A serious incident which occurred on 30 January 1998, in the airspace 10 NM east of Stockholm/Arlanda airport between the aircraft with registry YL-BAN and SE-DUR.

Micro-summary: **A failure of electronic flight instrumentation on this BAe-146 results in an altitude bust.**

Event Date: **1998-01-30 at 1021 UTC**

Investigative Body: **Swedish Accident Investigation Board (AIB), Sweden**

Investigative Body's Web Site: **http://www.havkom.se/**

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1. Accident reports can be and sometimes are revised. Be sure to consult the investigative agency for the latest version before basing anything significant on content (e.g., thesis, research, etc).

2. Readers are advised that each report is a glimpse of events at specific points in time. While broad themes permeate the causal events leading up to crashes, and we can learn from those, the specific regulatory and technological environments can and do change. ***Your company's flight operations manual is the final authority as to the safe operation of your aircraft!***

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1998-05-20 L-04/98

Swedish Civil Aviation
Administration

601 79 NORRKÖPING

Report C 1998:18e

The Swedish Board of Accident Investigation (Statens haverikommission, SHK) has investigated a serious incident which occurred on 30 January 1998, in the airspace 10 NM east of Stockholm/Arlanda airport between the aircraft with registry YL-BAN and SE-DUR.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Board submits herewith a final report of the investigation.

Olle Lundström

Rune Lundin Monica J Wismar

This report is translated from Swedish. If there are differences caused by translation, the Swedish version will be valid.

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Report finalized 1998-05-20

Aircraft; registration and type	**A. YL-BAN,** Bae 146/RJ **B. SE-DUR,** Fokker F28 MK0100
Owner/Operator	**A.** Trident Leasing Ireland/ Air Baltic Corporation, Riga, Latvia. **B.** Debis Air Finance B.V. Netherlands/ Transwede Airways AB
Time of incident	30-01-1998, 10:21 hrs, in daylight *Note:* All times in the report are noted in Swedish standard time (SST) = UTC + 1 hour.
Place	The airspace approximately 10 N.M. east of Stockholm/Arlanda airport, AB County, (pos 5941N 1820E; approximately 7 000ft./2 150m. above sea level)
Type of flight	**A.** Scheduled traffic. **B.** Scheduled traffic.
Weather	Arlanda at 10:20 hrs: Wind 350 degrees at 12 kts, visibility 1 200 m in, snow-showers broken clouds at 600-1 000 feet, temp./dew-point –6/-8° C, QNH 999 hPa. At Flight Level 70 the flight conditions were IMC with moderate icing
Numbers on board: crew	**A.** 5 **B.** 4
passengers	**A.** 15 **B.** 65
Personal injury	None
Damage to aircraft	None
Other damage	None
Pilots´ age, certificate	**A.** Commander 56 years, Airline Transport Pilot's License (Latvian), Copilot 39 years, Commercial Pilot's License with Instrument Rating (Latvian) **B**. Commander 44 years, Airline Transport Pilot's License, (Swedish), Copilot 33 years, Commercial Pilot's License with Instrument Rating, (Swedish)
Pilot´s total flying hours	**A**. Commander 14 050 hours, of which 920 on the type; Copilot 3 040 hours, of which 1 218 on the type. **B**. Commander 8 500 hours, of which 1 800 On the type; Copilot 4 800 hours, of which 542 on the type.

The incident has been investigated by the Board of Accident Investigation (SHK) represented by Olle Lundström, chairman, Rune Lundin and Monica J Wismar, chief investigators flight operations.

SHK has been assisted by Nils-Gösta Hamnström as operational expert.

The investigation has been followed by the Swedish Civil Aviation Administration represented by Max Danielsson..

The sole purpose of SHK's investigations is to prevent future accidents and incidents.

History of the flight, etc

Aircraft **A,** a Bae 146/RJ with registry YL-BAN, initiated a scheduled IFR passenger flight on the 30th of January, 1998 at time 10:18 from runway 08 at Stockholm/Arlanda airport with destination Tallinn in Estonia via VOR-station NTL. Initially the flight received clearance to climb to flight-level (FL) 70 (2 150 m). After takeoff **A** was followed on radar by an air-traffic controller at the ARR-E sector of Stockholm control (ACC). Simultaneously during **A**'s easterly climb, aircraft **B**, a Fokker F28 MK0100 with registry SE-DUR was descending; arriving from the north for landing on runway 01 at Stockholm-/Arlanda.

As the two aircraft flight paths would intersect each other, the ATC controller limited **B**'s descent to FL 80 (2 450 m) in order to maintain requisite separation to **A.** When the two aircraft flight paths crossed one another the ATC controller observed that the radar echoes "merged" and the altitude information of same disappeared, which indicated that the separation had diminished below the minimal. When the echoes once again became visible the controller discovered that **A**'s altitude readout was FL 75 (2 300 m) climbing.

The crew of aircraft **A** has stated to SHK that during takeoff, just prior to lift-off from Stockholm/Arlanda, they experienced a technical mishap with the aircraft that resulted in the failure of most of the automated functions and the blinking of a number of warning lights (i.e. Flight Guidance Computer, Yaw Damper, Autopilot, Thrust Rating Panel, Flight Director, Altitude Preselect Alert). Aircraft type Bae 146/RJ is fitted with the latest technical equipment with a high degree of automatization and electronic instrument presentation. The crew's impression was that the aircraft was therefore more difficult to fly on the reserve instruments than older aircraft with conventional instrumentation.

While the copilot flew the aircraft on the reserve instruments the commander attempted to restart the failed systems. According to the crew's recollection, it was during this period that their cleared altitude of FL 70 was exceeded up to FL 75 – 77. Simultaneously as measures were taken to return to FL 70 aircraft **A** received clearance to climb further to FL 140. When separation minimum was violated **A** received an automatic collision warning (TCAS) in the Traffic Advisory format (yellow solid circle).

A military radar plot that shows the reciprocal positions and transponder altitude heights of the two actual aircraft is included in appendix 1. This plotting shows that when aircraft **B** passed the point of intersection of the two flight paths, aircraft **A** had approximately 400 m remaining to same. The minimal lateral distance between the aircraft was approximately 350 m at time 10:20:50. The altitude difference at that point in time was approximately 850 meters (**A**.1 785 m, **B.** 2 635 m). **A** had not then reached the cleared flight level of 70. This altitude was attained at time 10:21:09 and at time 10:21:29 **A**'s altitude was 2 400 meters (FL 78). From the plot it is evident that a vertical separation minimum was violated (altitude difference <1 000 ft./300 m.) approximately 20 seconds after the two flight paths intersected.

When aircraft **A** reached it's cruising altitude and experienced VMC conditions the crew successfully re-engaged the defective systems by removing and then reconnecting the power supply to same. After landing in Tallinn the failure was

reported to the company's technical division, which after trouble-shooting was unable to deduce or recreate the failure. A report concerning the occurrence however, has been sent to the aircraft manufacturer.

Conclusions

According to the information supplied by the crew onboard **A,** it is evident that an altitude overshoot took place in IMC during flight on reserve instruments. The good aircraft performance in conjunction with the modest weight also enabled a steep climb.

The copilot who flew the aircraft while the commander was occupied with trouble-shooting, had therefore no assistance with flight monitoring – neither by the automatic monitoring systems (AP and APS) nor by the normal two pilot concept, where the non-flying pilot monitors the instruments. Furthermore the crew was probably distracted by the continuous blinking of the warning lights from the system failures.

Flight safety is built to a great extent upon the concept that a crew is able to fully function even in the most stressful situations through task division that must be well practiced. To be able to safely overcome a critical flight safety incident such as this it is decisive that just such situations are more often practiced in the simulator and that crew co-operation is improved through instruction in so-called Crew Resource Management.

In the airline's own investigation of the occurrence two safety recommendations are directed internally to the company, one dealing with thorough information about the incident and one concerning increased simulator training to include procedures for failure of AP, TRP, Flight Director, and other automated functions.

Recommendations

The Swedish Civil Aviation Administration should ensure that airlines that operate aircraft with highly automated cockpits and high-technology instrumentation regularly practice simulator flights on reserve instruments, that is instruments that are not integrated within the automation.