Statens haverikommission
Swedish Accident Investigation Authority





# *Final report RL 2015:10e*

**Serious incident on 31 January 2014 involving the aircraft ES-PJR of the model Bae Jetstream 3200, operated by AS Avies at Torsby airport, Värmland county.**

File number L-0018/14

22/06/2015

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring again, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK´s web site: www.havkom.se

ISSN 1400-5719

This document is a translation of the original Swedish report. In case of discrepancies between this translation and the Swedish original text, the Swedish text shall prevail in the interpretation of the report.



| *Postadress/Postal address* | *Besöksadress/Visitors* | *Telefon/Phone* | *Fax/Facsimile* | *E-post/E-mail* | *Internet* |
|---|---|---|---|---|---|
| P.O. Box 12538<br>SE-102 29 Stockholm<br>Sweden | Sveavägen 151<br>Stockholm | +46 8 508 862 00 | +46 8 508 862 90 | info@havkom.se | www.havkom.se |

Statens haverikommission
Swedish Accident Investigation Authority

## Content

APPENDICES

The following appendices are attached to the report in original version:

1. Safety Recommendation
2. Reply from Transportstyrelsen (Swedish CAA)
3. Reply from *Lennuamet* (Estonian CAA)

## General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a government authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring again, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g. by insurance companies.

The task of SHK also does not include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

Investigations of aviation incidents are governed mainly by Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and by the Accident Investigation Act (1990:712). The investigation is carried out in accordance with Annex 13 of the Chicago Convention.

## The investigation

SHK was informed on 31 January 2014 that a serious incident involving one aircraft of the model Bae Jetstream 3200 with the registration ES-PJR had occurred at Torsby airport in Värmland county, on the same day at 20:59 hrs.

The incident has been investigated by SHK represented by Mr Hans Ytterberg, Chairperson, Mr Stefan Christensen, Investigator in Charge, Mr Peter Swaffer, Operations Investigator, Mr Christer Jeleborg, Technical Investigator (aviation), and Mr Urban Kjellberg, Investigator specializing in Fire and Rescue Services.

The investigation team of SHK was assisted by the following experts:

- AB Flygprestanda in the matter of performance calculations,
- Magnic AB for audio analyses,
- Kristoffer Danél for analysis and evaluation of flight recorders.

Accredited representatives have been Andrew Blackie from the UK Air Accidents Investigation Branch (AAIB) and Jens Haug from the Estonian Safety Investigation Bureau (ESIB).

The investigation was followed by Mr Lars Kristiansson of the Swedish Transport Agency.

The following organisations have been notified: Swedish Transport Agency (Transportstyrelsen), the International Civil Aviation Organisation (ICAO), the Estonian Safety Investigation Bureau (ESIB), the UK Air Accidents Investigation Branch (AAIB), the European Aviation Safety Agency (EASA), and the European Commission.

Investigation material
Interviews have been conducted with the crew in question and representatives of the operator. The airport manager and personnel from Torsby airport have also been interviewed during the investigation.

A fact finding presentation meeting with the interested parties was held on 10 December 2014. At the meeting, SHK presented the facts discovered during the investigation that were available at the time.

Status report
On 30 January 2015, SHK published an interim statement (SRL 2015:01) containing factual information and information on the progress of the investigation.

## Final report RL 2015:10e

| | |
|---|---|
| Aircraft: | |
| Registration, type | ES-PJR, Bae Systems (Operations) Jetstream |
| Model | Jetstream Series 3200 |
| Class, Airworthiness | Normal, Certificate of Airworthiness and Valid Airworthiness Review Certificate (ARC)[1] |
| Time of occurrence | 31/01/2014, 20:59 hrs during darkness Note: All times are given in Swedish standard time (UTC[2] + 1 hr) |
| Place | Torsby airport, Värmland county, (position 600917N 0125937E, 120 metres above sea level) |
| Type of flight | Commercial |
| Weather | According to Metar Torsby: Wind variable 03 knots, visibility 2,000 metres in snow, vertical visibility 1,900 feet, temperature/dewpoint M05/M06 °C, QNH[3] 1013 hPa |
| Persons on board: | 17 |
| crew members including cabin crew | 2 |
| passengers | 15 |
| Injuries to persons | None |
| Damage to aircraft | No known damage |
| Other damage | None |
| Commander: | |
| Age, licence | 56 years, ATPL(A)[4] |
| Total flying hours | 14,560 hours, of which 620 hours on type |
| Flying hours previous 90 days | 110 hours, all of which on type |
| Number of landings previous 90 days | 151 |
| Co-pilot: | |
| Age, licence | 22 years, CPL(A)[5] |
| Total flying hours | 620 hours, of which 450 hours on type |
| Flying hours previous 90 days | 96 hours, all of which on type |
| Number of landings previous 90 days | 133 |

[1] ARC (Airworthiness Review Certificate).
[2] UTC (Coordinated Universal Time).
[3] QNH (Barometric pressure at mean sea level).
[4] ATPL(A) (Airline Transport Pilot License).
[5] CPL(A) (Commercial Pilot License).

## SUMMARY

The aircraft departed from Stockholm/Arlanda Airport for a scheduled flight to Torsby in Värmland. The takeoff was delayed due to prevailing weather with heavy snowfall. On board were 15 passengers and two crew members. The weather forecasts for the current flight sector contained warnings of severe icing. The aircraft's propeller deicing system for the right engine was out of order, which was known by the commander. The malfunction was not noted in the aircraft logbook.

At the airport in Torsby snow clearing was in progress due to the weather with 2 000 meters visibility in snowfall. In the final phase of the clearing the friction coefficients were measured (see Section 1.6.9) on the runway and reported to the arriving aircraft. The measured coefficients - which corresponded to medium braking action - did not cause any action by the pilots as corrections for this was not included in the operator's performance data.

The aircraft initiated a manual approach to runway 16 with the co-pilot at the controls. The landing took place well into the runway with about 800 meters remaining runway length. After touchdown the commander took over control of the airplane and started braking. The aircraft was unable to stop before the runway end and the commander then decided to try to steer off to the right onto the taxiway. This was not successful, and the aircraft ran out into the snow in the angle between the runway and the taxiway. No one was injured during the incident.

SHK has analyzed the Aircraft´s Flight Recorder (FDR) and Voice Recorder (CVR). In the analysis of the FDR it was found that the recorded values could not be used as the operator lacked proper documentation for readout. SHK’s own corrections of the recordings showed that the approach was not stabilized and indicated altitude and speed variations, and showed that touchdown occurred with a higher speed than normal. Data from the CVR could not be used because the device had not been disconnected in time after the incident.

The investigation has revealed a number of deviations associated with the flight:

- The landing was carried out without having made use of friction coefficients and without having access to any relevant performance data for landing on contaminated runways.
- The approach was not stabilized and the operator had no coherent concept for stabilized approach.
- A deficiant technical standard regarding the operator's maintenance of the FDR aimed at securing the possibility of a correct readout of the recorded data.
- Inadequate management of CVR regarding the shutdown of the unit after an incident.

During the investigation, SHK has also noted other shortcomings of the operator that have not had any direct connection with the incident:

- The operator's system for handling technical remarks did not follow current regulations.

- The decision to start from Arlanda with the right side's propeller de-icing system unserviceable, under conditions entailing a risk of severe icing conditions, implied non-compliance with the Minimum Equipment List.

The direct cause of the aircraft running off the runway is simple to establish:

*The touchdown took place too far into the runway and at too high a speed.*

However, this conclusion is inadequate as a thorough explanation of the incident and, even more so, as a basis for any effective safety recommendations.

SHK has therefore on the next page attempted to make a brief visualisation of the reasoning that may summarise the cause analysis of the incident in Torsby.

*The crew was unable to get the aircraft to stop after landing and it veered off the runway.*

Why ?

*The touchdown took place too far into the runway and at too high speed.*

Why ?

*The approach was not stabilised.*

Why ?

*The operator did not apply any coherent concept for stabilised approach.*

Why ?

*The operator's weighing of production against safety has not been in balance.*

Why ?

*The operator's systematic safety work has not lived up to the requirements that must be imposed on a commercial operator.*

Why ?

*The responsible regulator has failed to detect and take measures against the deficiencies in the operator's systematic safety work.*

**Safety recommendations**

Considering that the Swedish Transport Administration has terminated the contract with the operator in question, SHK has limited the report's recommendations to only one directed to the Estonian civil aviation regulator, *Lennuamet,* which is recommended to:

- Tighten its supervision of the operator, AS Avies, in order to ensure that operations are conducted in accordance with applicable flight safety requirements, in particular with respect to such deficiencies as identified in section 2.5 of this report. (*RL 2015:10 R1)*

# 1. FACTUAL INFORMATION

## 1.1 History of the flight

### *1.1.1 Background conditions*

The flight was a scheduled flight from Stockholm/Arlanda to Torsby Airport in Värmland with a Jetstream 3200 (J32), see Figure 1, from the Estonian airline AS Avies with flight number AIA 205D. Due to the prevailing weather conditions at Arlanda with heavy snow, departure was delayed by about one hour.

Figure 1. ES-PJR, BAe Jetstream 32. Photo: AS Avies.

After landing at Torsby, refuelling was to be performed during a short ground stop. The plan was that the aircraft would then continue to the company's home base in Tallinn. There were 15 passengers and two crew members on board the flight from Arlanda.

Due to the prevailing weather situation, the flight was planned with two alternate airports. The fuel on board was reported as the minimum permitted fuel quantity according to current regulations for the flight in question. The aircraft's mass at take-off was calculated at 8 kilos under the aircraft's maximum authorised structural take-off mass.

The aircraft was de-iced before take-off from Arlanda and commenced taxiing at 19.38 hrs. According to information from the pilots, the start-up procedure for the engines went normally, and taxiing out towards the runway was carried out in accordance with current procedures.

The take-off – where the co-pilot had been designated PF[6] – came to be further delayed due to snow clearance and took place at 20.07 hrs.

[6] PF (Pilot Flying) – the pilot who is flying the aircraft.

Nearly all of the region of Svealand was covered by a snowfall area with low visibility values and icing conditions.

### *1.1.2 Sequence of events*

The flight towards Torsby proceeded without any known disruptions, and the pilots planned for an instrument approach towards runway 16[7]. The approach was to be performed from the north via a procedure turn at the outer NDB[8] marker TH. Electronic approach aids on runway 16 consist of LLZ[9] and DME[10]. For visual glide path information, PAPI[11] is installed on the left side of the runway.

The current weather at Torsby Airport was 2,000 metres visibility in snow. 1 hour and 40 minutes before the estimated landing, friction tests were carried out on the runway resulting in friction coefficients 0.25, 0.25 and 0.23 respectively. Snow clearance was commenced during continued snowfall, and the next friction measurement was carried out 19 minutes before landing with the coefficient results 0.30, 0.31 and 0.33. Snow clearance then continued for a number of minutes more, and the clearance vehicle left the runway when the aircraft passed TH on the way out into the procedure turn, approximately 7 minutes before landing.

The approach was performed manually with the co-pilot as PF. No problems or anything abnormal during the approach were reported by the crew. When the aircraft passed TH on the way in, the approach according to the crew was stabilised. According to the crew, contact with the runway's approach lights took place with a good margin to the established minimum altitude for instrument approach. The calculated mass upon landing was stated to be 21 kilos under the aircraft's maximum authorised structural landing mass.

### *1.1.3 The incident*

The aircraft landed about 800 metres into runway 16 with a high touchdown speed. The first officer retarded the throttles to idle and initiated thrust reversal, whilst at the same time handing over control of the aircraft to the commander.

After having taken over control, the commander commenced braking and also set the engine controls at full thrust reversal. However, the aircraft could not be brought to a stop – or manoeuvrable speed – before the taxiway that led in to the station building. The commander attempted to turn off to the right onto the taxiway, but the aircraft veered off the runway in the corner between the runway and the

[7] Runway 16 means that the runway's magnetic compass direction is about 160°, i.e. a south-southeasterly direction.
[8] NDB – Non Directional Radio Beacon.
[9] LLZ – Localizer.
[10] DME – Distance Measuring Equipment.
[11] PAPI (Precision Approach Path Indicator) – Visual lighting system for correct approach angle towards the runway.

taxiway and came to stand in a snowdrift with the nose 6-7 metres from the edge of the taxiway, see Figure 2.

Figure 2. The aircraft after the excursion. Photo: Torsby Airport.

After having informed the tower, the crew shut off the engines, and the co-pilot assisted with the evacuation of the passengers. No injuries to passengers or damage to the aircraft have been reported.

The incident occurred at position 600917N, 0125937E, 120 metres above sea level.

### 1.1.4 *Interviews with the crew*

*Commander*

During the interview, the commander stated that he was well acquainted with the route in question and the conditions at Torsby Airport. Cooperation with the co-pilot had functioned well, and they had flown together for a long period of time. The commander also stated that there had been no deviations from operational routines or regulations, neither on the day in question nor during previous flights together with the co-pilot.

Besides the delay caused by the prevailing weather, the flight towards Torsby had not entailed any difficulties or unforeseen problems. According to the commander, the weather in Torsby could be deemed normal winter weather and was not expected to entail any operational problems or limitations.

The commander was of the understanding that the aircraft model in question, J32, was approved for operations in all kinds of icing. He also considered the aircraft to be designed to cope with a lot of ice and only had good experiences of flight under severe icing conditions.

However, the commander did not recall that icing had constituted any major problem during the flight in question. When the aircraft was approaching Torsby, the crew discussed the approach procedure that the co-pilot should commence, full procedure via TH and LLZ/DME approach to runway 16. The landing was to be performed with 35° flaps and with a $V_{REF}$[12]of 115 knots.

The commander stated that he had not observed any notable icing on the aircraft and had therefore not ordered the addition of 10 knots to $V_{REF}$ that is prescribed in the flight manual (AFM[13]) if there is ice on the aircraft.

In the final stage of the approach, the commander had communicated to the co-pilot that the speed was too high. When contact was gained with approach lights and runway lights, he had also noted that PAPI indicated that the aircraft was too low in relation to the visual glide path.

The co-pilot had then raised the nose of the aircraft in order to correct the pitch angle. However, the commander assessed that the approach was stabilised. (SHK has found that the operator lacks established routines for determining whether an approach is stabilised or not – i.e. a “stabilised approach concept” – see section 1.18.4.)

According to the commander, the landing had taken place “a little way along” the runway, but he could not recall what the speed had been at the time of touchdown. When he took over the controls after touchdown, the engines had been put in initial reverse position, and the commander subsequently commenced braking while at the same time applying full reverse.

The commander said in the interview that he experienced the surface as “very slippery” when braking and noted that the runway end was approaching fast. When he realised that the runway would not be sufficient to stop the aircraft, he had two choices, to continue straight ahead and run off in the extension of the runway or to attempt at high speed to turn onto the taxiway.

In the turn on to the taxiway, the commander lost control of the aircraft and ran off the runway in the area between the taxiway and the runway. According to the commander, there was no panic on board, and when the engines had been shut down the co-pilot assisted the passengers in the evacuation.

[12] $V_{REF}$ (Reference speed) – the lowest speed that, with reference to the aircraft's actual mass, is to be maintained when passing the runway threshold at a height of 50 feet.
[13] AFM (Airplane Flight Manual) – manual approved by the certifying authorities.

*Co-pilot*

According to the co-pilot, take-off and climb-out from Arlanda had proceeded without any problems. During the climb, stricter attention was maintained with regard to icing since the de-icing system for the propeller of the right engine was unserviceable. This technical malfunction was however not communicated to the co-pilot. Indications concerning the de-icing systems are located on the left side of the cockpit. However, according to the co-pilot's understanding, they had not experienced anything other than light icing during the flight.

During the instrument approach, the co-pilot – who at the time was PF – was concentrated on flying since the aircraft in question did not have autopilot and had to be flown manually. The co-pilot therefore left it to the commander to check whether any ice had been formed on the wings. The speed that was to be maintained when passing in over the runway threshold ($V_{REF}$) had been agreed at 115 knots.

The co-pilot does not remember if any checks of ice on the wings were performed during the approach, but stated during the interview that no addition to $V_{REF}$ had been agreed on. Despite this, the co-pilot had decided to maintain a somewhat higher speed during the approach.

At the time of the interview, the co-pilot could not recall that the expression “stabilised approach” had been used during the approach in question and also said that the concept of stabilised approach was not included by the operator neither in training nor in daily flying.

The co-pilot also spoke of the corrections of speed and flight profile that were made after remarks from the commander. Regarding the altitude correction, the nose had been raised somewhat in order to adjust the aircraft's glide path with reference to the visual glide path information from PAPI. The co-pilot could not recall the PAPI indications during the final part of the approach but asserts that touchdown took place at an estimated distance of about 100 metres after the PAPI. The PAPI installation is placed about 250 metres from the runway threshold on runway 16 (SHK's remark).

After touchdown, the co-pilot put the power levers in initial reverse position and handed over control of the aircraft to the commander. The co-pilot has not been able to make an estimate of the speed when passing the runway threshold or at touchdown. It was also revealed in the interview that the airspeed indicator on the right side showed a speed about 5 knots lower than the corresponding airspeed indicator on the left side.

There had been no discussion between the pilots concerning runway conditions and the friction coefficients that had been reported. The reason for this, according to the co-pilot, was that the company's manuals described no procedures concerning corrections for contaminated surfaces.

### *1.1.5 Interviews with airport staff*

SHK has conducted interviews with staff from Torsby Airport. The official on duty in the tower on the evening in question has recounted his experience of the sequence of events.

The ramp personnel on duty that evening were witnesses to the event as, at the time of the occurrence, they were placed so that they could observe the approach and landing. Besides interviews with these staff, SHK has made use of their observations in connection with the practical flight tests conducted at the airport – see Section 1.16.1.

## 1.2 Injuries to persons

| | Crew members | Passengers | On board, total | Others |
|---|---|---|---|---|
| Fatal | 0 | 0 | 0 | - |
| Serious | 0 | 0 | 0 | - |
| Minor | 0 | 0 | 0 | Not applicable |
| None | 2 | 15 | 17 | Not applicable |
| Total | 2 | 15 | 17 | - |

## 1.3 Damage to aircraft

No known damage.

## 1.4 Other damage

None

### *1.4.1 Environmental impact*

None

## 1.5 Personnel information

### *1.5.1 Commander*

The commander was 56 years old and had a valid ATPL(A) license with flight operational and medical eligibility. At the time the commander was PM[14].

[14] PM (Pilot Monitoring) – the pilot who assists the Pilot Flying.

| Flying hours | | | | |
|---|---|---|---|---|
| Latest | 24 hours | 7 days | 90 days | Total |
| All types | 2.5 | - | 110 | 14,560 |
| This type | 2.5 | - | 110 | 620 |

Number of landings this type previous 90 days: 151.
Type rating concluded on 2 November 2012.
Latest PC[15] conducted on 28 June 2013 on J31/32.

### 1.5.2 *Co-pilot*

The co-pilot was 22 years old and had a valid ATPL(A) license with flight operational and medical eligibility. At the time the co-pilot was PF.

| Flying hours | | | | |
|---|---|---|---|---|
| Latest | 24 hours | 7 days | 90 days | Total |
| All types | 2.5 | - | 96 | 620 |
| This type | 2.5 | - | 96 | 450 |

Number of landings this type previous 90 days: 133
Type rating concluded in October 2013.
Latest PC conducted on 29 September 2013 on J31/32.

### 1.5.3 *Cabin crew*

Not applicable

### 1.5.4 *The duty schedule of the pilots*

Both pilots were on day 5 of a five-day schedule. The flight in question, Torsby – Stockholm/Arlanda – Torsby, had been preceded by a period of leave of 20 hours.

## 1.6 Aircraft information

### 1.6.1 *General*

Jetstream 32 is described in the type certificate as a low-wing turboprop aircraft intended for passenger traffic. Two turboshaft engines mounted conventionally above the wings drive the four-bladed propellers.

[15] PC (Proficiency Check).

### 1.6.2 Aircraft

| | | |
|---|---|---|
| *General* | | |
| TC-holder | BAe Systems (Operations) Ltd. | |
| Model | Jetstream 3200 series | |
| Serial number | 949 | |
| Year of manufacture | 1991 | |
| Gross mass, kg | Max authorised start/landing mass 7,350/7 080, actual 7,342/7,059. | |
| Centre of gravity | Within permitted limits. C/G 46.8. | |
| Total flying time, hrs | 18,593 | |
| Flying time since latest inspection | 22 | |
| Number of cycles | 30,955 | |
| Type of fuel loaded before event | Jet A1 (the aircraft was refuelled at Torsby). The remaining fuel amount at Arlanda for the flight in question was 617 kilos. | |
| *Engine* | | |
| TC-holder | Honeywell International Inc. | |
| Type | TPE331-12UHR-702H | |
| Number of engines | 2 | |
| Engine | No 1 | No 2 |
| Serial number | P-66330 | P-6632C |
| Total operating time, hrs | 13,602 | 5,105 |
| Operating time since overhaul, hrs | 6,576 | 3,207 |
| *Propeller* | | |
| TC-holder | McCauley Propeller Systems | |
| Type | 4HFR34C653L | |
| Serial number | 011389 | 911615 |
| Total operating time, hrs | 4,004 | 10,138 |
| Operating time since overhaul, hours | 2,131 | 1,135 |
| Deferred remarks | No remarks were noted in the aircraft logbook at the time of the incident. According to information from the commander, remarks from preceding flights were noted in the document “Maintenance request”, see Sections 1.6.3-1.6.4. | |

The aircraft had a Certificate of Airworthiness and a valid ARC.

### *1.6.3 Regulations regarding technical remarks*

Commission Regulation (EC) No 2042/2003, section M.A. 403, concerning the handling of aircraft malfunctions, states that any aircraft defect that hazards seriously the flight safety shall be rectified before further flight.

Furthermore, only authorised certifying staff, as a main rule, can make such an assessment of a defect and therefore decide when and which rectification action shall be taken before further flight and which defect rectification can be deferred. Any defect not rectified before flight shall be recorded in the aircraft technical record system or in the operator's technical logbook.

Section M.A. 306 of the same Regulation also describes how the operator's technical log system is to be structured for each aircraft. This shall be done in such a way that factors such as maintenance status, deferred defects and scheduled maintenance can be understood; as this information of operational nature is necessary for the crew. This system must also be approved by the operator's regulator.

### *1.6.4 The technical log in this case*

SHK has reviewed the notes in the aircraft's technical log at the time of the incident, as well as the periods immediately before and after the incident.

During the period from 27 January to 31 January (the day of the incident), there were no remarks noted in the section of the log intended for technical remarks or notes (Defect Report Details). According to interviews with the crew, however, it could be established that the aircraft had some technical defects that were known both to the pilots and the company's technical department.

These remarks had been reported to the company by the pilots but not entered in the aircraft logbook. An internal document, “Maintenance request”, which is managed by the company's technical department, contained the following technical remarks regarding the aircraft individual in question, dated 29 January 2014:

- Crew reported: R/H propeller deicing U/S[16],
- Crew reported: R/H Cabin window lights are working only 2-3 seconds,
- Crew reported: Missing some pitot covers.

The day after the incident in Torsby, the aircraft in question was flown to Tallinn to carry out planned maintenance (A-check). In the technical log for this flight two of the items above were noted –

[16] U/S – Unserviceable.

*propeller de-icing U/S* and *Cabin Lighting U/S*. In addition to this, one further remark was noted: FDR[17] U/S, MEL[18] 31-3, referring to operations without FDR. This remark was associated with the FDR, having been removed from the aircraft in question after the incident at SHK's request.

In a previous report (RL 2014:07e) concerning the same operator, SHK demonstrated the same type of deviations from the said regulations as those manifesting themselves in connection with the event presently in question. This previous report shows that the deviations are not a chance occurrence but were part of a system created by the operator. The report described the system as follows:

> *Technical remarks are not normally noted in the aircraft's logbook; they are instead transferred to a document named "Maintenance request". This document is sent in an appropriate manner to the operator's maintenance organisation for a decision concerning appropriate measures.*
>
> *The pilots are instructed not to write any technical remarks before the defect/problem which has arisen has been confirmed by a certified technician. The routes that the operator's aircraft fly in the Swedish line network entail that the aircraft meet a technician once per week on average.*
>
> *The operator has stated that the system works well in general and that there have only been a few instances of misunderstandings. The reason for the pilots being instructed not to write the technical remarks in the logbook is, according to the operator, that this entails a greater risk that the aircraft will be grounded.*

### *1.6.5 Operations in icing conditions*

The aircraft model J32 is designed and certified to meet the requirements of FAR[19] 23, Appendix 23 - 34. These appendices were added after the certification in order for airplanes certified in accordance with FAR 23 to meet the requirements relating to operations in icing conditions in the higher certification category FAR 25, Appendix C.

According to the Type Certificate holder, the model J32 has undergone systems analyses, ground and flight testing to demonstrate that the model's characteristics meet the requirements of FAR 25, Appendix C. The aircraft's approved AFM, however, contains no information about which icing conditions the model can be operated under. There is also no requirement in the current certification category that this must be stated.

[17] FDR – Flight Data Recorder.
[18] MEL – Minimum Equipment List.
[19] FAR - (Federal Aviation Regulations) – certification requirements within the US Aviation Authority.

The AFM, chapter 3, section 10, contains however warnings and instructions for the crew in case the aircraft encounters severe icing.

### *1.6.6 Operations without a serviceable propeller de-icing system*

As previously mentioned in Section 1.1.4, the propeller de-icing system was unserviceable on the right engine. This condition was not known to the co-pilot.

As regards MEL, it is stated in the aircraft's MEL 30-13 that the aircraft may be flown without a serviceable propeller de-icing system. However, this may only take place provided that the aircraft is not operated in known or forecast icing conditions.

### *1.6.7 Pitot and static pressure*

In the cockpit, current forward airspeed is presented on two instruments placed on the right and left sides of the instrument panel, respectively. The indicated forward airspeed for the respective systems is based on information from separate pressure systems. The forward airspeed and the altitude registered by the Flight Recorder (FDR) are based on pitot pressure – shared with the airspeed indicator on the right side – and on a separate single static pressure.

Each system contains a total pressure and a static pressure. The altitude information is based on the static pressure, and the indicated speed (IAS)[20] is based on the total pressure compensated with the static pressure. The total pressures for the systems are obtained from two pitot tubes.

The static pressures are measured via static ports placed in the rear part of the fuselage where the air is normally the most free from disturbance. There are ports on both sides of the fuselage. Each side's static pressure for the respective systems (S1-S5) is linked together, thus forming an average value of the static pressures. At positions where the pressure system has longer tube lengths, water traps and drainage points are placed. Figure 3 shows the different pressure systems and their placement on the aircraft. A schematic view of the different pressure systems is shown in Figure 4.

The instruments for speed and altitude on the left side obtain pressure from pressure system 1 (P1 and S1), and the right side's instruments obtain pressure from system 2 (P2 and S2). The FDR in turn bases the altitude information on the S5 system and indicated speed on the S5 and P2 systems.

Among other things, the static pressures are used to obtain information on altitude and, together with the dynamic pressure, constitute the two parameters on which the forward speed is based.

[20] IAS – Indicated Airspeed.

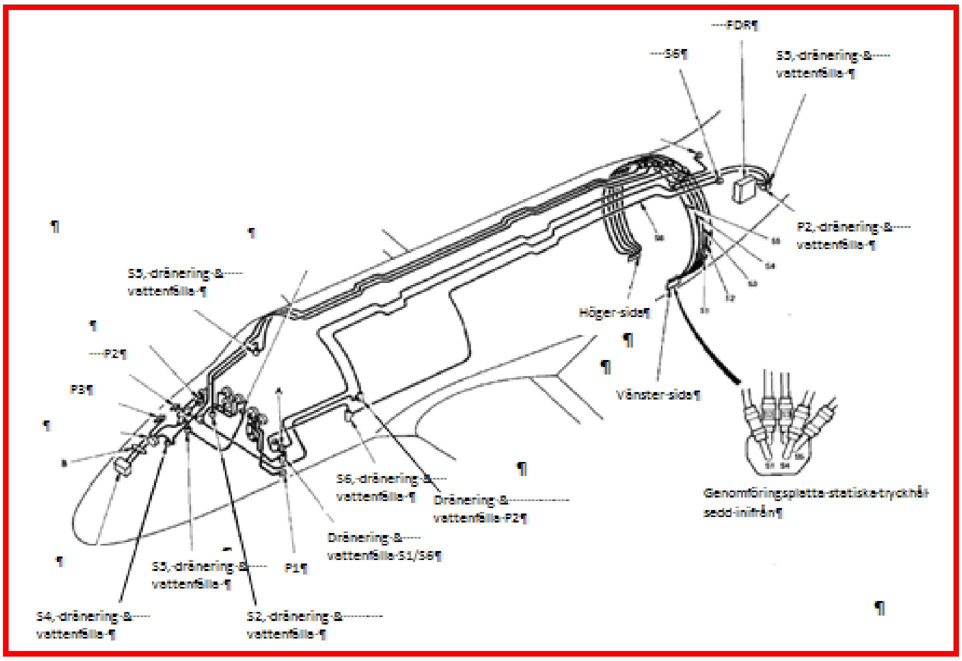


Figure 3. The aircraft's pressure system with water traps.

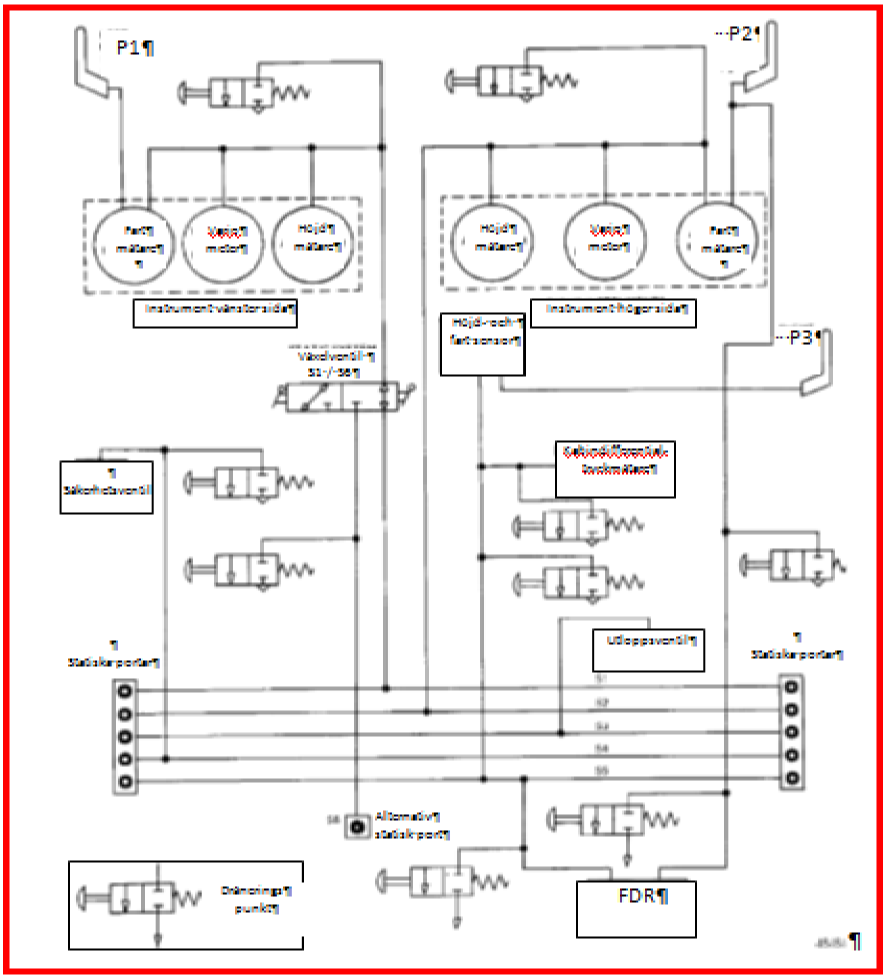


Figure 4. Schematic view of the pressure system.

### 1.6.8 *The pressure systems*

The static pressure is the pressure to which a body is subjected when at rest. If the body has a relative motion against the medium it is in – in this case air – an increased pressure will arise on the surfaces facing the direction of motion.

This increased pressure (P0) is called total pressure, alternatively pitot pressure, and consists partly of the contribution from the speed relative to the medium and the body, and partly of the contribution from the static pressure (Ps) constituted by the medium on the body. To obtain only the contribution from the speed, the static pressure is subtracted from the total pressure; the result is termed dynamic pressure (q); q=P0-Ps. This relationship is reasonably correct at speeds below about one third of the local speed of sound (a). At these speeds, the compressibility effects are considered negligible. The dynamic pressure (q) is defined as follows: q=1/2 ρv^2, where ρ is the medium's density that varies with pressure and temperature.

To gain an acceptable indication of the flight speed, it is necessary to take into account the influence of compressibility, which in turn depends on the relationship between airspeed (v) and the local speed of sound (a). This ratio (M= v/a) is termed Mach number. The speed of sound in turn depends strongly on the local static temperature T[21], which in turn varies with factors such as altitude.

As previously mentioned, the airspeed recorded in the FDR and the indicated airspeed shown on the pilot's instruments are based on the pressure difference between P0 and Ps. For SHK's calculations, the remaining variables have been set to constants with values corresponding to the reference values prevailing at standard atmosphere at zero altitude.

This means that the indicated airspeed will deviate from actual speed if the ambient pressure and temperature deviate from the reference values.

### 1.6.9 *Landing on runways with contaminated surfaces – general*

To calculate how slippery a surface is, e.g. on an asphalted landing runway, samples are taken using a measuring vehicle to establish a friction coefficient, see Section 1.10.2. The friction coefficient is directly proportional to the braking action that an aircraft can achieve when braking after landing or after the decision to abort a take-off.

The measured friction coefficient can be described as a value corresponding to the friction between the aircraft's tyres and the runway's surfacing. Lower coefficients mean a reduced braking ability for the aircraft and thereby a longer stopping distance. Low friction also adversely affects the nose wheel's steering ability.

[21] T – Temperature in Kelvin used in physical calculations.

The relationship between the measured value of the friction coefficient, the published phraseology for reporting current braking action from air traffic control bodies to aircraft and the MOTNE39 code for telex are shown in the table in Figure 5 below.

| Friction coefficient, measured value | Braking action, phraseology | Braking action, MOTNE39 code |
|---|---|---|
| 0.40 and above | Good | 5 |
| 0.39 to 0.36 | Good to Medium | 4 |
| 0.35 to 0.30 | Medium | 3 |
| 0.29 to 0.26 | Medium to Poor | 2 |
| 0.25 and below | Poor | 1 |
| Unreliable | Unreliable | 0 |

Figure 5. Table, BCL-F 3.2, Subsection 8.2.8, which shows how information on friction coefficients and braking action is communicated.

### *1.6.10 Landing on runways with contaminated surfaces – regulations*

The operational documentation for which the type certificate holder of an aircraft is responsible – usually found in the aircraft's AFM – reports facts including aircraft performance with regard to required runway length for varying mass under differing conditions.

The regulations regarding landing on wet and contaminated runways contained in the regulations EASA[22]OPS, CAT.POL.A.235 (a) govern only performance calculations for operations on dry and wet surfaces. Briefly, these rules may be described as stating that the available landing distance under conditions with a wet runway is to be at least 115% of the required landing distance according to OPS, CAT.POL.A.230.

Since the data provided by the type certificate holder does not normally contain any calculations for operations on contaminated surfaces, such calculations must be performed by the operator – or by a company engaged by the operator – in the cases these operations will be conducted on runways with contaminated surfaces.

For such conditions, it follows from the regulations in OPS, CAT.POL.A.235 (b) that the calculations shall be performed in accordance with “approved contaminated landing data”, i.e. approved landing data for contaminated surfaces. These also state that the available landing distance as calculated with reference to the contaminated surface shall also be 115% of the requisite landing distance according to OPS, CAT.POL.A.230.

[22] EASA – European Aviation Safety Agency.

### *1.6.11 Landing on runways with contaminated surfaces – calculations*

As mentioned above, the operator is responsible for producing operational performance data if operations are to be conducted in areas with winter conditions, where there is a risk of contamination of take-off and landing runways.

The types of contamination caused by meteorological winter conditions that usually entail correction of required take-off and landing distances can be summarised as follows:

- Frost
- Dry, wet or compacted snow
- Slush
- Dry or wet ice

Normally, air traffic control reports to aircraft taking off and landing regarding the surface of the runway in question, together with the measured friction coefficient or braking action.

Besides correction of the required runway length for the reported friction coefficient or braking value, correction shall also be performed with consideration for the type of contamination and the thickness of the covering.

The values reported are used by the crew as initial values for the calculation of two alternative areas of use:

- Calculation of maximum authorised landing mass for a given runway length.
- Calculation of required runway length for a given landing mass.

These calculations are usually based on tables for the runway on which the landing is to be performed and where fixed values such as runway length and runway slope are entered. In addition to adjustments for the runway's condition (friction coefficient and type of surface) and actual landing mass, corrections are also made for aircraft configuration (selected flap position and $V_{REF}$), as well as prevailing meteorological conditions such as wind, temperature and air pressure.

### *1.6.12 Landing on runways with contaminated surfaces – the operator*

During its investigation of the incident with the excursion at Torsby Airport, SHK has examined the performance data used by the operator in operations on contaminated runways.

The data is produced by an external performance calculation company and approved by the Estonian regulator *Lennuamet*. For the calculation of landing performance, tables are used by which the maximum authorised weight in varying conditions can be derived.

Figure 6 presents the relevant data for landing on runway 16 in Torsby. It is evident from the data that a choice can be made only between a dry runway (DRY RWY) and a wet runway (WET RWY) for various flap configurations and wind components.

It can be seen in the table that the performance data relates to the model Jetstream Super 31. In connection with the consultation procedure for the draft report, the operator has informed SHK that this model designation is used in the performance tables for the model Jetstream 32.

-- TYF -ESST -- LANDING PERFORMANCE -- TYF -ESST --
JETSTREAM SUPER 31 TORSBY, SWE
ELEVATION 393 TPE 331-12 ENG FRYKLANDA

*** APPROACH CLIMB LIMITS - APPROACH FLAPS 10 ***
CLIMB PERFORMANCE NOT LIMITING BELOW 39 (C)

| TEMP(C) | -20 | 39 | 40 | 50 |
|---|---|---|---|---|
| CLMB WT | 7080. | 7080. | 7061. | 6581. |

*** LANDING FIELD LENGTH LIMITS ***

| RUNWAY LENGTH SLOPE | WIND KTS | *** LNDG FLAPS 35 *** DEST-DRY RWY FCTORED 70% | DEST-WET RWY FCTORED 115% | *** LNDG FLAPS 20 *** DEST-DRY RWY FCTORED 70% | DEST-WET RWY FCTORED 115% | LANDING FLAPS ZERO(0) |
|---|---|---|---|---|---|---|
| | -10 | 7080 | 7080 | 7080 | 7080 | 5193 |
| 16 | | | | | | |
| 1590M | 0 | 7080 | 7080 | 7080 | 7080 | 6753 |
| 0.82 | | | | | | |
| | 10 | 7080 | 7080 | 7080 | 7080 | 7080 |
| | 20 | 7080 | 7080 | 7080 | 7080 | 7080 |
| CRT | TW | -10 | -10 | -10 | -10 | |
| SUB | LB/KT | 0 | 0 | 0 | 0 | |
| | -10 | 7080 | 7080 | 7080 | 6889 | 5193 |
| 34 | | | | | | |
| 1590M | 0 | 7080 | 7080 | 7080 | 7080 | 6753 |
| -0.82 | | | | | | |
| | 10 | 7080 | 7080 | 7080 | 7080 | 7080 |
| | 20 | 7080 | 7080 | 7080 | 7080 | 7080 |
| CRT | TW | -10 | -10 | -10 | -8 | |
| SUB | LB/KT | 0 | 0 | 0 | -210 | |

AFM HP4.16 04Feb14

Figure 6. The operator's performance table for landing in Torsby.

The table shows that landing on runway 16, with the maximum authorised structural landing mass, 7,080 kg, is possible under all conditions. There were no further correction factors for the calculation of maximum authorised landing mass in the operator's data.

### *1.6.13 Examination of the operator's performance calculations*

In order to analyse the performance data used by the operator, SHK has engaged the special expertise of Flygprestanda AB. Besides a review of the data, the task has also encompassed calculations regarding the landing in question.

As regards the data used by the operator for calculations of landing performance during the flight in question, Flygprestanda AB has submitted the following statement:

*"The data that Flygprestanda has had access to concerning Avies' incident with Jetstream 32, (ES-PJR), in Torsby on 31 January 2014, only contains performance calculations for take-off and landing regarding a dry and a wet runway.*

*As in the case in question, not compensating in any way for reduced braking action due to an icy/slippery runway is not something that Flygprestanda recommends. If there is no data, one has to be prepared to deviate to an alternate airport or cancel the flight".*

The calculations regarding the flight in question have been performed on the basis of the following conditions:

- Landing on runway 16 with known conditions according to AIP[23],
- Wind variable 03 knots,
- Actual mass upon landing 7,059 kg (max 7,080),
- $V_{REF}$ 125 knots (115 knots + 10 knots for icing according to AFM),
- Friction coefficient 0.275 (See 1.10.3 below).

On the basis of the above values, Flygprestanda has performed a calculation of the required runway length for the landing in question according to current regulations. The required landing distance amounts to 1,473 metres. In relation to the actual runway length of 1,590 metres, this had entailed a calculated margin of 117 metres for the landing.

However, this margin had been used up during the landing in question because the touchdown speed was higher than normal, and the touchdown took place about 800 metres into the runway.

## 1.7 Meteorological information

### *1.7.1 General*

According to the Swedish Meteorological and Hydrological Institute, SMHI: Nearly the whole of the region Svealand was covered by snowy weather with visibility values generally between 700 metres and 5,000 metres, and vertical visibility or cloud base of between 500 feet and 2,000 feet. During the day, six SIGMETs[24] were issued for severe icing. Three concerned eastern Svealand, and the last (applicable 18.00 – 20.00) that was issued covered parts of western Svealand.

[23] AIP – Aeronautical Information Publication.
[24] SIGMET – Significant Meteorological Conditions.

Areas with moderate to severe icing varied during the day. An extensive area with snow and icing covered large parts of Scandinavia. According to SMHI, a number of observations had also been reported during the afternoon from aircraft regarding observed moderate to severe icing in Stockholm FIR[25].

### *1.7.2 Local weather*

Origin airport:

According to Metar Stockholm/Arlanda at 19.50 hrs: Wind 100°, 08 knots, visibility 2,400 metres in snow, cloud base 800 – 1,200 feet, temperature/dewpoint M04/M04 °C, QNH 1016 hPa.

Destination airport:

According to Metar Torsby at 20.40 hrs: Wind variable 03 knots, visibility 2,000 metres in snow, vertical visibility 1,900 feet, temperature/dewpoint M05/M06 °C, QNH 1013 hPa.

## 1.8 Aids to navigation

All electronic and visual aids to navigation at the airport functioned without remarks. There are no reports regarding faults or malfunctions on any of the navigation systems on board the aircraft.

## 1.9 Communications

The radio communication between the aircraft and the air traffic control tower in Torsby has been recorded and secured by SHK. This shows that the current weather and measured friction coefficients – with the actual time for the measurement (20.40 hrs) – were communicated to the aircraft about 15 minutes before the landing.

After the runway excursion followed a dialogue between the pilots and the tower regarding assistance from the airport's rescue services, among other things. Other radio communication merely verifies the testimonies given and has been deemed not to offer any additional factual information to the investigation.

## 1.10 Aerodrome information

### *1.10.1 General*

Torsby Airport has an asphalted runway with the dimensions 1,590 x 30 metres, see Figure 7. The runway is equipped with high-intensity runway edge and approach lights in both directions. For instrument approach, there are Non-Directional Beacons (NDB) and localisers (LLZ) installed in both approach directions.

[25] FIR – Flight Information Region.

The airport is also equipped with a distance transmitter (DME), placed in the centre of the airport area. Light ramps with visual glide path information (PAPI) are placed on the left side at the respective runway start. Electronic glide path information is not installed.

At the time of the incident, the airport had operational status in accordance with the Swedish AIP.

### *1.10.2 Runway maintenance*

In winter conditions when the runway's surfacing can be contaminated by ice or snow, friction measurement is to be carried out at the airport. This is usually carried out with standardised measuring equipment to produce a current friction coefficient as a measure of braking action. Measurement of braking action shall take place daily during operation, except when the friction coefficient can with certainty be considered to have a value of 0.40 or better.

Friction measurement at Torsby airport is carried out routinely with a SAAB Friction Tester, a method for continuous friction measurement that has been used in Sweden since the mid-1970s. According to the airport's local instruction *Field control winter (C4A:2)*, friction values during the winter season are to be measured approximately 30 minutes before the airport is opened.

The first measurement shall be made in the morning before the first known take-off or landing and other measurements thereafter shall be distributed evenly across operating hours. In addition, braking action shall be measured as soon as there is reason to assume that a new measurement of the braking action would produce a value which deviates by 0.05 units or more from the required value within any of the sections.

The relationship between the measured value of the friction coefficient and braking action and the published phraseology for reporting from air traffic control bodies to aircraft and the MOTNE39 code for telex is shown in the table in Figure 5.

### *1.10.3 Actual runway conditions*

Friction measurement on the runway was carried out at 18.17 hrs, i.e. 1 hour and 40 minutes before the estimated landing. The values that were measured at that time were 0.25, 0.25 and 0.23 respectively causing the snow clearance manager to decide that snow clearance operations would be commenced.

Snow clearance was commenced during continuous snowfall, and at 19.40 hrs a new friction measurement was carried out with the results 0.30, 0.31 and 0.33 respectively. Snow clearance then continued for about another 10 minutes. According to interviews with the field personnel, this time was mainly devoted to clearance of the edges in order to increase the cleared width of the runway.

When the aircraft passed the outer NDB marker TH out into the procedure turn, all vehicles left the runway. At this point in time, about 7 minutes remained until landing. To be able to perform calculations of the landing in question, SHK made certain assumptions regarding the current friction coefficient when the aircraft landed.

The first measurement was 0.25 and below. The runway was then cleared, and the second measurement was just above 0.30. From this measurement, 17 minutes elapsed during continuous snowfall before the aircraft landed. SHK has therefore made the assumption that the prevailing friction coefficient upon landing had deteriorated and for calculation reasons set a value of 0.275, which represents a reasonable mean value between the previously measured friction coefficients.

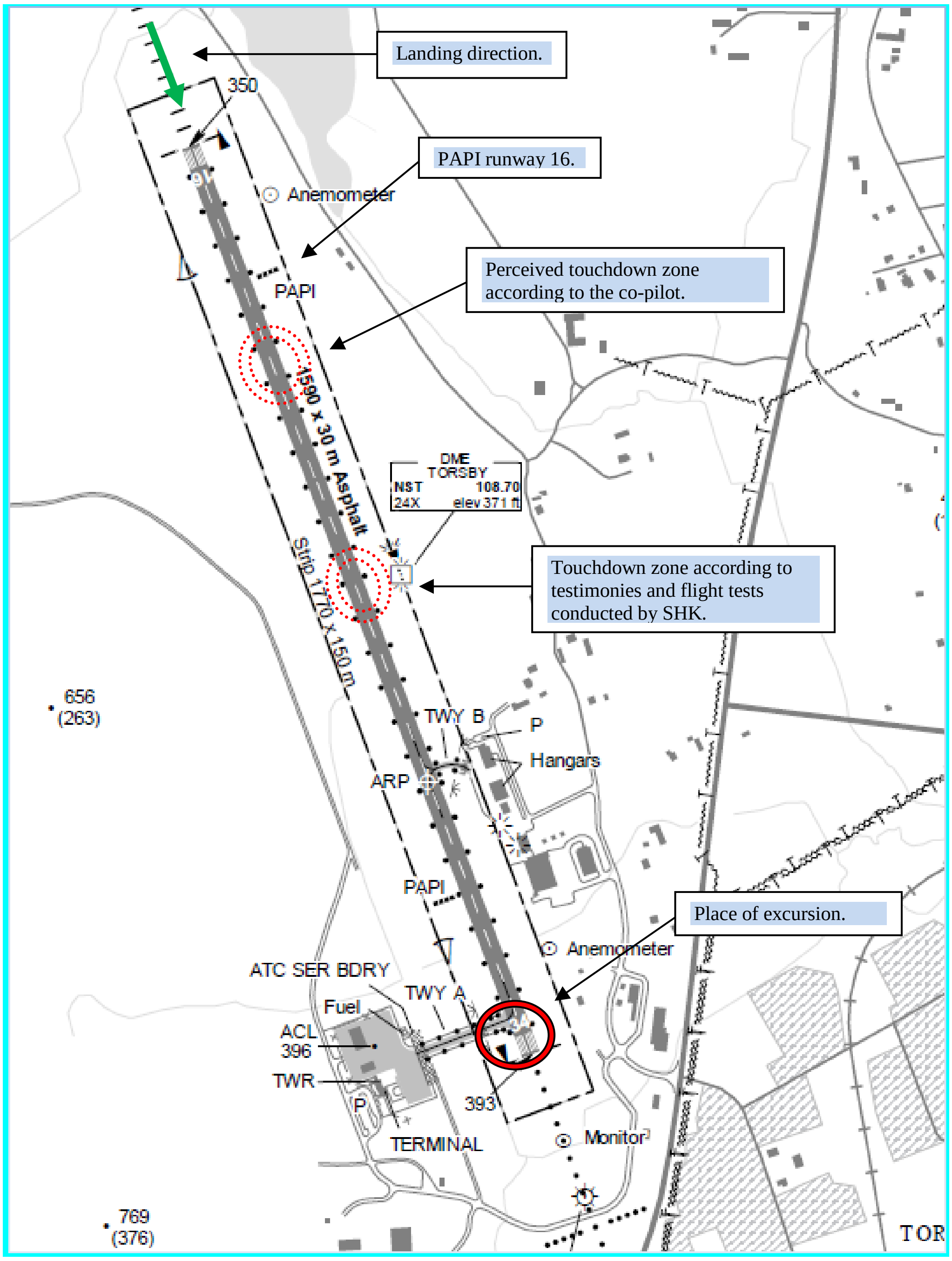

Figure 7. Torsby Airport marked with places relevance for the event.

Figure 7 above shows the zone where the crew perceived the landing to take place, as well as the zone where the touchdown was executed according to the testimonies. The remaining runway length from this touchdown zone is about 800 metres.

## 1.11 Flight recorders

After the incident, SHK had the aircraft's FDR and CVR[26] removed.

The units were sent to the AAIB's[27] laboratory in the UK for reading of the recorded data.

### *1.11.1 Cockpit Voice Recorder – CVR*

The aircraft was equipped with a CVR of type Fairchild A100A. Sound from microphones in the cockpit is recorded and saved on a protected magnetic tape. The tape consists of a closed loop with 30 minutes' recording time.

Section 11 of the operator's operations manual, OM-A[28], contains instructions – addressing both pilots and maintenance personnel – to cut the power supply to the aircraft's CVR in the event of an incident deemed to be "serious" in order to avoid stored information being recorded over when the unit is powered up again.

All sound recorded from the flight in question was however overwritten as the power supply to the cockpit voice recorder was not turned off in time after the incident. The only recordings that remained were telephone conversations between the commander and the company's technical department some time after the incident. These conversations have been analysed by SHK but have been deemed not to offer any substantial factual information to the investigation.

In a previous report (RL 2014:07e), SHK demonstrated the same type of deviation from the operator's regulations regarding the handling of the CVR in connection with incidents.

### *1.11.2 Flight Data Recorder – FDR*

The aircraft was equipped with an FDR of type Fairchild F1000 with the capacity to record up to 19 different parameters, where information from the last 25 recorded hours is saved. The FDR is placed in the rear part of the aircraft and has the task of recording flight data for use in safety investigations by accident investigation authorities.

The unit is powered with 115-volt alternating current via the electricity system's main transfer bus and via a relay that detects if

[26] CVR – Cockpit Voice Recorder.
[27] AAIB (Air Accidents Investigation Branch) – the United Kingdom's investigation authority for accidents and incidents in civil aviation.
[28] OM-A – Operations Manual.

ground power is connected. If ground power is connected, the relay breaks the power supply to the FDR. The unit contains a microprocessor that converts, digtalises and formats data. Data from the latest flights is stored in binary form on internal memory chips. The FDR contains internal pressure sensors that detect the total pressure (P2) and the static pressure (S5).

The FDR records binary data containing coded information from the aircraft's various systems. When reading FDR data, the data values are converted (decoded) into engineering units (e.g. knots, degrees) by means of documentation specific to the installation in an individual aircraft.

In addition to indicated speed, the recorded parameters include barometric altitude and acceleration along the three axes (longitudinal, lateral and vertical). According to the standard ARINC 542 A and the aircraft maintenance manual, data recorded by an FDR from the longitudinal accelerometer shall have an accuracy of ±0.2 g. Recorded speed on an FDR shall have an accuracy of ±10 knots in the speed range between 100 and 260 knots. Recorded altitude in the FDR shall have an accuracy of ±100 feet.

*Recorded data from the unit in question*

The FDR in the aircraft had recorded data over the entire sequence of events. However, the operator lacked the necessary documentation to enable implementation of a converted reading. Data on several parameters were not representative and thus not reliable. This deficiency was previously known to the operator and has for example been mentioned in SHK Report RL 2014:07e.

The parameters concerned included: speed, the engines' rpm and torque, lateral acceleration and outside air temperature. With reference to this, SHK has had to use generic conversion documentation for reading, which was obtained from the AAIB to which the unit was sent.

Figure 8 shows a graph of altitude, speed and longitudinal acceleration from the flight in question. The values are based on FDR data, radar data from MUST[29] and civil radar data in the form of IOR files. However, radar data did not cover the entire sequence.

[29] MUST – Militära Underrättelse och Säkerhetstjänsten [Military Intelligence and Security Service].

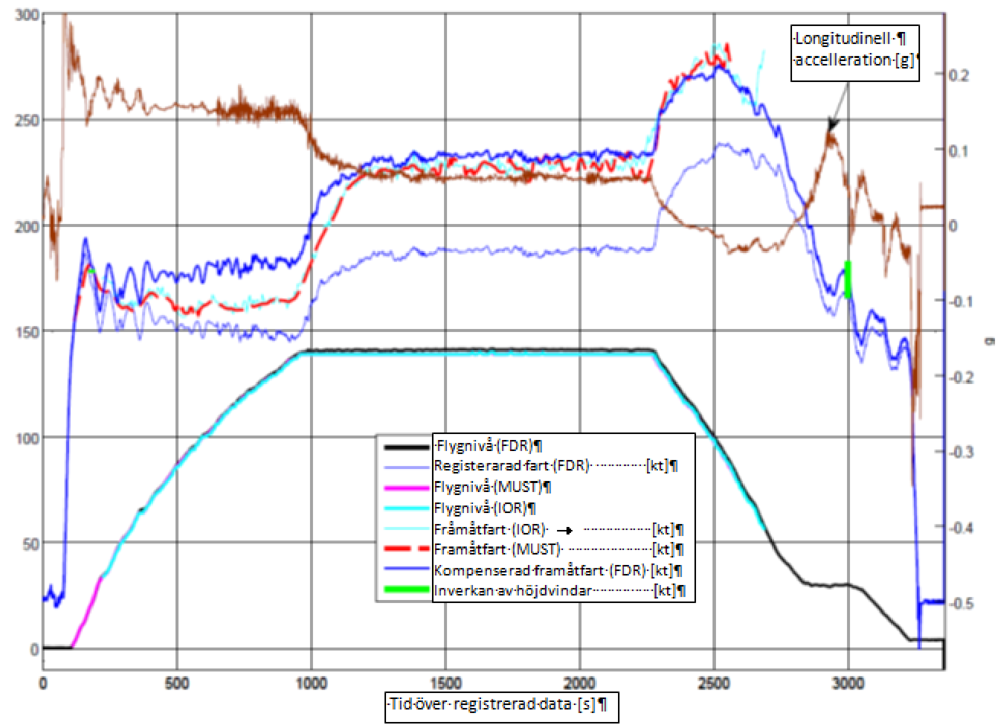


Figure 8. The aircraft's altitude, speed and longitudinal acceleration.

Speed correction has been performed with regard to the effect of altitude. Since the recorded outside temperature has been found to be incorrect, an assumption has had to be made that the ambient temperature has varied in accordance with the ICAO standard atmosphere.

SHK has also examined the effect of winds at altitude in three positions along the route. The effect at the first two points has only been some occasional knot. At the end of the flight, however, the effect was 17 knots (highlighted in green in the graph in Figure 8). The values are based on SMHI's forecasted winds along the route.

The graph shows that the recorded speed during the last 50 seconds of sequence was 20 knots. However, during that time, the aircraft was standing still on the ground. It is also possible to see that where the retardation transitions to a constant value in the final phase, the forward speed is 0 knots for a short while and thereafter rises to 20 knots. The forward speed can also be calculated by means of the time integral of the acceleration. The constant term formed in integration constitutes a boundary condition and is set to 0 knots where the acceleration becomes constant.

It is furthermore assumed that the constant value of the acceleration term in the end, where the aircraft stood still, has been caused by a drift in the system or that the aircraft was not horizontal or by a combination of these two factors. Integrating the speed with the assumption above, from the time when the aircraft stood still and back to about the time when the touchdown occurred, results in the graph presented in Figure 9.

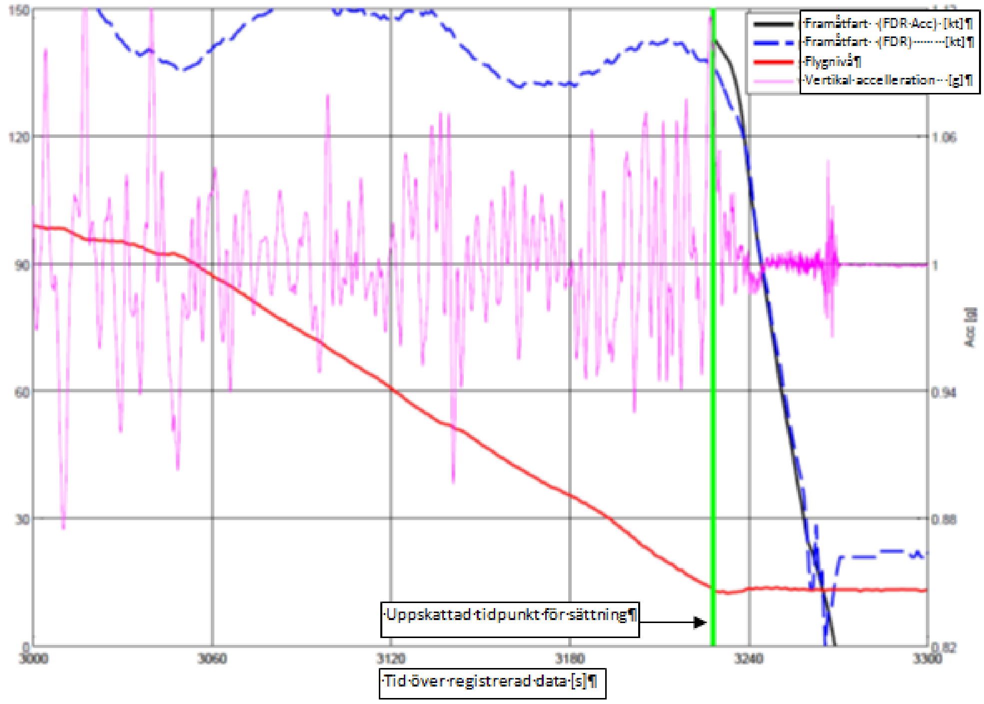


Figure 9. Altitude and speed during the final 3,000 seconds of recorded data. The green line shows an estimated time for touchdown.

The graph shows that during touchdown and rollout, the calculated speed from the accelerometer corresponds well with the recorded speed from the flight data recorder. The assessment of touchdown time is based on values including those from the vertical accelerometer signal recorded by the FDR.

This shows that the probability is high that the recorded speed when the aircraft was in the air is correct and that it is only the recorded speed of 20 knots when the aircraft was standing still which is incorrect. Theoretically authenticated by the accelerometer signal, among other things, this also entails a very high probability that the touchdown speed was higher than normal.

From the graph in Figure 9, it can also be inferred that the speed varied greatly during the final 120 seconds of the approach. About 40 seconds before touchdown, there was a marked speed increase of 10-15 knots that is only broken about 10 seconds before touchdown on the runway.

## 1.12 Site of occurrence

The incident occurred at the end of runway 16 where the exit to the apron takes place via taxiway A. The aircraft ran off in the transition between the runway and the taxiway and stopped in about a 45° angle from the runway with the nose 6-7 metres from the taxiway edge.

The snow depth at the site in question was about 30-40 cm, for which reason the aircraft was rapidly slowed after the excursion. In the incident, several taxiway lights were passed without being damaged by the aircraft's wheels. Figure 10 below marks the aircraft's final position after the incident.

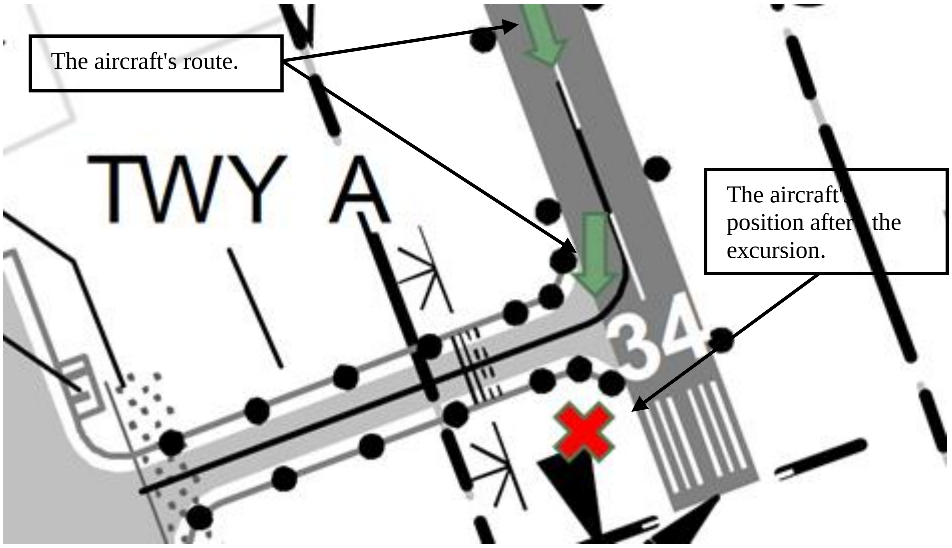


Figure 10. Subsection of the airport from AIP with the site of occurrence marked.

## 1.13 Medical and pathological information

Nothing indicates that the physical or mental condition of the pilots was impaired before or during the flight.

## 1.14 Fire

There was no fire.

## 1.15 Survival aspects

Neither crew nor passengers sustained any physical injuries during the incident.

### *1.15.1 Rescue services*

Provisions on rescue services are found primarily in the Civil Protection Act (2003:778, Swedish acronym LSO) and the Civil Protection Ordinance (2003:789, Swedish acronym FSO).

According to Chapter 1, Section 2, first paragraph of LSO, the term “rescue services” denotes the rescue operations for which central government or municipalities shall be responsible in the event of accidents and imminent danger of accidents in order to prevent and limit injury to persons and damage to property and the environment. Central government is responsible for mountain rescue services, air rescue services, sea rescue services, environmental rescue services at sea, and rescue services in case of the emission of radioactive substances and for searching for missing persons in certain cases. In other cases, the municipality concerned is responsible for the rescue services (Chapter 3, Section 7, LSO).

### *1.15.2 Rescue operation*

After the landing, the crew informed AFIS[30] in the tower at Torsby Airport that the aircraft was standing on the grass outside the runway. A crash alarm was immediately triggered from the tower in accordance with the red checklist at 20.59 hrs.

The airport's rescue services arrived at the aircraft approximately one minute after the alarm. The Torsby municipal rescue services, which were alerted from SOS Alarm, arrived at the site with a first unit at 21.06 hrs. An ambulance and the police also arrived at the scene.

No persons were injured and no further rescue operation was needed.

The ELT[31] was not activated during the incident.

## 1.16 Tests and research

### *1.16.1 Practical flight tests*

In order to establish the probable touchdown point, SHK has conducted practical flight tests at Torsby Airport. The two airport employees who were witnesses to the event participated at the time of the tests.

During the incident, the two witnesses were positioned at the fuel tank installation to prepare for refuelling during the short ground stop that was planned. From this location, the runway beginning and the second half of runway 16 are visible. The other parts of the runway are obscured by a hill.

The flights were conducted with an aircraft of the type Taifun 17 E2. Two employees from SHK participated in the tests, one on board the aircraft and one in position at the tank installation, see Figure 11. All observers were in radio contact with each other during the tests.

[30] AFIS – Aerodrome Flight Information Services.
[31] ELT - Emergency Locator Transmitter.

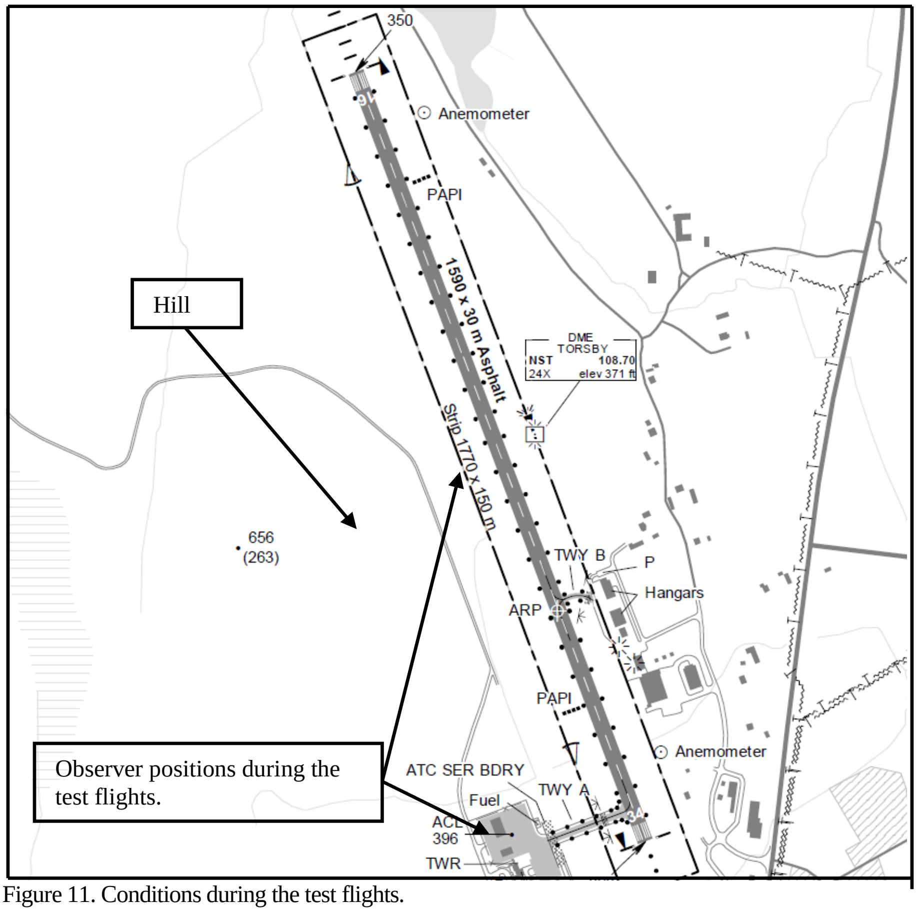


Figure 11. Conditions during the test flights.

The tests began with normal approach and landing within the normal touchdown zone about 300 metres into the runway. In these conditions, the aircraft was visible during approach and touchdown but not during parts of the rollout towards the far end of the runway.

The following flights were simulated according to the witness information provided to SHK, i.e. with a displaced descent path entailing that the touchdown pointalso was displaced. The glide path flown was adapted so that it corresponded to the witnesses' observations of the landing in question where the aircraft was visible during the entire approach and landing.

The approaches were adapted to an assessed touchdown zone along the runway. With the help of the observer at the runway, it was possible after a number of flights to establish this zone to be about 800 metres from the runway end of runway 16.

## 1.17 Organisational and management information

### *1.17.1 General*

AS Avies is an Estonian airline whose registered office is in Tallinn. The company was founded in 1991 and conducts flight operations of both a regular and non-regular nature. The non-regular traffic consists mainly of charter flights and air taxi and is operated using smaller jet aircraft of the types Hawker and Learjet.

The regular traffic consists of scheduled services in various countries and is operated using aircraft of the type Jetstream 31/32. In Sweden, the company operates a number of routes, including Torsby – Stockholm/Arlanda, for the Swedish company Avies Sverige AB, which was awarded the traffic rights on these routes following a public tender procedure. The flights generated through the public tender procedure have led to an expansion of the operator's J31/32 operations.

### *1.17.2 Public tender of air traffic*

The basic principle within the EU is that all Community air carriers are entitled to freely exercise traffic rights on all air routes within the Union. The principle is established in article 15(1) of Regulation (EC) No 1008/2008 of the European Parliament and of the Council of 24 September 2008 on common rules for the operation of air services in the Community (Recast).

A departure from the principle of the right to freely operate air traffic concerns routes being considered vital for the economic development of a particular region and which are not possible to operate solely on the basis of usual commercial interests. For such routes, as provided for in Article 16 of the same Regulation, a public service obligation may instead be imposed. This means, in so far as is relevant in this case, that a single air carrier is awarded the exclusive right to operate air traffic on the route in question. An exclusive right of this kind must be offered through a public tender procedure (Articles 16 and 17 of the Regulation).

Air traffic on the route in question between Torsby and Stockholm/Arlanda is not operated on the usual commercial basis. Instead, a public service obligation applies on the route. The airline Avies Sverige AB has been awarded a contract giving it the exclusive right to air traffic following a public tender procedure. The authority responsible for the public tender procedure is the Swedish Transport Administration. Avies Sverige AB has in turn engaged the Estonian operator AS Avies to conduct air traffic as a subcontractor.

### *1.17.3 Operational prerequisites*

A prerequisite for a company to be allowed to operate air traffic within the EU is that it holds an operating licence. Under Article 4 of Regulation 1008/2008, the company is entitled to obtain an operating licence if it holds a valid AOC[32]. An issued AOC certifies that the company has the professional ability and organisation to ensure the safety of operations.

In order to obtain the operating licence, it is furthermore required that the company demonstrates that it has access to aircraft and that the company, and the persons behind it, meet certain requirements with

[32] AOC – Air Operator Certificate.

regard to insurance and good repute, including not having been declared bankrupt, and other financial conditions.

An operating licence is issued by the competent authority of the EU country in which the company is registered. From Article 15(2) of the Regulation follows that a Member State may not subject a Community air carrier that holds an operating licence and an AOC to any further licensing requirements to be allowed to exercise air traffic within the Union. Under Article 6 of Council Regulation (EEC) No 3922/91 of 16 December 1991 on the harmonisation of technical requirements and administrative procedures in the field of civil aviation, Member States shall recognise such certifications issued by another Member State in respect of legal and natural persons engaged in the operation of aircraft, among other things.

At the time of the Swedish Transport Administration's public tender procedure for air traffic on the route in question, AS Avies held a valid operating licence and AOC issued by the Estonian regulator *Lennuamet* in accordance with EU law. Thus there was hardly any basis for the Swedish Transport Administration to undertake additional controls or place other demands on the company from a safety perspective.

### *1.17.4 Contract conditions*

The contract signed between the Swedish Transport Administration and Avies Sverige AB, which constitutes the basis for operating Torsby – Stockholm/Arlanda and other routes, includes the following conditions. Avies Sverige AB is responsible for AS Avies as for itself. The operator is responsible for observing the statutes and administrative decisions applicable at any given time. The Swedish Transport Administration has the right to carry out quality audits of the operator's activities during the contract period, i.e. a control that the traffic commitment is being performed in accordance with the contract conditions.

The Swedish Transport Administration also has the right to terminate the contract for reasons associated with operator shortcomings of an economic nature or in relation to the requirements specification forming the basis for the award decision,– but also if the operator has been guilty of serious professional misconduct. See also Section 1.18.4.

Furthermore, according to the specifications used in the traffic public tender procedure a tender is to be rejected if the tenderer has been guilty of serious professional misconduct.

## 1.18 Additional information

### *1.18.1 Provisions regarding FDR and CVR*

In Commission Regulation (EC) No 859/2008, also called EU-OPS, the following is stated in OPS 1.160 – *Preservation, production and use of flight recorder recordings*.

> *When a flight data recorder is required to be carried aboard an aeroplane, the operator of that aeroplane shall*
>
> *[---]*
>
> *ii) keep a document which presents the information necessary to retrieve and convert the stored data into engineering units.*

In Annex 6 of the Chicago Convention, Attachment D, *Flight recorders*, the following is specified in point 1.3.4:

> *Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator. The documentation needs to be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.*

### *1.18.2 Actions taken – regulators*

With reference to the shortcomings identified in this investigation with regard to the operator's performance calculations for landing on contaminated take-off and landing runways, SHK made a decision to call attention to these deficiencies during the course of the investigation by means of safety alert addressed to the Estonian and Swedish regulators for civil aviation.

In this context, it should be mentioned that it is the Estonian authority – in the capacity of responsible issuer of the operator's AOC – which has regulatory responsibility for the company. The Swedish Transport Agency has no regulatory responsibility, but has the opportunity, among other things through SAFA[33] safety alert inspections, to check parts of the operation's safety and quality.

The safety alert contained a safety recommendation to both regulators to – separately or jointly – conduct relevant operational inspections of the operator – or take other appropriate measures – in order to ensure that relevant performance calculations for operations on contaminated take-off and landing runways are used by the operator. Appendix 1 to this report contains the safety alert in its entirety.

[33] SAFA – Safety Assessment of Foreign Aircraft.

The concerned regulators' responses to SHK can be summarised as follows:

The Swedish Transport Agency has, with reference to this recommendation, conducted SAFA inspections of the operator, specifically focused on performance calculations. Through these it was possible to note shortcomings in the data for such calculations. The report from this inspection has been followed up with a letter to the Estonian regulator Lennuamet, in which the Swedish Transport Agency requests that the regulator take immediate measures to ensure that AS Avies uses a correct basis for performance calculations, or limit or revoke the Air Operators Certificate of the company.

The Estonian regulator *Lennuamet* has, with reference to the safety recommendation, responded that AS Avies has demonstrated that relevant performance calculations are used by the operator to secure operations on contaminated take-off and landing runways.

The responses from the Swedish Transport Agency and *Lennuamet* are found in their entirety as Appendices 2 and 3 to this report.

### *1.18.3 Actions taken – the operator*

A manual with performance data has been produced on behalf of AS Avies for operations on contaminated surfaces. The manual was developed by a hired consultant and contains tables and correction data for the operator's aircraft of the models BAe Jetstream 31/32.

The performance data produced was submitted by the operator to the regulator *Lennuamet* on 24 October 2014 for review and approval. Already on that same day, the proposed correction tables were approved for use and the data was to be distributed to the pilots.

The manual is of a generic type, i.e. only general calculation bases have been produced. This means that the pilots must enter all conditions manually for operations at a specific airport, such as runway lengths, slopes, height above sea level, etc.

Operators usually present this information in an RPM (Route Performance Manual) containing all the airports to which an operator flies in the form of separate pages for each runway. In such a manual, the pilots can quickly consult tables for the runway in question and, for example, find the mass they can land with under the prevailing conditions.

However, as far as is known, the operator still does not use such complete performance calculation data in the form of an RPM.

### 1.18.4 Actions taken – the Swedish Transport Administration

The Swedish Transport Administration made the decision on 6 March 2015 to terminate, with immediate effect, the present contract with AS Avies regarding three routes and not to sign agreements according to the award decision of January 2015 regarding traffic on a further two routes.

The decision regarding the present contract covers traffic on the routes Torsby/Hagfors – Arlanda, Sveg – Arlanda and Pajala – Luleå. The award decision made in January regarding traffic from 25 October 2015 on the routes Östersund – Umeå and Sveg – Arlanda is also amended, and another operator will operate the routes.

Among the reasons undergirding the termination of the contracts, in addition to extensive deficiencies in the performance of the contracted air traffic with cancelled, delayed and incorrect flights without acceptable reasons, the Swedish Transport Administration has also stated that the operator has been involved in four serious incidents at airports in Pajala, Sveg, Torsby and at Arlanda Airport.

### 1.18.5 Stabilised approach

Under current regulations in the European aviation provisions, all approaches shall be performed according to the concept of “stabilised approach”. This is characterised by the approach being controlled within established limits regarding speed, sink rate, deviations from the runway's inbound heading and nominal glide path, engine thrust and aircraft configuration.

Depending on the aircraft model and type of approach, the operator then establishes the frames of reference and divergences that shall apply for the various criteria during the approach's final stage towards the runway. This is implemented in instructions to be applied at check heights, usually 1,000 and 500 feet above the runway threshold.

At these check heights, the pilots verify that the aircraft is stabilised within the limit values that have been established. If for some reason the aircraft is outside these values – i.e. it is not stabilised – the approach shall be aborted and a “go around” commenced.

The picture in Figure 12 shows how an operator may illustrate the company's application of a stabilised approach. At the FAF (Final Approach Fix) – or where the final approach begins – the aircraft shall be configured according to the established policy, and speed, attitude, position and other parameters shall be within permitted tolerance values.

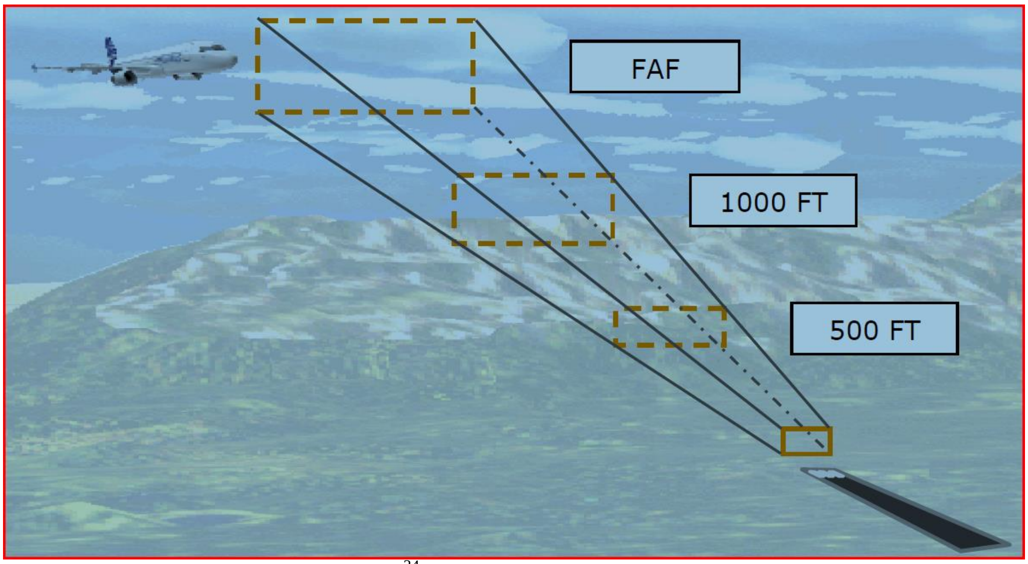

Figure 12. Stabilised approach. Source FAA[34].

The margins of the tolerance values become gradually smaller at the subsequent check heights of 1,000 and 500 feet in order to be at the ideal values when passing the runway threshold. Some operators also set limit values for the last checkpoint at the threshold of 50 feet.

The approach in question to runway 16 in Torsby was not stabilised with respect to altitude and speed. Interviews with the crew also made clear that the operator does not apply – or train its crews in – any concept for stabilised approach, where the pilots verify between themselves that the flight is stabilised when passing the established check heights.

The crew's information has been verified against AS Avies' Operations Manual (OM A). This prescribes that all approaches shall be performed as “stabilised approaches”. The manual describes this term in body text under different sections, containing tolerance values for only certain parameters.

However, the operator lacks a coherent concept for stabilised approach in which established tolerances for input parameters are checked at predetermined heights. There are also no directions to the crew regarding which procedure is to be followed if and when the approach is not stabilised.

### 1.18.6 *Deviations from standards and procedures*

Based on the ICAO Safety Management Manual, deviations from aviation safety standards and routines can be broadly described as follows.

Deviations from regulations or established procedures constitute examples of human behaviours that are present in most operations.

[34] FAA (Federal Aviation Administration) – the aviation regulator of the United States.

Many of these deviations occur on account of unrealistic targets or production conditions.

As a result of this, people can create shortcuts or their own solutions to be able to complete an assignment. Such actions are often rooted in the desire and motivation to carry out the assignment and to do a good job. Such a behaviour is more rarely a result of carelessness or negligence.

Some deviations are created spontaneously in situations where people are faced with unexpected or unplanned decisions, possibly together with time pressure or a high workload. On these occasions, people can, against their better judgement, deviate from rules and norms – but usually with the conviction that the deviation will not lead to any negative consequences.

Another form of deviation, which commonly involves more individuals or groups, can arise when there are recurrent problems or difficulties in performing the work while at the same time following the stipulated procedures and rules. In such circumstances, routine deviations can arise where the deviation eventually becomes *"the normal way to do business"* without the individual regarding the procedure as a real deviation.

However, a basic prerequisite for these deviations – sometimes overlooked – is the operator's responsibility regarding the balance between production and flight safety. The operations of smaller airlines, which sometimes have limited resources for systematic safety work, occasionally border on what would be considered a deviation.

An operator's flight safety work is not decisively a matter of creating an environment in which no errors or mistakes are committed, but rather of effectively and purposefully identifying and capturing deviations from the established standard within operations and managing them so that they do not develop into serious safety deficiencies.

When the production targets for operations are determined – or expanded – it is therefore also necessary to define how the personnel, operational and technical resources shall be utilised in order to achieve the equivalent levels of safety.

## 1.19 Special methods of investigation

Not applicable.

# 2. ANALYSIS

## 2.1 Operational

### *2.1.1 Planning of the flight*

The prevailing weather on the day of the incident was difficult, with an extensive area of snow that covered most of Central Sweden. The crew had planned the flight with the minimum quantity of fuel in order to carry all passengers. On account of the weather at the destination airport Torsby, the flight was planned with two alternates.

The pilots had had a longer duty period together and stated that they felt rested on the day in question. According to the interviews, the commander was of the understanding that no deviations from operational regulations had taken place during the current period of duty together with the co-pilot.

The interviews have not shown that the crew had paid any special attention to the significant weather warnings, with severe icing in the area where the flight was to be performed. However, the commander's opinion that the aircraft was approved for flight in all ice conditions does not correspond with the limitations prescribed in the aircraft's AFM.

The flight was planned – and performed – with an aircraft mass at take-off and landing that was largely the same as the maximum authorised structural mass for the type. Overall, it may be noted that the flight in an operational respect was planned within permitted values.

However, SHK is able to note that the aircraft's technical status did not correspond to the requirements applicable with respect to the meteorological conditions prevailing on the day in question. According to MEL, there shall be a serviceable propeller de-icing system for both engines if a flight is to be performed under icing conditions. Therefore, in principle, the aircraft's technical status cannot be deemed to have been acceptable for the flight that was planned and carried out.

The fact that the commander made the decision to carry out the flight with the right propeller's de-icing system unserviceable in a weather situation where severe icing was expected may be considered remarkable.

### *2.1.2 The flight*

No operational difficulties or problems during the flight have emerged in the investigation or interviews with the pilots. The pilots had only observed light icing during all phases of the flight. However, since observations had been reported during the afternoon from other aircraft regarding moderate to severe icing in the area in question, this may rather be considered to have been a pure coincidence.

As stated in 1.1.1, it had been agreed that the co-pilot would be PF on the flight. Since the aircraft did not have autopilot, the co-pilot's focus was on operating the aircraft. It was therefore the commander's task, among other things, to check for any presence of ice on the wings ahead of approach and landing.

### *2.1.3 Approach and landing*

*Friction coefficients*

Just over 15 minutes before the landing, the aircraft was informed of the current weather for Torsby Airport and of the friction coefficients that had been measured for runway 16. According to interviews with the pilots, the received values were not particularly discussed ahead of the landing since the operator did not apply any system for correcting the required landing distance with respect to the measured friction coefficient.

SHK cannot see that the pilots' action in this regard constitutes any deviation from the operator's instructions and regulations, but rather that it was in accordance with the operator's policy. However, the absence of data for making such corrections can lead to situations in which a danger to flight safety may arise (see Section 2.3).

*Approach speed*

The co-pilot planned the approach, and the pilots together went through an approach briefing[35]. In this, it was decided that $V_{REF}$ would be 115 knots, i.e. nominal speed with respect to the actual weight without any addition for potential icing. According to information from the pilots, only light icing had been noted during the flight.

It is not known how much ice was on the aircraft when the approach was commenced, but with respect to prevailing conditions – and at least some confirmed presence of icing – the decision not to add any speed to $V_{REF}$ can be questioned.

In practice, the co-pilot nevertheless maintained a somewhat higher speed during approach and landing. The knowledge that the airspeed indicator on the right side showed a speed about 5 knots lower than that on the left probably also contributed to the co-pilot maintaining a higher speed than the $V_{REF}$ speed that had been agreed.

[35] Approach briefing – cockpit review of the planning for approach and landing.

*Stabilised approach*

Guided by data from the FDR and interviews with the pilots, it can be established that the final phase of the approach had not been stabilised. Speed and glide path angle have varied to a significant degree during the final part of the approach towards the runway.

Both pilots had a recollection of it having been necessary to correct altitude and glide path angle when the signals from PAPI indicated that the aircraft was too low. Given that an altitude which is too low is perceived as a more hazardous position than the opposite, it is easy for an altitude adjustment to result in an overcorrection that leads to a reverse situation in which the aircraft will be too high.

In this position, where the aircraft in a late stage of the approach was too high and with overspeed, the scope for further correction of these parameters was probably insufficient, and the aircraft came in with too high speed and at an incorrect height above the runway threshold.

The workload for the crew during a manual approach in bad weather without electronic glide path indication may be considered to be high. It is therefore important that the crew has an established and trained concept for stabilised approach to rely on in order to assess whether – and when – an approach is to be completed or aborted.

In this case, it is very likely that an effective crew cooperation supported by a coherent concept for stabilised approach would have led to the approach being aborted and a "go around" commenced.

### *2.1.4 The incident*

By means of the conducted flight tests and witness information obtained, SHK has been able to establish that the aircraft landed with about 800 metres of remaining runway length and with a speed that probably was well over the normal touch down speed. After touchdown, the co-pilot had initiated reverse position with the power levers and handed over control of the aircraft to the commander.

According to the interviews, the commander had immediately set the controls to full reverse and also commenced braking. It has not emerged during the investigation that there was any delay of routines at this stage. Nor are there any indications of deviations from normal procedures in connection with landing.

When braking, the surface was perceived as "very slippery". SHK sees no reason to question this assertion. As previously mentioned, 17 minutes had elapsed since the latest friction measurement, and given the continuous snowfall, it is likely that the friction coefficient had gradually deteriorated.

Figure 13. The aircraft after the excursion. Photo: Torsby Airport

When the commander realised that the aircraft would not be able to be brought to a stop before the runway end, he chose to attempt to turn to the right onto the taxiway, see Figure 13. It has not been evaluated as to whether an excursion straight ahead would have entailed any other consequences, but the excursion that took place in the present case was successful in that no injuries/damage arose, either inside or outside the aircraft.

## 2.2 Technical

### *2.2.1 Technical remarks*

SHK can establish that the operator did not comply with applicable regulations in Commission Regulation (EC) 2042/2003, M.A. 403, regarding the log-keeping and follow-up of technical remarks on aircraft. Instead of entering the technical faults – which at the time of the incident were known to both the crew and the operator's technical department – into the technical log, the crew had reported these to the operator in another way.

The aim of the existing regulations is for the technical log system to describe all technical faults that have arisen during operation. If this system is managed in another way, the risk increases of noted faults and malfunctions remaining unknown, for example, to a new crew commencing duty on the aircraft in question.

As stated in 1.6.4, the system created by the operator, and which is evidently still applied, thus does not follow current regulations. Nor has the deviation arisen in order to further raise the safety level but has instead had the stated purpose of reducing the risk that aircraft will be grounded (the operator does not have technicians stationed at all the places where the aircraft have night stops and where technical service could consequently be carried out), i.e. a purely economic purpose. This is, from a safety perspective, remarkable.

It must also be questioned why this manifest deviation on the part of the operator has not been discovered by, and resulted in measures from, the Estonian aviation regulator, *Lennuamet*, whose responsibility it is to approve and continuously exercise supervision over the activities of the operator in question.

### *2.2.2 Recording of sound and flight data*

*General*

According to the provisions of EU-OPS, an operator of aircraft must be able to provide documentation in order to convert the stored data in an FDR into engineering units. These requirements have arisen to enable investigating authorities to have suitable formats by which to examine and analyse incidents and accidents in commercial aviation in order to improve flight safety.

It is thus of the utmost importance that SHK can have access to correct data in order to make a reliable analysis of the sequence of events. The event that occurred in the present case – where important parameters included speed and altitude – constitutes an example of incidents where data from an FDR can be regarded as the single most important factual basis for the investigation.

The requirement for documentation of the kind mentioned should be interpreted as meaning that the operator is obligated to ensure that the recorders in the aircraft it operates are continuously maintained and calibrated so that investigating authorities at any given time have the opportunity to read out correct information.

As described in Section 1.11.3, SHK has found that the operator, as in a previous event investigated by SHK, lacked such useful and mandatory documentation for being able to convert the digitally recorded information into engineering units.

*FDR data from the flight*

As previously described in Section 1.11.3, SHK has commissioned an analysis of the data that was recorded but could not initially be used. The analysis focused primarily on assessing the degree to which recorded FDR data regarding forward speed during landing and rollout until stop were reliable.

Among the parameters that could not be considered reliable were forward speed, where the FDR had recorded 20 knots even though the aircraft was standing still. The problem was therefore whether the recorded landing speed should also be reduced by 20 knots.

To perform a correct analysis, use has been made of speed as it appeared from radar data obtained and from accelerometer values. The effect of winds at altitude has been considered marginal except in the final phase of the flight in which the wind vector coincided with the aircraft's direction of travel.

The graphs in Figures 8 and 9 show that the forward speed recorded by the FDR corresponds well with the altitude-corrected speed during the flight. It can also be noted that there is no constant speed difference of 20 knots. The actual forward speed calculated, which is based on calculations using the longitudinal accelerometer signal recorded by the FDR, shows a high level of consistency with the forward speed recorded by the FDR.

This consistency is good until the speed recorded by the FDR takes a step from 0 up to 20 knots. The discrepancy that initially exists between the calculated speed and the speed recorded by the FDR is probably due to changes in the aircraft's attitude.

Since the forward speed recorded by the FDR is based on the pressures S5 and P2, and the altitude recorded by the FDR is based on the pressure S5, an assessment of the source of error can be made. The minor erroneous display on the right side's airspeed indicator that had been noted by the co-pilot indicates that a partial explanation for the FDR fault can be found in the P2 system. If the fault had been found in the S5 system, the recorded altitudes from the FDR and transponder would have differed, which it has not been possible to establish (see Figure 4).

The fault should thus be either in the parts of the P2 system that do not affect the right speed instrument in the FDR, where the fault is likely to be found in the pressure sensor, or in the data conversion/encoding of data. It is worth noting that this fault manifested itself when the P2 and S5 pressures were equal, i.e., when the aircraft was standing still.

If the FDR had been maintained and calibrated in the way required according to EU-OPS, these faults and other erroneous data (such as lateral acceleration and outside temperature) would with great certainty have been found and be rectifiable. Most probably, these errors are thus ultimately due to a lack of maintenance and inspection of the unit.

A previous investigation (see SHK's report RL 2014:07e) concerning the same operator noted the same deficiencies in maintenance and required documentation for the FDR of the aircraft individual in question. The fact that AS Avies has not rectified these deficiencies indicates a manifest weakness in the operator's systematic safety work.

*CVR*

The information stored on a CVR normally constitutes a significant support for the investigation, among other things, to verify the crew's statements. The cockpit voice recorder on the aircraft individual in question was found to be fully functional at the time of the incident. However, it has not been possible to read out any recording from the time of approach and landing since the unit was not turned off in time and the recording thereby came to be recorded over.

The aforementioned investigation of the same operator (see SHK's report RL 2014:07e) noted the same deficiency regarding the CVR as in the present case. SHK therefore once again urges the operator to take measures to ensure that the company's pilots immediately turn off the CVR unit after an incident.

### 2.3 Performance calculations

As previously reported, an operator is required to use special performance data and correction tables if activities are to be conducted where start and landing occurs on contaminated surfaces. The analysis of the operator's performance data undertaken by SHK has shown that there was no such data at the time of the incident.

As stated in Section 1.6.10, the operator has instead made use of data for calculating landing performance that contains information only regarding either a dry or a wet runway. The data thus does not contain any guidance for the crew in landings on a contaminated runway.

The performance company engaged by SHK during the examination of the operator's data for operations on contaminated runways also concluded that the data was inadequate and that the operator should in such conditions consider cancelling the flight or flying to an alternate airport. SHK concurs with that assessment.

However, the route network in Sweden operated by the operator largely covers at smaller airports in the northern parts of the country, where “winter runways” are an everyday occurrence during the winter half of the year. From a flight safety perspective, planning and implementing a traffic programme in such an area without the required data for performance calculations regarding contaminated runways should not even be considered.

To do this means that the individual pilots working for the operator do not have sufficient knowledge of the aircraft's landing distance on surfaces with varying contamination. It also means that they lack knowledge of the margins – or absence of margins – that they have regarding runway length in relation to the mass that the aircraft is calculated to have in the planned landing.

Thus, for the landing in question, no corrections were carried out with respect to measured friction coefficients. On account of other circumstances, the touchdown came to take place far into the runway and at high speed, whereby an excursion was in practice impossible to avoid, this leading to the conclusion that friction calculations in this case would not have changed the actual sequence of events anyway.

On the other hand, it is likely that correctly executed performance calculations would have made the crew aware of the limited margins that existed on that occasion with regard to required runway length in relation to available runway length. This could in turn have led to the crew planning and executing approach and landing so that the touchdown was made in the intended touchdown zone and at the correct speed.

In SHK's opinion, the new performance data produced by the operator during the course of this investigation also fails to live up to reasonable expectations regarding flight safety. This conclusion is based on the fact that the data does not contain an RPM (Route Performance Manual), but only a generic manual that requires the crew to perform manual calculations for each individual landing on contaminated runways.

The operator's understanding that the data used in the incident and which is intended only for a dry or a wet runway, is also adequate for operations on a contaminated runway bears witness to a fundamental lack of understanding regarding performance calculations and operations on contaminated surfaces.

## 2.4 Stabilised approach

The analysis of the approach phase has shown that there were large variations in speed and altitude during the latter part of the approach towards the runway. This is corroborated both by interviews with the crew and by recorded FDR data.

According to the testimonies, there were altitude variations that have been corrected during various stages. It is probable that one of these corrections in a late stage of the approach led to the aircraft coming to be above the nominal glide path that was indicated on PAPI.

When correcting this position, it is inturn natural for an undesired speed increase to occur as a consequence of the performed altitude correction downwards. Such an increase has also been identified in FDR data, see Figure 9, where a marked speed increase can be observed about 40 seconds before touchdown. This increase then ceased about 10 seconds before touchdown, after which the speed gradually decreased.

Although the pilots have stated during the interviews that they perceived the approach to have been stabilised, this understanding is contradicted by the variations in altitude and speed during the approach demonstrated in the investigation. In addition, the operator lacks a coherent concept for stabilised approach for the crew to adhere to.

The investigation has shown that although the operator uses the expression “stabilised approach” in its manuals, there are no directions for how this is to be translated into practical approach methodology. There are no comprehensive instructions on intervals or permitted limit values at established check heights for the various parameters during an approach. The manuals also lack instructions for when an approach is to be aborted.

The idea behind using an overall concept is for the individual pilot during every approach to have criteria at predetermined check heights with which to decide whether an approach is to continue or whether it is to be aborted. Besides the fact that such a concept is to be described in the operator's manuals, it should be implemented in both initial and recurrent pilot training for the aircraft type operated.

If a coherent concept for stabilised approach had been applied by the operator and if its pilots had been educated and trained in this, it is likely that the approach in question would have been relevantly controlled and monitored, or that it would have been aborted during some part of the final stage of the approach.

## 2.5 Production and safety

The investigation has demonstrated a number of deviations in connection with the flight:

- The landing was carried out without having made use of the information on friction coefficients that was available and without having access to any relevant performance data for landing on a contaminated runway.
- The approach has not been stabilised, and the operator has not had a coherent concept for stabilised approach.
- A deficient technical standard regarding the operator's maintenance of the FDR aimed at securing a correct reading of recorded data.
- A deficient handling of the CVR regarding the turning off of the unit after an incident.

During the investigation, SHK has also noted other shortcomings of the operator that have not had any direct connection with the incident:

- The operator's system for handling technical remarks did not follow current regulations.

- The decision to take off from Arlanda with the right side's propeller de-icing system unserviceable, under conditions entailing a risk of severe icing conditions, entailed non-compliance with the MEL.

Deviations such as these probably do not have their primary basis in deficiencies of the crew, but can be viewed as a measure of how well the operator is doing in its systematic safety work. Commitment, management and communication with the intent to create systematic safety work at a high level must come from the operator's management level.

In this case, the crew's actions have also mainly corresponded with the routines and standards applicable with the operator. There is no reason to assume anything other than that the pilots were convinced that the deviations could not have any negative consequences for safety.

The deviations that have occurred regarding the noting of technical faults in the aircraft's logbook are of a particular character. The operator's system for how to manage such technical faults, described in Section 2.2.1, is in contravention of the applicable regulations (Commission Regulation (EC) No 2042/2003, section M.A. 403).

The purpose of the deviating design of this system of the operator has been to avoid its aircraft being grounded, i.e. a purely economic motive, which has thus been prioritised ahead of regulatory compliance motivated by reasons of flight safety.

Besides the direct flight safety risks entailed by such a working method, applying a system where technical remarks are not immediately entered into the log – as with the operator in this case – risks eventually leading to both operational and technical personnel coming to the understanding that the working method is merely a routine deviation that is acceptable.

The shortcomings in this technical and operational handling identified by SHK in the investigation are thus largely rooted in the organisation-induced deviations from standards and regulations found with the operator. The operator's weighing of production against safety cannot be considered to have been in balance.

In summary, the deviations found with the operator have been both of a kind and an extent that are hardly consistent with the requirements that must be placed on a commercial operator.

In this regard, it must also be questioned why these recurring deviations with the operator have not been discovered by and occasioned measures from the Estonian aviation regulator, *Lennuamet*, whose responsibility it is to approve and continuously exercise supervision over the activities of the operator in question.

## 2.6 Contract conditions

As stated in Section 1.17.4, the agreement between the Swedish Transport Administration and the operator contains a termination option in the case where the operator has been guilty of serious professional misconduct. What the expression "serious professional misconduct" more exactly means is not clear from the contract documents.

Since shortcomings of an economic nature and deficiencies in the contracted traffic supply are given separately as grounds for terminating of the contract, it is reasonable to assume that the expression instead primarily has in view e.g. serious deficiencies with respect to flight safety. In the present regard, the termination clause may be considered to reflect the fact that a basic prerequisite for the contract is that the operator is not guilty of any such professional misconduct.

In light of the operator's shortcomings highlighted in the present report, as well as what has been previously identified by SHK in other contexts, there were in SHK's opinion – in connection with the follow-up of existing agreements and with the awarding of new contracts – good reasons for the Swedish Transport Administration to consider whether the agreements with the operator should be terminated.

## 2.7 Cause analysis

When there is reason to do so, SHK shall, within the scope of an accident investigation, issue safety recommendations on measures that aim to prevent a similar incident from happening again or limit the effect of such a recurrence.

The opportunity for such safety recommendations to be reasonably accurate presupposes that they are based on a sufficiently penetrating cause analysis.

In this case, the direct cause of the aircraft running off the runway is simple to establish:

*The touchdown took place too far into the runway and at too high speed.*

However, this conclusion is inadequate as a thorough explanation of the incident and, even more so, as a basis for effective safety recommendations.

In Section 3.2, SHK therefore attempts to give a brief visualisation of the reasoning that may summarise the cause analysis of the incident in Torsby.

# 3. CONCLUSIONS

## 3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a Certificate of Airworthiness and valid ARC.
c) The flight was performed with the right-side propeller de-icing system unserviceable.
d) The flight was performed when severe icing had been observed and forecast.
e) There were variations in altitude and speed control during the approach.
f) The operator did not apply any coherent concept for stabilised approach.
g) The airspeed indicator on the right side showed about 5 knots lower speed than the airspeed indicator on the left side.
h) The landing took place during snowfall.
i) The friction coefficients 0.30, 0.31 and 0.33 respectively were measured 17 minutes before landing and were reported to the aircraft.
j) The friction coefficients upon landing had probably deteriorated since the latest measurement.
k) The operator did not use any system for correcting calculated landing distances in landings on a contaminated runway.
l) The landing took place approximately 800 metres into the runway.
m) The speed at touchdown was probably higher than normal.
n) Technical remarks revealed in the investigation had not been noted in the aircraft's logbook.
o) No sound recordings from the flight were available to the investigation due to power to the cockpit voice recorder (CVR) having been turned off at too late a stage.
p) The operator lacked useful and mandatory documentation from the flight data recorder (FDR) for converting digital data into engineering units.
q) The deviations revealed have been assessed to indicate serious deficiencies in the operator's systematic safety work.
r) The Swedish Transport Administration has terminated the contract with the operator on 6 March 2015.

### 3.2 Causes

SHK has chosen to give a picture of the incident that occurred by means of the following description of cause:

*The crew was unable to get the aircraft to stop after landing and, it veered off the runway.*

Why ?

*The touchdown took place too far into the runway and at too high speed.*

Why ?

*The approach was not stabilised.*

Why ?

*The operator did not apply any coherent concept for stabilised approach.*

Why ?

*The operator's weighing of production against safety has not been in balance.*

Why ?

*The operator's systematic safety work has not lived up to the requirements that must be imposed on a commercial operator.*

Why ?

*The responsible regulator has failed to detect and take measures against the deficiencies in the operator's systematic safety work.*

## 4. SAFTEY RECOMMENDATIONS

Considering the fact that the Swedish Transport Administration has terminated the contract with the operator in question, SHK has limited the report's recommendations to only cover the Estonian civil aviation regulator, *Lennuamet*, which is recommended to:

- Tighten its supervision of the operator, AS Avies, in order to ensure that operations are conducted in accordance with applicable flight safety requirements, in particular with respect to such deficiencies as identified in section 2.5 of this report. (*RL 2015:10 R1)*

The Swedish Accident Investigation Authority respectfully requests to receive, by **1st October 2015** at the latest, information regarding measures taken in response to the recommendation included in this report.

On behalf of the SHK investigation team,

Hans Ytterberg Stefan Christensen

Statens haverikommission
Swedish Accident Investigation Authority

Type of document
LETTER

Date
~~09/05/2014~~ *10/10/2014

Page
1 (1)

File number
L-0018/14

Doc. number



* Rättelse enl. 26 § förvaltningslagen (1986:223)

*Lennuamet*
(Estonian Civil Aviation Administration)
*Transportstyrelesn*
(Swedish Transport Agency)

## Safety recommendation concerning the operator AS Avies

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is investigating a serious incident in Torsby, Sweden, on 31 January 2014 involving the Estonian operator AS Avies. This still ongoing investigation has revealed serious deficiencies in the performance calculations system used by the operator for operations on contaminated runways. The operator has not been able to show that it is using friction coefficients when calculating required runway lengths, which must be regarded as a safety hazard when operating under winter conditions.

This finding supports the following safety recommendation to the *Estonian Civil Aviation Administration (Lennuamet)*, being responsible for the issuance of Estonian air operator certificates (AOC) and operator licences (OL), as well as for the continuous supervision of Estonian operators regardless of where they operate; and to the *Swedish Transport Agency (Transportstyrelsen)*, being responsible for carrying out safety assessments of foreign aircraft (SAFA) that operate in Sweden:

*The agencies are recommended, in cooperation or individually, to perform relevant operational audits of the operator AS Avies – or take other relevant measures regarding the operator – in order to ensure that appropriate performance calculations are used by the operator to secure safe operations on contaminated runways.*

SHK respectfully requests to receive, by 31 October 2014 at the latest, information regarding measures taken in response to the safety recommendation above.

On behalf of the Swedish Accident Investigation Authority,

Hans Ytterberg
Director General
and Chair of the Investigation

Stefan Christensen
Investigator in Charge

*Postadress/Postal address*
P.O. Box 12538
SE-102 29 Stockholm
Sweden

*Besöksadress/Visitors*
Sveavägen 151
Stockholm

*Telefon/Phone*
+46 8 508 862 00

*Fax/Facsimile*
+46 8 508 862 90

*E-post/E-mail*
info@havkom.se

*Internet*
www.havkom.se

TRANSPORT STYRELSEN

**Yttrande**



| Datum | Dnr/Beteckning |
|---|---|
| 2014-10-30 | TSL 2014-805 |
| Ert datum | Er beteckning |
| 2014-10-10 | L-0018/14 |



Kopia till
Trafikverket
TS - Simon Posluk
TS - Britt-Marie Kärlin

Statens haverikommission
Box 125 38
102 29 Stockholm

## Transportstyrelsens svar på säkerhetsrekommendation angående flygoperatören AS Avies

Den 16 okt 2014 genomförde Transportstyrelsen en SAFA inspektion på flygoperatören AS Avies som var specifikt inriktat på prestanda beräkning och där brister i underlaget för prestanda beräkning har identifierats. SAFA rapporten från inspektionen har följts upp med ett e-post (20 okt 2014) till den Estniska luftfartsmyndigheten (Lennuamet) där Transportstyrelsen begär att den Estniska luftfartsmyndigheten omedelbart vidtar åtgärder för att säkerhetsställa att Avies AS använder korrekta underlag för prestanda beräkning, alternativt begränsar eller återkallar Avies tillstånd.

Den Estniska luftfartsmyndigheten svarade på Transportsstyrelsens e-post(21 okt 2014) och bekräftade att rekommendationen från Statens haveri-kommission är omhändertagen av den Estniska luftfartsmyndigheten, samt att Avies har publicerat ett "leaflet" och en cockpit bulletin (19 okt 2014) för "Slippery/ Contaminated Runway" med reviderade underlag för prestanda beräkning. Den Estniska luftfartsmyndigheten anser att Avies utför en säker operation.

Transportstyrelsen har i e-post (22 okt 2014) till den estniska luftfartsmyndigheten betonat behovet av att lägga fram detaljerade och dokumenterade korrigerande åtgärder avseende operatörens förmåga att ta fram prestanda beräkningar.

Transportstyrelsen har i tillägg haft en intensifierad kommunikation med den Estniska luftfartsmyndigheten under 2014 angående Avies och de brister som identifierats i haveriutredningar och händelserapporter, samt hur den Estniska myndigheten bedriver tillsyn av Avies i Sverige.

För utländska operatörer är Transportstyrelsens mandat att genomföra tillsyner begränsat till ramp inspektioner. Dessa genomförs vid en "turn around" och ger en begränsad ögonblickbild av operatörens förmåga att efterleva de regelkrav som ställs på en operatör. Transportstyrelsen har inte mandat att vidta åtgärder mot en utländsk operatörs tillstånd.

Bilaga: Dokument innehållande e-post korrespondens den 20 okt 2014, 21 okt 2014 och 22 okt 2014.

Med vänlig hälsning

Simon Posluk

Haveriordförare

**Från:** Ljungberg Gunnar
**Till:** Kaupo Toodu
**Kopia:** Kristjan Telve; Söderberg Staffan; Haglund Lars; Cherfils Ingrid; Öberg Per-Erik
**Ärende:** SV: Request regarding AS Avies, AOC EE-004
**Datum:** den 22 oktober 2014 15:35:40

---

Dear Kaupo,

Thank you for information of ongoing action to work presented issues.
This information shall only be regarded as additional information to request of limitation of operator activities previous sent.

We emphasise the need to present detailed and documented corrective actions regarding the performance calculation capabilities within the operator. The capability for this including operators resources, competence, crew training and quality assurance is within the scope of the competent authority.

Regarding the documentation previously presented as basis for performance calculations the position from Swedish Transport Agency is still that the operator show non-compliance, which will be firmly adopted in case of forthcoming ramp inspection with slippery or contaminated runway in force.
The observations, both from Swedish Transport Agency and Swedish Accident Investigation authority show major shortcomings in the operators system for performance calculation.

To be clear, documentation to assure adequate performance calculations is a according to our view far more comprehensive than generic percentage calculations based on available runway length. This might be one of several factors, but never the only method. Regulations clearly states "whichever the greatest" in this regard. The system presented to Swedish Transport Agency and Swedish Accident Investigation authority show shortcoming in capability to:
-Different publications, crew cannot present witch manual to use for calculation: OM-A, OM-B, AFM, Performance Manual or other information. Added to this is the fact that available method from AFM differs from BAE J31 and BAE J32.
-Take off runway acceleration distance is affected by contaminated runway, how is this addressed in procedures and calculations?
-Measured Friction Coefficient presented to crew by the airport affects both the needed runway length and capability to land/take off with side wind component, how is this addressed in procedures and calculations?
-Different airports combined with aircraft type have different limitations for obstacle clearance, affected by contaminated runway, how is this addressed in procedures and calculations?

We base our argumentation on the following paragraphs:

*EU-OPS*

*Proper performance calculation:*
*EU-OPS*

*OPS 1.400*
*Approach and landing conditions*

*Subpart F - Performance General:*
*OPS 1.475 (b) & (c)*

*Subpart G -Performance Class A*
*OPS 1.490 Take-off (c)*

*OPS 1.520 Landing — Wet and contaminated runways (b)*

*Also*

*1.192 Terminology*
*The terms which are listed below are for use within the context of this regulation.*
*(a) Adequate Aerodrome.*

*OPS 1.295*
*Selection of aerodromes (b)*

*Appendix 1 to OPS 1.1045*
*Operations Manual Contents*
*B. AEROPLANE OPERATING MATTERS — TYPE RELATED*
*4.1. Performance data.*
*4.1.2.*

Best Regards

Gunnar

---

**Från:** Kaupo Toodu [mailto:Kaupo.Toodu@ecaa.ee]
**Skickat:** den 21 oktober 2014 11:09
**Till:** Söderberg Staffan; Haglund Lars; Cherfils Ingrid; Ljungberg Gunnar
**Kopia:** Kristjan Telve
**Ämne:** RE: Request regarding AS Avies, AOC EE-004

Dear Gunnar,

Thank You for the E-mail notification on the 20th October about the level 3 finding during SAFA inspection. First of all I would like to draw Your attention to the fact that that SAFA was conducted on 16th of October not on the 18th October as You state it. Also, Estonian CAA reacted on that SAFA and also informed Swedish CAA about the actions taken on it on 20th of October with letter to Swedish CAA. In that letter a detailed actions with timeline was presented. I would like to emphasise, that the timeline is still valid and we are monitoring the results and actions closely, ready to take any further actions if the timeline or the outcome is not satisfactory.
The Safety recommendation issue sent to Estonian CAA by the Swedish Accident Investigation

Authority is also dealt with. The AVIES effort at first to explain the method described in their OM-A was not acceptable by the Swedish CAA somehow and therefore additional pilot information leaflet was issued together with the cockpit bulletin ( reminding on how to use the SLIPPERY/ CONTAMINATED RUNWAY) The issuing date for the bulletin was 19.10.2014. The revised performance calculations were also distributed to the crew flying in Sweden.
Considering the actions taken, the effort AS AVIES is putting in, in order to ensure, validate and monitor the compliance with the regulation and ensuring that Swedish CAA has all adequate information regarding safety issues raised and methods and results to mitigate any further safety concerns, I am confident, that AS AVIES is conducting safe operations.
As on the final note I would like to continue the practice on the information sharing with Swedish CAA in a regular bases, to ensure the proper and timely reaction and prevention of issues in the future. I hope, that the urge from Swedish CAA to limit, suspend or revoke the AOC of operator AVIES is getting adequate attention and we agree on the actions taken to be satisfactory.

Best regards,

Kaupo Toodu
Head of operations department
Estonian CAA
Tel: +372 56689188

-------- Algne sõnum --------
Saatja: Ljungberg Gunnar <Gunnar.Ljungberg@transportstyrelsen.se>
Kuupäev: 20/10/2014 09:46 (GMT+02:00)
Saaja: Kristjan Telve <Kristjan.Telve@ecaa.ee>
Koopia: Söderberg Staffan <Staffan.Soderberg@transportstyrelsen.se>,Haglund Lars <Lars.Haglund@transportstyrelsen.se>,Cherfils Ingrid <Ingrid.Cherfils@transportstyrelsen.se>
Teema: Request regarding AS Avies, AOC EE-004

Dear Mr Telve,

During a SAFA rampinspection on the 18th October 2014 a level 3 finding was issued to the operator Avies, AOC EE-004.
The finding showed no performance calculation documentation and procedures available to crew for contaminated runways and winter conditions. Safe operation cannot be conducted in winter conditions without these calculation procedures implemented, trained and available to crew.
Avies flight operations department presented an ad-hoc method for performance calculation to SAFA team via e-mail, though this is beyond the scope of the SAFA tool and no fact based or performance specialist assurance was presented. Nor can this be trained and implemented in standard operating procedures.
Given the time of year, flight operational winter conditions and contaminated runways is a fact in Sweden from today and further during the winter season.
These facts combined with previous reported flight safety concerns, result of inspections and

Swedish Accident Investigation Authority reports are all, to our understanding, pointing to a systemic problem of the operator.
The Swedish Transport Agency requests the Estonian Civil Aviation to immediately as appropriate limit Avies to operate without properly implemented performance figures for all foreseeable runway conditions and put in place appropriate actions to achieve sustainable systemic improvements for the operator in question. Those actions may as pointed out earlier include limiting, suspending or revoking the AOC operator AS Avies, AOC EE-004 operations in Sweden until compliance with the regulation in force is reaffirmed

Yours sincerely

**Gunnar Ljungberg**

Chef Enheten för Operatörer, Fartyg och Luftfartyg /
Head of Operators, Ships and Aircraft unit

Swedish Civil Aviation and Maritim Department
Direkt: +46 (0)10-4953740
Mobil: +46 (0)733-018609

**Transportstyrelsen**
601 73 Norrköping
www.transportstyrelsen.se
Telefon: +46 (0)771-503503

SWEDISH TRANSPORT AGENCY

**Statement**

Date
4 November 2014



**AS Avies performance review:**

Review off document "Performance information for takeoff and landing on contaminated runways" approved by the Estonian Aviation Authority.

Document meets the requirements of ICAO Annex 6, Section 4.3 (f), 5.2 and 5.3 as well as EASA OPS ORO.GEN.110, ORO.AOC.150, AMC1 ORO.MLR.100, AMC3 ORO.MLR.100, CAT.POL.A .100, CAT.POL.A.105, CAT.POL.A.200, AMC1.CAT.POL.200 and GM1 CAT.POL.A.205.

Performance data was examined and referenced against regulations above by sampling and fulfills compliance.

In conversation with Hakan Örtlund Produktion AB the originator of document, he states that this is a one-time job. No contract exists between AS Avies and Hakan Örtlund Produktion AB. Note that no update of the performance calculations will be performed or monitoring of obstacles database.

Recommendations:

Follow-up of the product must be done to meet regulatory requirements for compliance monitoring.

Training of pilots should be performed in using the above performance data.

The performance tables must be implemented into existing manuals and management system.

Lars Kristiansson

Jörgen Weden

**Swedish Transport Agency**
Civil Aviation and Maritime Department
SE-601 73 Norrköping, Sweden
Office address
Olai Kyrkogata 35, Norrköping

Telephone +46 771 503 503
Telefax +46 11 415 22 50

www.transportstyrelsen.se
kontakt@transportstyrelsen.se

Operator, Ship and Aircraft Unit
Section for Air Operators and Maritime Safety Management
staffan.soderberg@transportstyrelsen.se
+46 10 495 38 08

REPUBLIC OF ESTONIA
CIVIL AVIATION ADMINISTRATION

Hans Ytterberg
Swedish Accident Investigation Autority
P.O Box 12538
SE-102 29 Stockholm
Sweden

Your ref: 10 October 2014

Our ref: 04 November 2014 No 1.16-3/14/3314-3

**Actions regarding Safety recommendation concerning the operator AS AVIES**

Dear Mr Ytterberg

Thank You for the Safety recommendation on the 10th October concerning the AS AVIES deficiencies in the performance calculations for operations on contaminated runways.

The following measures were taken in response to the Safety recommendation: AS AVIES has demonstrated that appropriate performance calculations are used by the operator to secure safe operations on contaminated runways.

I would like to continue the practice on the information sharing with Swedish Accident Investigation Autority in a regular basis, to ensure the proper and timely reaction and prevention of issues in the futuure.

Yours sincerely

Kristjan Telve
Director General

Mattias Kosemets
+372 610 3583
Mattais.kosemets@ecaa.ee