the altimeter setting pressure of QNH 1011. In the incident area the lowest limit of the Turku terminal area is 1500 ft above sea level and the upper limit is FL 95. The Turku tower and approach control is responsible for this area which is categorized as air space class D.

KFB662 (OH-SAI) was a four-engine commercial aircraft Avro RJ85 with a 79 passenger seat configuration. The aircraft was on a scheduled flight from Copenhagen to Turku, operated by Oy Air Botnia Ab. There were 13 passengers and a crew of four on board.

EXC316 (SE-LNV) was a twin-engine light commercial aircraft Jetstream 32 with a 19 passenger seat configuration. The aircraft was on a scheduled flight from Turku to Mariehamn, operated by European Executive Express. There were 16 passengers and a crew of two on board.

The sun set in Turku at 14.35. Twilight conditions prevailed. In the entire report all times are given in co-ordinated universal time (UTC), i.e. Finnish normal time minus two hours.

#### **1.1.2 Events in the Turku air traffic control**

In the afternoon of Thursday, October 31, 2002, one air traffic controller was on duty in the Turku combined tower and approach control. At the same time there were two air traffic controller students from Avia College on a two-week familiarisation visit in accordance with their syllabus to learn about different operations at the airport. They spent their time in the air traffic control because no program had been arranged for them at that time. The air traffic controller asked them: *"Would you like to play at being an air traffic controller?"* One of the students had handled radio communications at the controller's workstation the night before while being alone with the same controller in the air traffic control. Now the other student answered affirmatively and took a seat at the workstation. There was no entry of the students' work in air traffic control log.

During the interviews the investigation commission found out that both the air traffic controller and the students were aware that in accordance with Avia College's instructions the purpose of the students' current visit to the airport did not comprise practicing

of air traffic controlling. Nor did their educational progress qualify them for approach controller's work. Their procedural approach control training did not begin until January 2003.

The air traffic controller moved back two to three meters to the right from the student who was sitting at the workstation. At that time daylight conditions prevailed and the visibility was good. The traffic consisted of VFR flights in terminal area. The students had practiced handling this kind of traffic in Avia College's simulator. The student handled the radio communications, made notes of the traffic on the controller's flight strips and took care of the Air Navigation Services system (ANS). She worked well.

The air traffic controller took care of the telephone communication and also made some phone calls not related to operative air traffic control. He could hear the radio communications from the air traffic control loudspeakers and gave air traffic control clearances which the student forwarded by radio to the aircraft. In the Turku air traffic control there was no possibility of monitoring/override system for supervising telephone and radio communications in training situations in accordance with the Finish Civil Aviation Administration's instructions for on-the-job training.



Figure 1. The air traffic controller's view from his position

In the beginning the other student was at a computer working station located at about two meters behind the back of the person working at the controller's workstation. The terminal is not used for operative air traffic control work, but controllers off duty and on sick leave use it for example in their own data communications. At some point this stu-

dent moved so that he was between the student at the workstation and the air traffic controller, which further limited the air traffic controller's possibility of getting information from the strips or radar monitor. An air traffic controller on sick leave came to the air traffic control and took a seat at the above-mentioned computer terminal.

The traffic had now changed into IFR flights, i.e. three departing and one arriving aircraft. The student noticed that she was not able to handle IFR traffic and asked for help from the air traffic controller who let the student still continue her work at the workstation and dictated the clearances to be forwarded to the aircraft by the student. Due to the air traffic controller's location and distance he could not follow the student's annotations on strips or see the radar monitor display because the monitor was hidden by the student seated at the workstation. The monitor is quite small and therefore it is impossible to interpret the screen at a distance exceeding two meters.

The air traffic controller dictated the clearances based on the radio traffic from the loudspeakers and on his own memory. The first aircraft to depart was a Piper 31, OH-PNX, to Mariehamn at 14.20. The air traffic controller dictated the route clearance FL 60, which the student at the workstation forwarded to the aircraft. Next EXC316 requested start-up clearance. The aircraft was taxiing when the student forwarded to it the air traffic controller's route clearance: *"EXC316, cleared to Mariehamn, T86, flight level 80, squawk 3236."* The crew read back the clearance correctly. Runway 08 was in use at Turku, but the student gave, according to the controller's instruction, to EXC316 takeoff clearance runway 26 at 14.32 hrs after checking the location of OH-PNX. After this the student instructed OH-PNX to contact the Tampere area control centre.

KFB419 received start-up clearance at 14.34. The air traffic controller received a phone call from the area control centre at 14.35: *"Botnia 419 may be cleared to FL 200 taking into account Botnia 662."* The student forwarded the clearance to the taxiing KFB419 at 14.37: *"Botnia 419, cleared to Arlanda, T81, flight level 200, after departure maintain flight level 90 or below until on radial 228, squawk 2256."* The first officer read back the clearance correctly and asked: *"Botnia 419, is that radial 228 restricting, to be intercepted and a distance or why?"* The student replied: *"Botnia 419, follow radial 228 from Rusko until further notice after departure, area control will reclear you."*

The air traffic controller received a call at 14.38. The area control centre reported: *"Botnia 662 released."* The air traffic controller acknowledged: *"Released."* During the phone call KFB662 contacted on radio: *"Turku tower afternoon, Botnia 662 through 110 to flight level 100, information Kilo and 35 miles."* At 14.39 the student forwarded the clearance ordered by the air traffic controller: *"Botnia 662, cleared to Mapus PERKA 3B arrival, expect VOR/DME approach runway 08, no delay, continue descending to 3200 feet."* The first officer read back the clearance correctly. The student still reported: *"New QNH 1011."* The aircraft acknowledged the QNH.

KFB662 approached Turku from Mariehamn direction with a clearance to 3200 ft. EXC316 climbed in opposite direction cleared to FL 80. At 14.39.41 KFB662 requested: *"Turku tower, 662, we have an aircraft in front, on the TCAS, 1400 below, climbing, where is it going?"* At 14.39.51 the air traffic controller asked: *"Botnia 41, correction Bot-*

nia 662, did you ask about TCAS or what?" At 14.39.57 KFB662 replied: "Yes, it is about 10 miles in front of us, opposite, less than thousand feet and climbing". KFB662 reported slightly later: "Now maintaining". At 14.40.07 the controller replied: "Yes, wait a minute." At 14.40.10 the controller said: "Maintain that level 90." At 14.40.15 KFB662 replied: "Climbing back to 90, 662, we have 86 now." The distance between EXC316 and KFB662 decreased to about six nautical miles during this conversation. The distance between the two aircraft was four nautical miles (about 7.4 km), when KFB662 again reached FL 90 at 14.41.10. The minimum vertical distance between the aircraft was about 500 ft (150 m). KFB662 reported to have received a TA. The controller did not reply to the request of KFB662 about opposite traffic until the aircraft had landed.

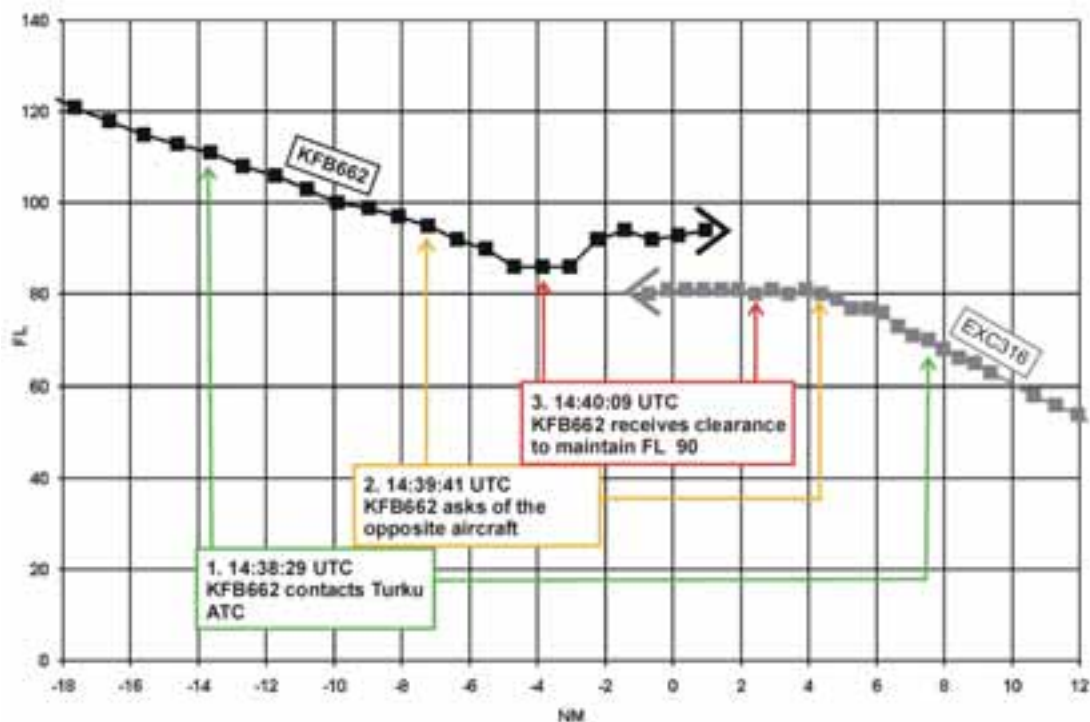


Figure 2. Altitude profiles of KFB662 and EXC316 based on the radar recording

At 14.39, right before the above-mentioned conversation, KFB419 had reported to be ready for departure. At 14.40 the controller cleared it in to takeoff position and changed the given clearance instructing to maintain 2200 ft or below until on radial 223. At 14.43 KFB419 reported to maintain 2200 ft and received from the controller clearance to maintain altitude until 10 NM from RUSKO VOR/DME. After this the controller requested from KFB662 whether runway 26 would be ok for them to land adding that in this way it would be easier for them to pass each other. KFB662 replied affirmatively and requested the wind. At 14.46 KFB419 reported to be at a distance of 10 miles on radial 223 at an altitude of 2200 ft. The controller cleared it to turn on route and to climb to FL 200. Immediately after this KFB662 reported being on the right-hand down-wind leg to runway 26. The controller cleared it to land.



EXC316 did not report having reached FL 80, but reported at 14.43: *"Echo Express 316, we are 27 miles from Rusko."* Thereafter the controller instructed it to change to the ACC radio frequency.

The Turku air traffic control had information on a controller flight strip about the arriving KFB662 and its estimated arrival time to Turku at 14.48. In accordance with the air traffic control units' letter of cooperation the ACC had cleared the aircraft to FL 100 and instructed it to contact the Turku air traffic control on radio at the usual location while approaching the boundary of the terminal area. The ACC informed about the releasing to Turku by phone and had informed about three minutes earlier that the departing KFB419 was allowed to climb to FL 200 observing KFB662. With the intention of taking into account the arriving traffic the original clearance instructed KFB419 to follow radial 228 from the VOR beacon RUSKO after departure.

The air traffic controller filled out an incident report complying with GEN M1-4 of the National Aviation Regulations and a confidential report of the Finnish Civil Aviation Administration.

### 1.1.3 Cockpit crew actions

KFB662 was approaching Turku from the southwest. The ACC for South Finland had cleared it to FL 100 and issued arrival route PERKA 3B and runway 08 which was the runway in use. The commander acted as pilot flying (PF) and the first officer as pilot not flying (PNF). The ACC instructed the aircraft to contact the Turku air traffic control in the standard location at a distance of about 35 NM from Turku while reaching FL 100. The pilots heard radio traffic in Finnish on the Turku frequency. The first officer contacted Turku in Finnish. KFB662 received from the air traffic control in Finnish clearance for approach on arrival route PERKA 3B and a clearance to descend to 3200 ft, clearance limit being reporting point MAPUS. The air traffic control did not report QNH. The first officer requested it and then the control reported QNH 1011.

The pilots had set their TCAS display at the range of 20 NM. They noticed an opposite climbing aircraft at a distance of about 15 NM on their display and enquired about the opposite traffic from the air traffic control. After short delay another voice than earlier on the frequency made a counter question: *"Botnia 419, I correct Botnia 662, did you ask about TCAS or what?"* The commander had started to decrease the aircraft's rate of descent. Their TCAS generated a TA: opposite aircraft symbol turned yellow and voice alert was heard: *"Traffic, traffic"*. The commander disengaged the autopilot and continued by steering manually. The first officer reported on radio that the opposite was at a distance of 10 NM 1000 ft below climbing. The commander levelled the aircraft at FL 85. The pilots noticed that the opposite remained on level flight 500 ft below them, which the first officer reported to the air traffic control. The air traffic control replied: *"Yes, wait a minute."* Slightly later when KFB662 was at FL 86, the air traffic control instructed it to maintain FL 90. The commander initiated climb and the first officer reported on radio: *"Climbing back to 90, 662, we have 86 now."*

KFB662 was flying above clouds in VMC conditions, but the pilots did not obtain visual contact with the opposite aircraft at this time. During the interview the commander stated that he had obtained visual contact with the opposite aircraft's lights six to seven seconds prior to the passage. The other aircraft passed KFB662, which had reached FL 90, on the left side below. In the interview the first officer stated that he did not see the opposite aircraft at all during the incident. The pilots heard that EXC316 changed to the ACC frequency shortly later and came to the conclusion that it was the opposite aircraft.

The Turku air traffic control had cleared EXC316 to Mariehamn at FL 80. The cockpit crew of EXC316 did not understand Finnish or the clearance given by the air traffic control to KFB662 crossing the EXC316 cruising altitude or the conversation between KFB662 and the air traffic control about the TCAS observation. According to the commander of EXC316 they too observed the opposite aircraft on their TCAS display. They did not, however, receive any TA.

In their reports both the operator European Executive Express and the commander of EXC316 complained about the use of the Finnish language in international radio communication because the pilots of the company do not understand Finnish.

The commander of KFB662 filled out Air Botnia's flight occurrence report (FOR) which the company delivered to the Flight Safety Authority.

#### **1.1.4 Avia College's instructions**

Avia College had in advance sent a letter to Turku Airport about the students' introductory visit to the airport. In the letter it had asked the airport to prepare a daily program and an instructor-specific training program for the students' two-week training phase. The letter emphasized that this was the students' first extensive contact with airport operations. The college defined the purpose of this training phase to be an introduction to the different branches at the airport and their operative tasks as well as to the tasks of the operators' ground organisations.

The instructions of the college stated that the students intended to familiarise themselves with and to follow the operations of administration, communication and electrical branches, rescue services as well as aviation companies and communities. Whenever possible they should participate in the work of airport terminal service and maintenance branches and definitely participate in on-the-job training in briefing.

As to the air traffic control the letter from the college instructed as follows: *"Presentation of the branch and the job description. Provision of services to the air traffic and ground traffic. Presentation of tools, but no in-depth introduction to separation."* The students' procedural approach control training was planned not to be started until at the beginning of 2003. For this reason they had no qualifications for establishing separations or working in approach air traffic control.

The person responsible for training in Turku air traffic control was on sick leave, and consequently no-one prepared an introductory program required by Avia College. Ac-

cording to the Manager of Turku Airport no preparations were made for training the students because *"Avia College is not in a position to give orders to Turku Airport."* The Finnish Civil Aviation Administration's rules of procedure state that the responsibility for air traffic controllers' on-the-job training lies on the profit centres, in this case on Turku Airport. The students had stayed at the airport for ten days before the incident. They had visited different offices and their study books had been appropriately marked. The offices had not made arrangements for training them. For lack of preparations also practicing in briefing was insignificant. The students spent most of their time in the air traffic control tower.

## 1.2 Injuries to persons

No injuries.

## 1.3 Damage to aircraft

No damages.

## 1.4 Other damage

No other damages.

## 1.5 Personnel information

<b>Air traffic controller:</b>	Male, 57 years
Licence:	Air traffic controller, valid until April 28, 2003
Medical certificate:	Air traffic controller medical certificate valid until April 28, 2003
Ratings:	All necessary ratings were valid.

<b>Air traffic controller student:</b>	Female, 21 years
Licence:	No licence

The student was in a study period complying with Avia College's syllabus and which consisted of familiarisation with different operations at the airport. She had completed tower controller training and practised aerodrome traffic circuit control in the simulator of the college. She had not yet completed approach controller period which includes procedural approach control training.

<b>Commander of KFB662:</b>	Male, 40 years
Licence:	Airline transport pilot, valid until October 8, 2006
Medical certificate:	JAR class 1, valid until May 3, 2003
Ratings:	All necessary ratings were valid.

The commander's total flight experience was about 8400 hours of which about 500 hours on Avro RJ85.

**First officer of KFB662:** Male, 30 years  
Licence: Commercial pilot, valid until January 9, 2007  
Medical certificate: JAR class 1, valid until September 1, 2003  
Ratings: All necessary ratings were valid

The first officer's total flight experience was about 2100 hours of which about 360 hours on Avro RJ85.

**Commander of EXC316:** Male, 62 years  
Licence: Airline transport pilot, valid until June 5, 2006  
Medical certificate: Class 1 (Norway), valid until May 3, 2003  
Ratings: All necessary ratings were valid

The commander's total flight experience was about 19145 hours of which 437 hours on Jetstream 31/32.

**First officer of EXC316:** Male, 35 years  
Licence: Commercial pilot, valid until March 24, 2003  
Medical certificate: JAR class 1, valid until February 18, 2003  
Ratings: All necessary ratings were valid

The first officer's total flight experience was about 1600 hours of which 500 hours on Jetstream 31/32.

## 1.6 Aircraft

KFB662, Avro RJ-85, OH-SAI, four-engine commercial jet aircraft with a 79 passenger seat configuration, operated by Oy Air Botnia Ab, max. takeoff weight 42180 kg.

EXC316, Jetstream 32, SE-LNV, twin-turboengine light commercial aircraft with a 19 passenger seat configuration, operated by European Executive Express, max. takeoff weight 7350 kg.

## 1.7 Weather

An occluded front was approaching South-West Finland from west and it was forecast to reach Turku in the evening of October 31, 2002. There were middle clouds in front of the front. Winds were light, at FL 100 westerly wind 15-20 knots. In connection with the front Turku was forecast rain and snow in the evening.

Terminal area forecast (TAF) for Turku valid between 12.00 and 21.00 UTC:

Wind 130°/7 kt, visibility over 10 km, clouds 1-2/8 2000 ft, forecast between 16.00 and 18.00 visibility 6 km, rain and snow, clouds 5-7/8 1000 ft, occasionally between 18.00 and 21.00 visibility 2 km, rain and snow, clouds 3-4/8 400 ft.

Weather observations (METAR):

At 14.20: Wind 120°/5 kt, visibility over 10 km, clouds 5-7/8 3900 ft, 1-2/8 25000 ft, temperature 0 °C, dew point -5 °C, QNH 1011.

At 14.50: Weather exactly similar to previous observation.

## **1.8 Aids to navigation**

Navigation equipment had no significance to the incident.

## **1.9 Radio communications**

Radio communications were listened to on the frequency of 118.300 MHz of Turku Airport. The quality of radio transmissions was good.

The Turku air traffic control used Finnish in its radio communications with KFB662. The pilots of EXC316 did not understand the conversations in Finnish. At the same time only KFB419 was on the frequency and the air traffic control used Finnish also with it.

The Turku air traffic control used the frequency of 118.300 MHz, although its use in accordance with the Civil Aviation Administrations' ATS instruction and rule COM 2, (dated December 31, 1996), is limited to only 25 NM radius with upper limit of FL 40. The Accident Investigation Board Finland paid attention to the matter in its investigation B 6/2001L. In the respective investigation report The Civil Aviation ANS department gave the following statement: *"The flight safety department will take measures so that radio frequency user rights cover the responsibility areas of the ATS units in both vertical and horizontal direction."*

Also another radio traffic frequency (121.100 MHz) has been reserved for Turku covering the entire responsibility area.

## **1.10 Airport**

The airport did not have any significance for the incident.

## **1.11 Flight recorders**

Data from flight recorders were not available in the investigation.

## 1.12 Organisational and management information

The Civil Aviation Authorities' rules of procedure establish that the duty of an airport, as profit centre of a public-service company, is to provide passenger, ground traffic, ramp, traffic area and ANS as well as other commercial services related to airport operations. The airport manager leads the operations at Turku Airport and at the same time acts as area manager of the co-operation area of West Finland. Branch supervisors lead the air traffic control services and technical communication system operations for the ANS, and the branch manager is in charge of the airport maintenance. They are subordinated to the airport manager. The Civil Aviation Administrations rules of procedure establish that airports are responsible for air traffic controllers' on-the-job training.

The Turku air traffic control is a combined tower and approach control. Usually one air traffic controller is on duty in the air traffic control who takes care of providing both the tower and approach services. The air traffic control has no radar at its disposal, but it functions as a so-called procedural control. A radar monitor has been placed on the left side of the controller's working position enabling the air traffic controller to follow the traffic shown by the ACC's MSSR radar (monopulse secondary surveillance radar) allocated to Turku Airport. The ANS department's ATS instruction and rule RAC 59 state that the equipment must not be used for separation, but only as auxiliary informative device to facilitate traffic planning. Flight safety can be improved by using the equipment in following up and controlling traffic complying with the procedures specified in the instruction.

The ANS department of the FCAA is responsible for e.g. the safety and quality management of the air navigation services in the entire area of Finland, as well as for air-space use and flight procedure planning and air traffic service systems, their development and follow-up of their functionality. The ANS department is in charge of matters related to training in the branch and of co-ordinating their arrangement with Avia College.

The ANS department has issued instructions for on-the job training on October 31, 1994. They define the target as follows: "*The purpose is that only an on-the-job instructor with appropriate education gives on-the-job training in the future.*" Air traffic control units were obliged to arrange and prepare instructions for on-the-job training complying with the said instructions and to deliver the on-the-job training instructions signed by the air traffic control manager to the operative office of the ANS department by December 31, 1994. The ANS department had in its letters dated August 24, 1998 and June 15, 1999, drawn the receivers' attention to defective workstation arrangements in air traffic controls from the training point of view and urged the airports to immediately take corrective actions and to inform to the ANS department by August 30, 1999, that the required technical arrangements had been completed. These arrangements had not been made at Turku Airport by the time of the investigation commission's visit to the air traffic control on November 20, 2002.

Avia College is the FCAA's training unit authorized by the Civil Aviation Authority. It operates in accordance with the regulations established for vocational education and adult

education. Avia College's function is to provide vocational basic and additional education requested by the FCAA's different branches and profit centres to maintain and improve the staff's professional skills. These are e.g. air navigation training, basic and additional training of airport operations as well as occupational training and preparatory training for specialized professional examinations, apprenticeship contract training and passenger safety-related training. The college is responsible for air traffic controllers' basic training and qualification training until the student has got his/her air traffic controller licence and rating to work in some air traffic control. The FCAA orders this training from Avia College and recruits its air traffic controllers among the persons trained by the college. The FCAA's airports provide posts for the students during their on-the-job training. The air traffic controllers' examination has been drastically developed during the last two years on account of the regulations of the Aviation and Education Authorities. This incident occurred in the middle of training system's three years transition phase.

Avia College had not checked the suitability of the Turku air traffic control for air traffic controllers' on-the-job training and had not secured that the above-mentioned arrangements in accordance with the ANS department's instructions for on-the-job training had been made. After the above-mentioned on-the-job training instructions had been issued, Turku Airport had been used as on-the-job training site for air traffic controller students every year. Avia College's instructors have not visited Turku to follow the students' work during their practising period. In other professional fields corresponding training is essentially connected to close co-operation between the educational institute and the company providing posts for students, and to jointly performed follow-up of training and proficiency assessment.

In Avia College's new training plan, which has been completed after this incident and accepted on 19.9.2003, the contents, targets and guidance of the on-the-job training have been improved. The on-the-job training tutors are trained for their duties together with the instructors of Avia College. Due to lack of instructor resources a closer training co-operation between the College and airports was not possible at the time of this incident.



## 2 ANALYSIS

### 2.1 Air traffic control operations

The South Finland ACC released KFB662 arriving from Copenhagen to the Turku air traffic control when the aircraft was at a distance of about 35 NM from VOR/DME RUSKO at FL 110 descending to FL 100. The air traffic controller student forwarded to KFB662 the arrival clearance given by the air traffic controller clearing it to descend to 3200 ft on QNH 1011. The clearance was through the clearance altitude FL 80 of EXC316 flying in the opposite direction. The information in the air traffic control flight strips at the workstation corresponded to the given clearances.

The air traffic controller student practising radio communication phraseology did not notice, nor was it possible to notice in this phase of her training, that she cleared KFB662, in accordance with the air traffic controller's instructions, to descend through the altitude of EXC316 flying in the opposite direction. The controller did not notice the error because he was not fully aware of the traffic situation. Due to his location he could not see the flight strip information or the radar monitor. He had neither followed the strip annotations nor watched the radar monitor, but had started to handle the traffic based on the radio communications and his memory. He had forgotten EXC316 or possibly mixed it with OH-PNX which had flown on the same route and had already left the approach area.

Both two students sat at the controller workstation at the same time. If the air traffic controller had intended to train them as he told during the interview, they should have worked at the workstation one at a time and the controller himself should have been at the workstation so that all information would have been available for him all the time and it would have been possible for him to immediately intervene in case of error. In a training situation the responsibility for handling the traffic lies on the instructor. The air traffic controller should have prevented the second student from taking a seat at the workstation beside the first student.

It is not allowed to let a person without appropriate training to perform the controller tasks to be seated at the controller workstation. The air traffic controller student working at the controller position should have been removed from the workstation at the latest when the traffic changed character from VFR to IFR traffic because the student was lacking required training to handle IFR traffic. The student who had handled the radio traffic told in the interview that she felt familiar with the VFR traffic but when the traffic changed she noticed that she could not any longer handle it and asked for help. The air traffic controller should have understood at the latest in this phase that the student did not have qualifications for practising at the workstation and should have taken over his duties.

The air traffic controller and the air traffic controller student did not notice the loss of separation and generation of the incident until KFB662 reported to have observed a TCAS target. The air traffic controller instructed KFB662 to maintain FL 90, but the air-



craft had already passed through it. KFB662 climbed to this clearance altitude after having visited FL 85, where it had remained in level flight for a while waiting for the air traffic controller's instructions after having received a TCAS traffic advisory. The vertical separation minimum halved, but there was no collision hazard for the two aircraft.

The air traffic controller's way of working was risky and indifferent to given instructions. He had not taken the trouble to ask in what training phase the students were or what the purpose of their visit to the airport was prior to offering to the students a possibility to practice at the controller workstation. He did not comply with the instructions for training given by the air navigation services department. As a responsible licence holder he did not keep himself up-dated of the traffic situation. He dictated to the student clearances based on the radio communication from the loudspeakers and on his memory without checking the traffic situation from the flight strip information or radar monitor.

The FCAA's ATS instruction and rule RAC 59 give instructions on the use of the radar display monitor in the ATS unit. In the investigation attention was paid to the location of this informative radar display monitor at the workstation of the Turku air traffic control and to how the air traffic controllers use the monitor in their work. It is recommended that the information provided by the monitor be actively used, although the monitor shall not be used in establishing proper separations. The controller can, however, monitor how the given clearances are complied with. In the investigated case the locations and altitudes of the approaching traffic and the affecting traffic on departure route could have been checked on the monitor while giving clearances. This could have been done for example when the arriving aircraft contacted the air traffic control for the first time.

In connection with this case and another incident investigation, the investigators' attention has been drawn to the fact that the Turku air traffic control generally omits distance from the track and altitude restrictions in the route clearance after departure. In this case the air traffic controller instructed the departing KFB419 in connection with the route clearance as follows: *"After departure maintain flight level 90 or below until on radial 228."* When the aircraft was on runway he gave a new clearance: *"Maintain 2200 feet or below until on radial 223."* The pilots had difficulties in understanding the route clearance because the deviation from route after takeoff did not comprise altitude or distance up to which the deviation should be followed. The lower limit of the Turku approach area is in some parts 2500 ft, which implies that following the altitude clearance of 2200 ft and radial 223 can lead to uncontrolled airspace. The air traffic controller did not give the distance until the aircraft reported maintaining the clearance altitude.

Runway 08 was in use in Turku. The air traffic controller used, however, runway 26 to all traffic. As a traffic situation solution it is not a well-functioning method to use opposite runways (08 and 26) for three departing and one arriving aircraft, all on the same route and the fastest of the departing aircraft last in the departure sequence with clearance to climb above the other departing aircraft. The air traffic controller should have used only one runway for KFB419 and KFB662. Then the arriving KFB662 would have been cleared to approach runway 26 from the beginning on which it finally landed, or the departing KFB419 would have used runway 08 which was the runway in use in Turku. Fig-

ure 3 illustrates the calculated locations of KFB662 and KFB419 based on the radio communications.

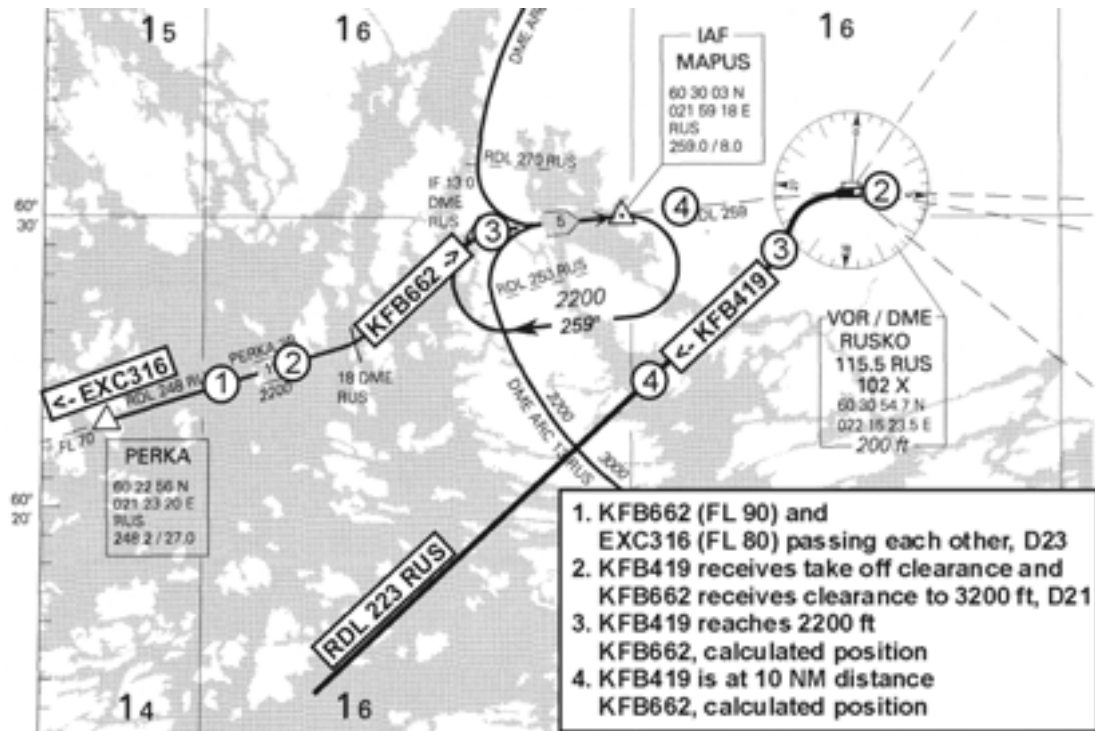


Figure 3. Flight tracks of KFB662 and KFB419

If KFB662 had used runway 08 for landing and KFB419 had taken off from runway 26, as originally planned, KFB419 should have taken off at the latest when the arriving KFB662 was PERKA inbound.

The use of opposite runways is a flexible solution, but risky. This easily leads to a situation in which the arriving aircraft cannot land on the planned runway and given clearances have to be quickly changed resulting in increased risk of misunderstandings.

## 2.2 Air traffic students' on-the-job training

The two-week introduction to different airport operations included in the air traffic controller training was according to the investigation commission's opinion too long, because the training schedule required by Avia College was not prepared at Turku airport. The students visited in the working places but they did not receive training according to the training targets of Avia College. The students spent most of the time in the control tower. The controller responsible for training at Turku Airport ATC had participated in Avia College instructor training for on-the-job training tutors but because he was on sick leave the information of training targets and contents of the on-the-job training had not been passed to Turku air traffic control and the on-the-job training's purpose was not understood there.

The air traffic controller's and airport manager's view of the students' training phase and of what the students could perform during this phase, differed from that of Avia College. Turku Airport did not act in a co-operation-oriented manner with the college. Avia College for its part had not checked that the arrangements at the airport complied with the training purpose.

The students were aware of the fact that they were not supposed to practice at the workstation, but did not turn down the offer. Due to their training and experience the students did not know how they should act at the air traffic controller workstation in on-the-job training, nor did they know how the air traffic controller should work as on-the-job instructor. They did not notice that they prevented the air traffic controller from getting traffic information, nor were they aware that the simultaneous presence of two students at the workstation was not practical either from the training or the controller work point of view.

### 2.3 Airport operations

The ANS department's instructions for on-the-job training issued on October 31, 1994, state that:

*"On-the-job training in the air navigation services branch shall be arranged at airports so that a responsible contact person for training has been appointed and that he/she is assisted by a sufficient number of instructors familiar with on-the-job training. The number shall not be too large so that uniformity in training will not suffer from it."* At Turku Airport instructors had not been appointed according to the meaning of the ANS department's instructions but the head of the ATC notified that all air traffic controllers acted as instructors. The same instruction states: *"On-the-job training included in the different training phases of the air traffic controllers' basic training puts a lot of responsibility on the instructors as it is very demanding to teach a correct professional attitude of "good air traffic controlship". Therefore it is important that the student is accompanied by the same instructor on duty in the beginning."*

The instructions require that the workstation shall be arranged so that it is possible for the instructor to have the situation under control if the student makes an error. Turku Airport had not fulfilled the requirement in the training instruction of *"monitoring/override system."* The Accident Investigation Board Finland has emphasised the defective training arrangements in its investigation report B 6/2001 L.

Turku Airport had not prepared any detailed training program for the students' introductory visit to the airport as Avia College had requested nor appointed instructors in the different offices to be visited. Although the person responsible for training was on sick leave, for example the branch manager for air traffic control services or the airport manager both with air traffic controller training would have been qualified to prepare the requested program and to supervise its execution. Turku airport had answered Avia College's inquiries and requests concerning the arrangements of the students' training. On ground of these answers Avia College was under the impression that required arrange-



ments in the Turku airport had been done. Nevertheless the arrangements required by Avia College to carry out the student training had not been done in Turku airport.

According to the Turku Airport manager and branch manager for air traffic control services *"air traffic control students have always practised at the controller working position in connection with their visit to the airport included in their training."* This does not comply with Avia College's current instructions for air traffic controller training. The air traffic branch at Turku Airport has not acted in a co-operative and safety-oriented way nor in accordance with the instructions of ANS department in performing assigned tasks of basic training for air traffic controllers.

In the working principles of Turku Airport, approved on February 1, 2002, the targets do not comprise any mention of maintaining or developing of safety in terms of various operations at the airport. The management principles and methods as well as attitude climate at Turku Airport should be inspected by an outside expert. A management system should be developed to the airport; a model in which the duties assigned by the FCAA to the airport are performed and monitored in accordance with given instructions. Special attention shall be drawn to the fact that the duties are carried out in accordance with given instructions aiming at operational safety.

## **2.4 Radio communication language**

There were three aircraft on the frequency of 118.300 MHz, which the Turku air traffic control used during the incident, each of which, i.e. EXC316, KFB419 and KFB662, operated on the basis of IFR. The pilots of all aircraft were familiar with English, but the pilots of EXC316 did not understand the radio communication in Finnish. Understanding the radio communications of other aircraft is important for the pilots enabling them to establish a general picture of the other traffic. In this case the Turku air traffic control should have changed into English in radio communication at the latest when EXC316 requested start-up clearance.

## **2.5 Cockpit crew actions**

KFB662 switched to the frequency of Turku as instructed by the ACC and after a short delay received clearance to approach on arrival route of PERKA 3B and clearance to descend to 3200 feet on QNH 1011. The pilots did not hear other radio communications on the frequency and the first officer taking care of radio communication used Finnish. The air traffic control also answered in Finnish.

The pilots had set their TCAS at the range of 20 NM and observed an opposite climbing aircraft at a distance of about 15 NM. The first officer enquired about it from the air traffic control and after a slight delay received an indefinite answer: *"Botnia 419, correction Botnia 662, did you ask about TCAS or what?"* The commander, as PF, decreased the rate of descent and the pilots followed the opposite aircraft on their TCAS. After receiving a TA, the commander disengaged the autopilot, and the first officer reported on radio that the opposite to be at a distance of about 10 NM, 1000 ft below, climbing. The commander levelled KFB662 off at FL 85, and the pilots noticed that the opposite would re-

main at FL 80. The first officer reported the observation on radio, and the air traffic controller answered to him: "Yes, *wait a minute*." A short time later the air traffic controller instructed KFB662 to maintain FL 90. The first officer reported that they would climb back to FL 90, and they reported after having reached it. The commander saw the lights of the opposite six to seven seconds prior to the passing of the aircraft.

The pilots followed the traffic in their front sector on the TCAS. To the credit of their alertness the collision hazard was avoided, but the required vertical separation was halved. In this situation their decision to remain on level flight between the flight levels was safety-oriented because the pilots observed that the opposite aircraft remained on level flight, and that the traffic was not under the air traffic controller's control. They did not immediately receive a proper answer to their question about affecting traffic nor did TCAS generate an RA.

EXC316 had received clearance to FL 80 from the air traffic control. The pilots climbed to the cleared level and observed the opposite aircraft on their TCAS, but they did not receive a TA. They did not understand the animated conversation in Finnish which took place at the same time. They did not report having reached FL 80. Slightly later they reported the distance of 27 NM from RUSKO, which is approximately where the boundary of the Turku terminal area (TMA) is located, but they did not report their flight level in this connection either. The air traffic controller instructed them to switch to the frequency of the ACC.



### **3 CONCLUSIONS**

#### **3.1 Findings**

1. The pilots of the two aircraft held valid licences and ratings required by their duties.
2. The air traffic controller held valid licence and ratings.
3. The air traffic was handled by an air traffic controller student but the air traffic controller was responsible for the operations.
4. The air traffic controller student cleared KFB662 to descend through the clearance altitude of EXC316 in accordance with the air traffic controller's instructions.
5. The two aircraft were flying complying with their valid air traffic control clearances.
6. The air traffic controller did not notice the error in separation until KFB662 reported its TCAS observation.
7. The air traffic controller followed the air traffic at an adjacent workstation which was, however, not adequately equipped for supervising the on-the-job practice, e.g. there was no radar monitor at the workstation.
8. The TCAS system of KFB662 generated a traffic advisory but not a resolution advisory.
9. The pilots of EXC316 noticed the opposite traffic on their TCAS display, but they did not receive any traffic advisory.
10. The aircraft did not pass through each others' altitudes.
11. The minimum horizontal distance of the aircraft was six NM while their vertical distance was 500 ft.
12. The distance between the aircraft was four NM when KFB662 again reached FL 90 and the mandatory vertical separation was established.
13. A detailed program for the introductory visit to the airport required by Avia College had not been prepared or instructors appointed.

### 3.2 Causes

The cause of the incident was the fact that the air traffic controller handed over the workstation to the air traffic controller student who did not yet have the qualification to carry out the tasks. The air traffic controller did not exploit the available traffic information, but ordered the air traffic control clearances based on the radio communications he heard and by memory forgetting the departed aircraft.

Contributing factors were:

- The air traffic controller himself moved away from the working position and was at a distance of about two to three meters from where he could not see the information wrote down by the air traffic controller student on the flight strips or the radar monitor display.
- Turku Airport had not prepared a training program for the air traffic controller students required by Avia College. Consequently the students spent their time mainly in the air traffic control although the purpose of this training phase was to get familiar with all the operations at the airport.



## 4 SAFETY RECOMMENDATIONS

The purposes in the working principles of Turku Airport do not include any mention of maintaining or developing safety in terms of various operations at the airport. The airport has not carried out the duties or instructions given by the FCAA as intended. During the incident which now has been investigated the air traffic controller has acted indifferently to instructions and in a risky way.

1. The FCAA and Turku Airport should together develop a management system to Turku Airport in which the duties assigned by the FCAA to the airport are carried out and supervised in accordance with given instructions. Special attention should be paid to the fact that the duties are carried out in accordance with given instructions aiming at operational safety.

The FCAA's ATS instruction and rule RAC 59 dated February 1, 2001, include instructions for using the radar display monitor in ATS units. The radar display monitor refers to an informative radar display located in an ATS unit the purpose of which is to provide an auxiliary device for perceiving, following and monitoring the airspace and traffic situation complying with the methods specified in the instruction. The monitor has not been designed or approved to be used for establishing aircraft separation. In this case the information provided by the radar display monitor was not utilised in planning air traffic control clearances for KFB662 or EXC316. In connection with the investigation attention was drawn to the disadvantageous location and small size of the radar display monitor at the air traffic controller's workstation at Turku Airport.

2. Turku Airport should locate the radar display monitor for training situations in such a place that it is possible to see the information on the monitor from both ATC workstations.

The ANS department of the FCAA has issued instructions for on-the-job training (October 31, 1994, Dnro 68/590/94), which present the requirement to the FCAA profit centres to appoint on-the-job air traffic control instructors and the targets of the on-the-job training as well as the technical arrangements of the air traffic controller workstation. The ANS department has again drawn the airports' attention to the technical arrangements of controller working positions for training purposes by letters dated August 24, 1998, and June 15, 1999. The Accident Investigation Board Finland emphasised the defective training arrangements of the Turku air traffic control in its investigation report B 6/2001 L. According to the instructions the nominated instructors should be professionally competent, willing to act as instructor and personally suited for a trainer. A compensation is paid of instruction work in order to cover the additional work when preparing the training and keeping contact with the other trainers. It is not according to the on-the-job instructions of ANS department to nominate all the controllers as instructor as they had done in Turku airport.




3. Turku Airport should prepare on-the-job training instructions and programs which define the students' and instructors' responsibilities and rights as well as training targets.
4. Turku Airport should appoint its on-the-job instructors according to the ANS department's instructions.

Avia College had at the time of this incident no co-operation contracts with those FCAA profit centres which are used as training sites. After that it had made a contract with all other centres except Turku.

5. Avia College should conclude co-operation contract also with Turku airport. This contract should determine the training arrangements necessary for air traffic controllers' on-the-job training so that reaching the training targets can be ensured.

Helsinki 20.10.2003

A handwritten signature in black ink, appearing to read "Jussi Haila".

Jussi Haila

A handwritten signature in black ink, appearing to read "Erkki Lepola".

Erkki Lepola

A handwritten signature in black ink, appearing to read "Ville Hämäläinen".

Ville Hämäläinen