



Investigation report

C 1/2003 L

Translation of the original Finnish report

Loss of separation west of Helsinki-Vantaa airport on 22.1.2003

RA-85185 Tu-154M

OH-KRC ATR-72-201

According to Annex 13 of the Civil Aviation Convention, 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 Wednesday 22.1.2003 at 18.56 UTC (co-ordinated universal time, Finnish time -2 h) there was an aircraft incident approximately seven nautical miles west of Helsinki-Vantaa airport. A Pulkovo Airlines Tupolev Tu-154M airliner (PLK230) on a scheduled passenger flight from Helsinki to St.Petersburg climbed above the initial climb altitude of 4000 ft of the standard instrument departure and the required separation was lost to a Finnair ATR-72 airliner (FIN225) on a scheduled passenger flight from Helsinki to Turku. The Accident Investigation Board Finland appointed 28.1.2003 an investigation commission to investigate the incident and appointed airline transport pilot Jussi Haila investigator-in-charge and air traffic controller Erkki Lepola and MSc Ville Hämäläinen members of the commission.

FIN225 took off from Helsinki-Vantaa to Turku and PLK230 approximately two minutes later to St.Petersburg. The beginning of the flight paths after take off of both aircraft were identical. PLK230 did not contact the departure radar after take off as instructed by the standard instrument departure chart and climbed above the initial climb altitude of 4000 feet. The radar controller noticed this and that PLK230 was approaching the slower FIN225 flying ahead. He ordered FIN225 to turn away from the flight path of PLK230. After this the radar controller asked the tower controller to instruct PLK230 to contact radar, but PLK230 had already climbed to 5100 feet. FIN225 was at 5400 feet at the same time. The horizontal distance between the aircraft was 2.2 NM. After this the radio traffic between the controller and PLK230 was normal.

PLK230 probably climbed above the initial climb altitude because the commander had lost remembrance of the initial climb altitude as he was busy with the actions required after take off. It is probable that the rest of the crew did not call his attention to maintaining the initial climb altitude. Probable contributing factors were the increased crew work load caused by the unsuccessful radio contract attempts, the absence of altitude alerter and altimeter movable markers, and the non-ergonomic way of using the SID chart in the cockpit.

The investigation commission presented two safety recommendations for Pulkovo Airlines, in which the company was recommended to improve crew resource management and to install altitude alert/capture systems in its aircraft. The received comments to the final draft of the report have been taken into account in the investigation report.



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1 FACTUAL INFORMATION

1.1 History of the flights

Finnair Oyj's ATR72, OH-KRC with callsign FIN225, departed from runway 22L to Turku at 18.53 UTC and was cleared to follow the Standard Instrument Departure (SID) ARTUR 4B. Pulkovo Airlines Tu-154M, RA-85185 with callsign PLK230, departed from the same runway to St.Petersburg at 18.55 and was cleared to follow SID PORVOO 5B. The SIDs are presented in figure 1.

The beginning of both SIDs is identical. They turn right to track 285° at a distance of 2.1 NM from HEL VOR/DME. After this the aircraft is supposed to intercept and follow HEL VOR/DME radial 266 with ARTUR 4B and radial 254 with PORVOO 5B. The SIDs include instructions to contact Helsinki Radar when passing 1500 ft (QNH), and to climb initially to 4000 feet. Both the Finnish Aeronautical Information Publication (AIP) and the Jeppesen Airway Manual contain the following instructions:

Climb to 4000 ft or assigned altitude if lower. Climb to higher level only when cleared by ATC. When passing 1500 ft contact Helsinki Radar.



Figure 1. Standard Instrument Departures ARTUR 4B and PORVOO 5B

FIN225 contacted Helsinki radar according to the instructions and was cleared to climb to flight level 80 and fly heading 300°, 15° right of the SID track 285°. By this the radar controller intended to ensure the radar separation because the PLK230 taking off after FIN225 was faster. The controller assumed PLK would climb initially to 4000 feet as in-

structed by the SID. He thus instructed FIN225 to turn direct to ARTUR after it had climbed above 4000 feet. The heading to ARTUR was approximately 260°.

PLK230 was not able to establish radio contact with the radar controller until 18.57.45 when it had already climbed to 5100 feet and turned to track 285° as instructed by the SID.

The radar controller instructed FIN225 to turn immediately heading 300° because PLK230 had not established radio contact with him and was climbing above 4000 feet. The controller also gave FIN225 traffic information about the Tupolev on its left side. FIN225 acknowledged both transmissions.

The radar controller phoned the tower controller at 18.57.20 and informed him that PLK230 had not established radio contact with the radar controller. The tower controller instructed on his frequency PLK230 to contact radar. PLK230 acknowledged and contacted the radar controller at 18.57.40. The controller instructed it to turn immediately left heading 180° and asked its level. The answer was unintelligible and unreadable. According to the Helsinki radar recording PLK230 had been flying at 5100 feet for approximately 30 seconds at that time. At 18.58.10 the radar controller cleared it direct to GOGLA and to climb to flight level 150. He also informed PLK230 that according to his radar display PLK230 had climbed to 5000 feet even though the initial climb altitude of the SID was 4000 feet.

The commander of PLK230 stated in his written report that the crew had tried unsuccessfully several times to contact the radar controller with both VHF radios. He also reported that the flight conditions after take off were difficult due to hard icing and turbulence. The commander of PLK230 also stated that retracting the flaps hindered the following of the initial climb altitude. Due to this and previously mentioned weather conditions PLK230 climbed, according to him, 800 feet above 4000 feet. According to the radar recording PLK230 maintained 5000 feet after levelling off and did not descend back to the initial climb altitude of 4000 feet.

1.2 Injuries to persons

There were no injuries to persons. PLK230 had 30 passengers and nine crew members on board. FIN225 had 39 passengers and four crew members on board.

1.3 Damage to aircraft

No damage.

1.4 Other damage

No other damage.



1.5 Personnel information

1.5.1 PLK230 crew

Commander: Male, 53 years
Licences: Airline transport pilot licence, class 1, valid until 21.11.2003
Medical certificate: Valid until 21.11.2003
Ratings: All required ratings were valid.

Co-pilot: Male, 50 years
Licences: Airline transport pilot licence, valid until 5.11.2003
Medical certificate: Valid until 5.11.2003
Ratings: All required ratings were valid.

Navigator: Male, 46 years
Licences: Navigator, valid until 30.5.2003
Medical certificate: Valid until 30.5.2003
Ratings: All required ratings were valid.

Flight engineer: Male, 53 years
Licences: Flight engineer, valid until 7.3.2003

1.5.2 FIN225 crew

Commander: Male, 37 years
Licences: Airline transport pilot licence, valid until 14.6.2007
Medical certificate: JAR 1, valid until 11.12.2003
Ratings: All required ratings were valid.

Co-pilot: Male, 30 years
Licences: Commercial pilot licence, valid until 10.7.2005
Medical certificate: JAR 1, valid until 29.1.2003
Ratings: All required ratings were valid.

1.5.3 Radar controller

Radar controller: Male, 31 years
Licences: Air traffic control officer, valid until 28.11.2004
Medical certificate: Air traffic control officer, valid until 28.11.2004
Ratings: All required ratings were valid.

1.6 Aircraft information

PLK230, RA-85185, Tu-154M, three-jet-engine airliner with 154 passenger seats, operator Pulkovo Airlines, maximum take off weight 104 000 kg.

FIN225, ATR-72-201, OH-KRC, twin turboprop airliner with 68 passenger seats, operator Finnair Oyj, maximum take off weight 21 500 kg.

1.7 Meteorological information

There was a weak low pressure area on the Sea of Bothnia. The Helsinki-Vantaa airport was in the warm sector of the low pressure area and a cold front was approaching from the west. The weather was cloudy and it snowed. Occasionally there was freezing drizzle. The south-eastern wind was light.

Helsinki-Vantaa weather 22.1.2003:

Terminal area forecast, TAF, valid between 18-03 UTC:

Wind 160°/10 kt, visibility 5000 m, snow grains, clouds 8/8 700 feet, tempo between 18-22 UTC visibility 3000 m, freezing drizzle, clouds 5-7/8 400 feet.

Weather observations, METAR:

At 18.20 UTC: Wind 160°/11 kt, visibility 3500 m, freezing drizzle, clouds 1-3/8 300 feet, 3-5/8 600 feet, temperature -1 °C, dew point -2 °C, QNH 1009, no change expected.

At 18.50 UTC: Wind 160°/11 kt, visibility 3500 m, freezing drizzle, clouds 5-7/8 500 feet, 8/8 900 feet, temperature -1 °C, dew point -2 °C, QNH 1009, no change expected.

Night conditions and darkness prevailed.

1.8 Aids to navigation

The Helsinki-Vantaa air traffic control system is based on a monopulse secondary surveillance radar (MSSR) and a primary surveillance radar (PSR). Also Kangasala and Turku MSS-radars are connected to the system. The back up system is the Helsinki secondary surveillance radar (SSR). The radar displays of the air traffic controllers usually show the MSS-radar returns but the PS-radar returns can also be selected to be displayed, for example to see aircraft not equipped with a functioning transponder.

The standard instrument departures used by both aircraft were based on the HELSINKI VOR/DME located at the aerodrome.



1.9 Communications

The VHF radio communications were listened from the Helsinki-Vantaa radio communication recordings. The audibility was good on all frequencies and no hints of failed communications could be detected.

1.10 Aerodrome information

The co-ordinates of the Helsinki-Vantaa aerodrome reference point are 60°19.0' N, 024°57.8' E. There are three runways at the aerodrome. Both aircraft took off from the asphalt runway 22L. Its length is 3 440 m and width 60 m.

1.11 Flight recorders

There was no flight recorder data available for use in the investigation.

2 ANALYSIS

2.1 General

There was no danger of mid-air collision, but the Accident Investigation Board Finland decided to investigate the incident because the required 3 NM radar separation was lost. The closest horizontal distance between FIN225 and PLK230 was 2.2 NM according to the Helsinki radar recording. The vertical distance between the aircraft was 500 feet at that time. It should have been at least 1000 feet for the required vertical separation to exist. If the vertical separation is less than 1000 feet, horizontal separation must be at least 5 NM. The flight paths of the aircraft were divergent at the closest point of approach. The radar controller had the situation under control at all times even though PLK230 was not able to establish radio contact with him before it had climbed above the initial climb altitude.

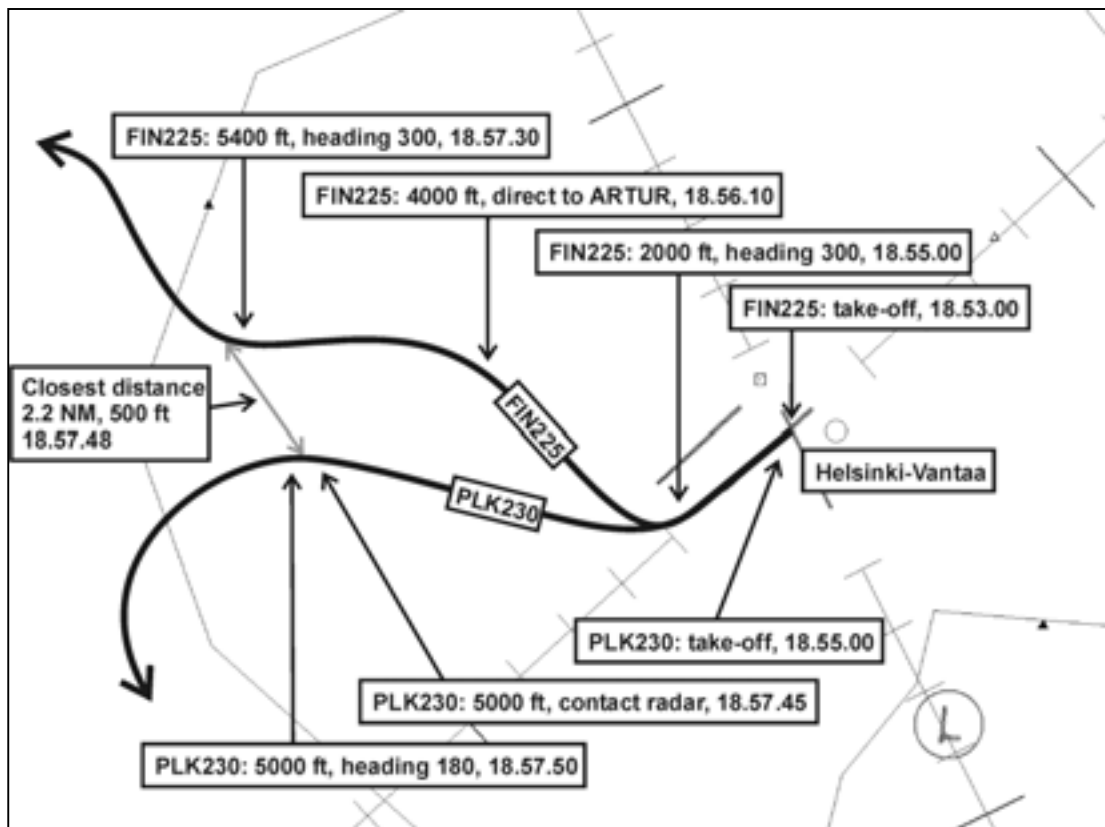


Figure 2. Flight tracks of the aircraft

2.2 Failure to establish radio contact

PLK230 was not able to establish radio contact with the radar controller at first when it became visible on the radar display of the controller. The investigators were not able to determine the definite cause of the unsuccessful VHF radio contact. It is possible that there was a technical malfunction in the radios or audio panel of PLK230. When the tower controller instructed PLK230 to contact radar at 18.57.20, PLK230 acknowledged

immediately and contacted the radar controller. After this there were no disruptions in the radio communication. There were no reported malfunctions in the Helsinki-Vantaa radios nor were there any hints of unsuccessful radio contacts in the radio communication recordings. A technical malfunction is not probable because VHF radio communication between air traffic control and PLK230 worked before take off and after established with the radar controller. It is possible that the crew of PLK230 made an error in changing the frequency. However, this possibility is not supported by the statement of the commander of PLK230 that they tried repeatedly with both radio stations, because the error would probably have been noticed during several attempts. It is probable that the crew forgot the instruction of the SID to contact radar as they were busy with the actions required after take off, and that they contacted radar only after the tower controller instructed them to do so.

2.3. Flight conditions

The statement of the PLK230 commander about the difficult flight conditions is not supported by the observations of other pilots flying in and out of Helsinki at the time of the incident. Nobody had observed turbulence or hard icing. Retracting of the flaps and the correct flap retraction speed requires crew attention after take off but it is a normal action performed on every flight. The take off weight of PLK230 was approximately 27 000 kg below the maximum allowed take off weight of 104 000 kg and the commander did not report in his statement any aircraft malfunctions during take off. The operator uses no movable markers in the air speed indicators which could be already set before take off to remind the pilots of the correct flap retraction speed, dependent on take off weight. The use of such movable markers is common amid other operators, so that remembering the critical flap retraction speed is not solely based on the memory of the crew.

2.4. Cockpit arrangements of Tu-154M and procedures of operator

The investigators familiarised themselves with Pulkovo Airlines Tu-154M cockpit arrangements and interviewed another captain of the company on 17.2.2003. It was noted that there were foot-scale altimeters with hPa sub-scale setting and metre-scale altimeters with mmHg sub-scale setting. The foot-scale altimeters had the prevailing QNH and the metre-scale altimeters the prevailing QFE setting while the aircraft was on the ground. The altimeters had no movable markers that could be used to remind crew of minimum or cleared altitudes. There was no Altitude Alerter/Capture -system in the cockpit, which is commonly used in commercial aircraft to alert pilots when approaching or reaching a cleared altitude. With the cockpit arrangements of the Pulkovo Airlines Tu-154M the remembering of a cleared altitude is based solely on the memory of the pilots.

According to Pulkovo Airlines there is one Jeppesen Airway Manual in the cockpit. Its SID chart is placed on top of the aft part of the cockpit centre pedestal during take off for the use of the pilots and the navigator. The place of the chart and small font size make the chart difficult to read in the dim cockpit lighting used during departure. The pilots have to turn their head completely away from the primary flight indicators when looking at the map. It would be recommended that both pilots had a map of their own and they could keep it in a well-visible place such as in the middle of the yoke.



3 CONCLUSIONS

3.1 Findings

1. The flight crew of both aircraft had valid licences and required ratings.
2. The radar controller had a valid licence and required ratings.
3. Both aircraft had a valid certificate of airworthiness.
4. Both aircraft were cleared to take off from runway 22L and to follow standard instrument departures.
5. When FIN225 contacted the radar controller after take off, he cleared it to fly heading 300° away from the track of faster PLK230 taking off next. He also cleared FIN225 to climb to flight level 80.
6. After FIN225 had climbed above 4000 feet the radar controller cleared it to turn direct to ARTUR. The heading to ARTUR was about 260°.
7. PLK230 did not contact the radar controller according to the SID instructions.
8. PLK230 did not level off at 4000 ft as instructed by the SID but climbed instead approximately 1100 feet higher.
9. As the radar controller noted that PLK230 was climbing above 4000 feet he instructed FIN225 to turn again right to heading 300°.
10. The radar controller tried unsuccessfully to contact PLK230 on his frequency.
11. The tower controller instructed PLK230 to contact the radar controller. After this there were no disruptions in the radio communication.
12. The radar controller gave FIN225 traffic information about PLK230.
13. According to the Helsinki-Vantaa radar recording the aircraft passed each other with a horizontal separation of 2.2 NM and a vertical separation of 500 feet.
14. The radar controller had the situation under control at all times and there was no danger of collision.

3.2 Cause of the incident

PLK230 probably climbed above the initial climb altitude because the commander forgot the initial climb altitude as he was busy with the actions required after take off. It is probable that the rest of the crew did not call his attention to maintaining the initial climb altitude.

Probable contributing factors were

- the increased crew work load caused by the unsuccessful radio contact attempts
- the absence of altitude alerter and movable altimeter markers
- the non-ergonomic way of using the SID chart in the cockpit.



4 RECOMMENDATIONS

The commander flew the aircraft and was assisted by the co-pilot and navigator. The commander probably forgot the initial climb altitude as he was busy with the actions required after take off. It is probable that the rest of the crew did not call his attention to maintaining the initial climb altitude.

1. The operator Pulkovo Airlines should develop its crew co-operation so that the complete crew would have a consistent conception of the flight path and its limitations. Then the monitoring crew members could support the flying pilot in completing the flight according to the clearance.

The Altitude Alert/Capture -system is commonly used in commercial aircraft to visually and aurally alert the crew when approaching or reaching a selected altitude. It also warns if the aircraft altitude changes from the selected altitude currently being flown. The autopilot, when used, flies the aircraft to the altitude selected in the Altitude Alert/Capture -system and maintains it. The implementation of such a system would improve safety by reminding the crew of the cleared altitude and would reduce the cockpit workload especially when autopilot is used.

2. The operator Pulkovo Airlines should install in its aircraft the Altitude Alert/Capture -system to remind the crews of approaching and reaching cleared altitudes, and make its use a part of its standard operating procedures.

Helsinki, August 27, 2003

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