Havarikommissionen
Accident Investigation Board Denmark

BULLETIN

Serious incident

6-2-2017

involving

PILATUS PC-12 47E

OY-NBS

Certain report data are generated via the EC common aviation database

FOREWORD

This bulletin reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this bulletin for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

A reprint with source reference may be published without separate permit.

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BULLETIN

General

File number:	HCLJ510-2017-323
UTC date:	6-2-2017
UTC time:	19:36
Occurrence class:	Serious incident
Location:	Copenhagen, Roskilde (EKRK)
Injury level:	None

Aircraft

Aircraft registration:	OY-NBS
Aircraft make/model:	PILATUS PC-12 47E
Current flight rules:	Instrument Flight Rules (IFR)
Operation type:	Non-Commercial Operations Pleasure Cross Country
Flight phase:	Approach
Aircraft category:	Fixed Wing Aeroplane Small Aeroplane
Last departure point:	United Kingdom EGBB (BHX): Birmingham
Planned destination:	Denmark EKRK (RKE): Kobenhavn/Roskilde
Aircraft damage:	Minor
Engine make/model:	PRATT & WHITNEY (CANADA) PT-6 FAMILY (PT6A-67P)

SYNOPSIS

Notification

All times in this report are UTC.

The Area Control Centre at Copenhagen, Kastrup (EKCH), notified the Aviation Unit of the Danish Accident Investigation Board (AIB) of the serious incident on 6-2-2017 at 19:42 hours.

The AIB notified the Danish Transport, Construction and Housing Authority (DTCHA), the Swiss Transportation Safety Investigation Board (STSB), the European Aviation Safety Agency (EASA), the Directorate-General for Mobility and Transport (DG MOVE) on 6-2-2017 at 23:56 hours.

The AIB notified the International Civil Aviation Organization (ICAO) on 12-6-2017 at 11:51 hours.

The STSB appointed a non-travelling accredited representative to the AIB safety investigation.

Summary

Non-commanded (i.e. erroneous) and repetitive activation of the stall warning system including stick shaker operation in flight in combination with non-adherence to the appropriate aircraft emergency procedure increased pilot workload to such an extent that it resulted in pilot cognitive tunnelling impacting pilot perception of the environment and the pilot decision making process.

Non-stabilized flight parameters during the last part of the visual maneuvering approach to EKRK most likely led to a subsequent bounced landing and the runway excursion.

The serious incident occurred in dark night under visual meteorological conditions (VMC).

FACTUAL INFORMATION

History of the flight

The serious incident flight was a private IFR flight from Birmingham (EGBB) to Copenhagen, Roskilde (EKRK).

Before departure from EGBB, the pilot in accordance with and as a part of the “Before Taxiing” checklist performed a test of the stall warning system. The stall warning system test gave no rise to remarks.

During descent, inbound EKRK, the pilot experienced light to moderate icing conditions.

The flight was uneventful until the Instrument Landing System (ILS) approach to runway 11 at EKRK. At that point, the pilot had selected the ice protection probes to on, the inertial separator to open, the propeller heating to on, and the wing de-icer boots to off.

Approaching the localizer to runway 11 at a radar presented altitude of 2500 feet mean sea level (msl) and at a radar presented Ground Speed (GS) of 200 knots, the pilot experienced that it was impossible to engage the approach mode (APR) of the Automatic Flight Control System (AFCS).

The pilot observed a “Vertical GP unavailable” advisory, and the pilot engaged the “Heading” and “Vertical Speed” modes of the AFCS and decided to continue the approach to runway 11.

The pilot had visual contact with runway 11.

While descending on final to runway 11 at 19:28.50 hours - with reference to the aircraft Fault History Database (FHDB) - the pilot experienced an activation of the aircraft stall warning system (visual and aural alerts, a non-commanded disengagement of the autopilot and a repetitive stick shaker operation). The radar presented altitude was 1900 feet msl, and the radar presented GS was 153 knots.

Until landing, the pilot multiple times tried to make use of the control wheel pusher interrupt push switch to disengage the non-commanded and repetitive stick shaker operation. However, the non-commanded and repetitive stick shaker operation remained active.

At 19:29:36 hours, the Aircraft Condition Monitoring System (ACMS) recorded the landing gear to be down and locked. The aircraft was on 4.3 nautical miles (nm) final to runway 11. The radar presented altitude was 1600 feet msl, and the radar presented GS was 128 knots.

After landing gear down selection, the pilot had doubts about whether or nor not the landing gear actually was down and locked. At that point, the pilot felt it difficult among active visual and aural cockpit stall warnings to locate the position of the landing gear indication lights.

At 19:30:11 hours, the air traffic controller at Roskilde Tower cleared OY-NBS to land on runway 11 and reported the wind conditions to be 070° and 10 knots. The aircraft was on 3.6 nm final to runway 11. The radar presented altitude was 1500 feet msl, and the radar presented GS was 127 knots.

The pilot reported to Roskilde Tower that: *My autopilot does not work. I can't get my gear out. Just hang on.*

The air traffic controller at Roskilde Tower alarmed the aerodrome firefighting and rescue services.

The pilot levelled out at approximately 800 feet msl and started working on an emergency landing gear extension.

At 19:31:25 hours, the pilot reported that he still had difficulties with the landing gear and intended to do a flyby of the aerodrome in order for the air traffic controller to try to make a visual inspection of the position of the landing gear. The aircraft was on 0.9 nm final to runway 11. The radar presented altitude was 800 feet msl, and the radar presented GS was 86 knots.

While initiating the landing gear emergency extension procedure, the pilot noticed that it via the hand pump handle was not possible to use full strokes, because the landing gear actually was down and locked.

At 19:31:31 hours, the ACMS recorded the flap setting to be 15°. The aircraft was on 0.7 nm final to runway 11. The radar presented altitude was 800 feet msl, and the radar presented GS was 80 knots.

At 19:31:43 hours, the pilot reported that the landing gear was down and locked and that he intended to circle right for landing on runway 11. Furthermore, the pilot reported, that the aircraft Ground Proximity Warning System (GPWS) presented stall warnings, though the indicated airspeed was 107 knots. The aircraft was on 0.4 nm final to runway 11. The radar presented altitude was 700 feet msl, and the radar presented GS was 88 knots.

The pilot initiated a go-around. The flight crew of a nearby rescue helicopter offered a visual inspection of the landing gear, which the pilot declined, because the landing gear was down and locked.

The pilot performed a figure eight visual manoeuvring approach overhead and close to runway 11.

Throughout the figure eight visual manoeuvring approach, the pilot struggled with visual and aural stall warnings and repeatedly tried to stop the non-commanded and repetitive stick shaker by use of the control wheel pusher interrupt push switch.

The pilot did not make use of the aircraft emergency procedure for non-commanded stick shaker operation.

During the figure eight visual manoeuvring approach (from the beginning of manoeuvring until the aircraft being on short final to runway 11), the Calibrated Air Speed (KCAS) varied between approximately 100 and 131 knots. See appendix 1.

At 19:35:39 hours, the ACMS recorded movement of the flaps from flap setting 15° to 30°. The aircraft was on 0.4 nm final to runway 11. The radar presented altitude was 500 feet msl, and the radar presented GS was 91 knots.

During the landing phase, the aircraft bounced, and the propeller blades encountered the runway.

The aircraft ran off the side of the runway and ended up in the runway safety zone.

See appendix 2.

Radar replay

Be observant that the timestamps of the radar data, the ACMS, the FHDB and the Air Traffic Services (ATS) voice recordings were not fully synchronous.

For that reason, the following generic radar replay with comments is a computerized approximation.

In order to view the computerized radar replay with comments, please make sure that an appropriate internet connection is available. The computerized radar replay is available in high definition quality.

Computerized radar replay with comments

Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious			
None	1		

Damage to aircraft

There were damages to the propeller blades and the nose wheel landing gear.

Other damage

During the runway excursion, the aircraft hit one southern runway edge light.

Personnel information

License and medical certificate

The pilot - male, 56 years - was the holder of a valid Danish Private Pilot License (PPL (A)) issued by the DTCHA on 18-11-2013.

The rating PC-12/IR was valid until 31-10-2017.

The medical certificate (class 2) was valid until 4-10-2017. The medical certificate held the limitation "VML" (correction for defective distant, intermediate and near vision).

Flying experience

	Last 24 hours	Last 90 days	Total
All types	2	39	1333
This type	2	39	500
Landings this type	1	14	280

Aircraft information

General information

Registration:	OY-NBS
Type:	Pilatus
Model:	PC-12/47E
Manufacturer:	Pilatus Aircraft Ltd.
Serial number:	1179
Year of manufacture:	2009
Engine manufacturer:	Pratt and Whitney Canada Inc.
Engine type:	PT6A-67P
Propeller manufacturer:	Hartzell Propeller Inc.
Propeller type:	HC-E4A-3D/E10477SK
Aircraft total flight hours:	967:26
Airworthiness review certificate:	Valid until 2-5-2017
Technical flight log:	No remarks
Maximum take-off mass (MTOM):	4740 kilos (kg) / 10450 pound (lb)
Mass at the time of the serious incident:	3100 kg / 6834 lb

Emergency procedure – non-commanded stick shaker operation

The Pilot Operating Handbook (POH) emergency procedure (section 3.13.2) for non-commanded stick shaker operation in flight – see appendix 3.

Stall speeds

A graph on stall speeds presented in the POH (section 5) – see appendix 4.

With reference to the stated mass at the time of the serious incident of approximately 6834 lb and flap settings of 0° and 15 ° respectively, the stall speeds, when not operating in pusher ice mode, were approximately 77 knots (indicated) and approximately 63 knots (indicated) respectively.

Be observant that stall in the presented figure is defined by pusher activation.

Flight in icing conditions

Stall speeds when operating in pusher ice mode presented in the POH (section 5) – see appendix 5.

An extract:

Flaps	*Stall speeds (pusher activation) at MTOM – Knots Indicated Air Speed (KIAS)*	
0°	*Icing conditions (stick pusher ice mode)*	*107 KIAS*
15°	*Icing conditions (stick pusher ice mode)*	*87 KIAS*

Stall warning / stick pusher system

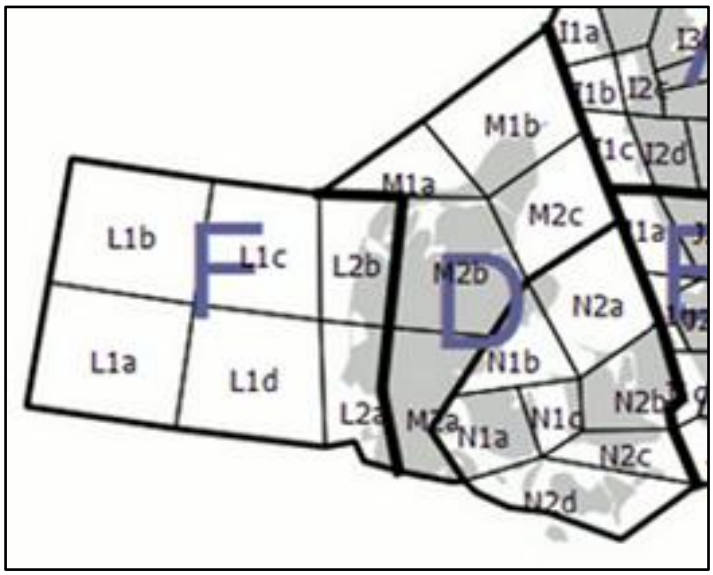
For a presentation of the stall warning / stick pusher system – see appendix 6, which is an extract from the POH (section 7-21).

Meteorological information

Forecast

Forecast (extract) for the area N, the islands. EKRK is located within the area N2b.

The forecast was valid on 6-2-2017 between 13:00 and 21:00 hours.



Moderate or severe turbulence:	It was not expected within the forecasted period.
Moderate or severe icing:	13:00 - 19:00 hours: Area N1b, N2a, and N2b - moderate ice 1000 feet - Flight Level (FL) 080. 19:00 - 21:00 hours: The whole area - moderate ice 500 feet - FL080.
Visibility/weather/clouds:	Area N1b, N2a, and N2b: Visibility >8 kilometers (km), locally 1.5 km - 3 km in showers of snow. Cloud base >4000 feet, locally 500 feet - 1000 feet.
Cloud top:	Area N1b, N2a, and N2b: Cloud top FL080.
Zero degree isotherm:	17:00 -19:00 hours: Zero degree surface - 800 feet. 19:00 - 21:00 hours: Zero degree surface - 700 feet.
Surface winds:	Area N2b: Easterly/7-22 knots gusting up to 30 knots.
Wind and temperature:	2000 feet: 19:00 -21:00 hours: 100/34 knob, -6° Celsius (C).
Lowest QNH:	1023 hPa.

Aftercast

General:	An intense high pressure area above Finland caused an easterly current of cold air above Denmark. Particularly above the southern half part of Zealand (south of and near EKRK), there was a mix of light snow and snow showers.
Visbility:	At EKRK, the visibility was good (more than 10 km). When snowing, the visibility might have been reduced, maybe locally down to 1500 meters.
Clouds and icing:	Broken/overcast stratocumulus - base at 5000-6000 feet and top at approximately 8000 feet. Below scattered/broken stratocumulus/cumulus - base at 2000 feet and up to 8000 feet. Moderate icing in clouds, locally severe icing.
Surface wind:	070° and 13 knots with hardly no gusts. Wind fluctuations might have been present with a maximum wind speed of 20 knots.
Altitude winds and temperatures:	At 100 feet: 070° and 14 knots, -1° C At 500 feet: 070° and 18 knots, -2° C At 1000 feet: 080° and 20 knots, -3° C At 2000 feet: 080° and 23 knots, -6° C

Flight crew reports

At 15:30 hours:	The flight crew of an Airbus 319 reported moderate icing at 2000 - 3000 feet near Copenhagen Kastrup (EKCH).
At 20:34 hours:	The flight crew of an Airbus 320 reported moderate to severe icing enroute at 5500 feet - 8000 feet from VOR KOR (112.800 MHz) to EKCH.

Significant weather chart

See appendix 7.

Terminal Aerodrome Forecast (TAF)

ekrk 061701z 0618/0703 07010kt 9999 bkn020 tempo 0618/0624 -snra bkn012=

Aviation Routine Weather Report (METAR)

ekrk 061920z auto 07012kt 9999ndv few021/// bkn065/// m00/m04 q1027=

ekrk 061950z auto 07013kt 040v110 9999ndv few020/// bkn065/// m01/m04 q1027=

Automatic Terminal Information Service (ATIS)

This is Roskilde information Juliet at 19:20. IFR flight expect ILS approach. Runway in use 11. Runway 11 damped. Transition Level 60. Wind 070° 12 knots. Visibility 20 kilometers. Few 2100 feet. Broken 6500 feet. Temperature -0. Dewpoint -4. QNH 1027. This was Roskilde information Juliet.

Aids to navigation

At the time of the serious incident, there were no reports on unserviceable approach aids to navigation at EKRK.

Communication

The pilot of OY-NBS was in radio contact with Roskilde Approach (125.525 MHz).

The AIB obtained involved ATS voice recording. The ATS voice recording was of good quality and useful to the AIB safety investigation.

Aerodrome information

General information

The Aeronautical Information Publication - Denmark (extract)

Location indicator:	EKRK
Position:	55 35 08.04N 012 07 53.14E
Elevation (msl):	146 fod
Runway 11:	116.3° GEO / 113.9° MAG - 1799 x 32 M
Rescue and firefighting services:	CAT 3 during aerodrome operational hours

ICAO aerodrome chart

See appendix 8.

Flight recorders

General information

The AIB in cooperation with the Danish aircraft maintenance facility downloaded data from the aircraft FHDB and the ACMS.

The aircraft manufacturer assisted the AIB in decoding downloaded data from the aircraft FHDB and the ACMS.

Due to lags in data recording, the correlation between the timestamps of the FHDB and the ACMS data were not fully synchronous.

However, the downloaded data were useful to the AIB safety investigation.

ACMS downloaded readouts (extract) on KCAS

Time	Airspeed (KCAS)
19:27:36 hours:	224 knots
19:28:36 hours:	163 knots
19:29:36 hours:	146 knots
19:30:36 hours:	146 knots

Note.
Referring to the FHDB, the first activation of the aircraft stall warning system occurred at 19:28:50 hours.

AIB safety investigation

Technical safety investigation

a. Auto flight - Air Transport Association (ATA) 22

Two tests were performed.

1. The speed and attitude correction test

The test was performed in accordance with DMC-12-B-22-20-00-00A-903A-A issue 009 section 1-4 and 6.

The test in section 4 – check of the stick pusher system – was performed three times without remarks.

The test in section 6 – functional test of the stick pusher servo and capstan – was performed one time without remarks.

The test in section 5 – functional test of the stick pusher system – was not performed, because the test would erase the memory of the stick pusher computer. This approach was in agreement with the aircraft manufacturer.

2. The autopilot test.

The test was performed in accordance with DMC-12-22-10-00-00A-903A-A issue 007 section 2-6.

The autopilot test was performed without remarks.

b. Landing gear - ATA 32

All landing gear tests were performed in accordance with DMC-12-B-32-30-00-00A-903A-A issue 008.

After resetting of the landing gear, a functional test of the extension and retraction system was performed in accordance with section 4. The functional test gave no rise for remarks.

c. Angle of Attack (AOA) probe heating

A functional test of the AOA probe heating was performed without remarks.

d. Examination of the stick shaker computer

A hard- and software examination of the stick shaker computer was performed without remarks.

Operational safety investigation

a. AFCS approach mode engagement

The AIB requested the aircraft manufacturer to comment on the pilot observed “Vertical GP unavailable” advisory when approaching the localizer to runway 11.

The aircraft manufacturer stated that incorrect selection of the primary navigation source most likely prohibited an AFCS approach mode engagement.

b. Non-commanded stick shaker operation occurrences

The aircraft manufacturer reporting system contained reports of non-commanded stick shaker operation in flight. The reported occurrences did not end up in neither accidents nor serious incidents. The reported occurrences were commensurate with the severity minor.

On request by the AIB, the aircraft manufacturer informed that they did not have any records on non-commanded stick shaker occurrences caused by wiring issues between neither the AOA sensors and the stick pusher computer nor any other wiring of the stall warning system.

c. Pilot training

According to the flight training department of the aircraft manufacturer, PC-12 student pilots are exposed to stick shaker and stick pusher activation conditions in order to be familiar with the stall characteristics of the aircraft.

d. ACMS recorded data

The aircraft manufacturer criteria for an ACMS recording of a “Landing Event” were:

The aircraft state AIR or GROUND is determined by the Aircraft On Ground Monitor. This is a Level A monitor provided by the MWF (Monitor Warning Function), hosted within the MAU (APEX). The ACMS itself does not determine the state, it only records it.

The Ground Monitor Logic uses inputs from the WoW switches, the Radar Altimeter and the airspeed (CAS).

- *The WoW switches provide a VALID signal for AIR or GROUND when both of them agree.*
- *The airspeed provides a VALID signal for GROUND when the calibrated air speed is less than 53 kts for more than 15 seconds.*
- *The Rad Alt provides a VALID signal for GROUND when the altitude was less than 5 ft. for more than 80% of the time during the last 2 seconds.*

The Ground Monitor Warning Function processes the combination of states according to the following logic:

Aircraft Air-Ground Monitor Logic							
AirGnd Conditions						AIRCRAFT_GND	
WOW AirGnd		RA AirGnd		CAS AirGnd			
Status	State	Status	State	Status	State	Status	State
Invalid	x	Invalid	x	Invalid	x	Invalid	AIR
Valid	GND	Valid	AIR	Invalid	x	Valid	GND
Valid	AIR	Valid	GND	Invalid	x	Valid	AIR
Valid	GND	Invalid	x	Valid	AIR	Valid	AIR
Valid	AIR	Invalid	x	Valid	GND	Valid	GND
Invalid	x	Valid	GND	Valid	AIR	Valid	AIR
Invalid	x	Valid	AIR	Valid	GND	Valid	GND
Valid	GND	Invalid	x	Invalid	x	Valid	GND
Valid	AIR	Invalid	x	Invalid	x	Valid	AIR
Invalid	x	Valid	GND	Invalid	x	Valid	GND
Invalid	x	Valid	AIR	Invalid	x	Valid	AIR
Invalid	x	Invalid	x	Valid	GND	Valid	GND
Invalid	x	Invalid	x	Valid	AIR	Valid	AIR
Valid	GND	Valid	GND	x	x	Valid	GND
Valid	AIR	Valid	AIR	x	x	Valid	AIR
Valid	GND	x	x	Valid	GND	Valid	GND
Valid	AIR	x	x	Valid	AIR	Valid	AIR

The AIRCRAFT_GND state is recorded by the ACMS.

Appendix 9 presents the last 60 seconds of two final approaches (until the ACMS recorded "Landing Event).

The first final approach is the previous flight inbound EGBB. The second final approach is the serious incident flight inbound EKRK. Both final approaches were performed with flap settings of 30°.

For comparison of the two final approaches, the AIB decided to present KCAS and Pitch Angles in degrees.

Survival aspects

The pilot used hip and shoulder harnesses.

Neither the pilot seat nor the pilot seatbelt were overstressed or suffered from malfunctioning.

At an early stage of the sequence of events, the air traffic controller at Roskilde Tower alarmed the aerodrome firefighting and rescue services.

When the aircraft landed on runway 11, the aerodrome firefighting and rescue services were in standby positions close to the runway.

Additional information

An official definition of cognitive tunnelling is:

"Cognitive tunnelling is the mental state in which your brain hangs on to the thing that is closest to you or in front of you, and does not see the rest of the environment, or other relevant data.

Cognitive tunnelling most likely occurs in stressful situations and may lead to "inattentional blindness" and "inattentional deafness."

ANALYSIS

General

The license, the qualifications and the medical status held by the pilot had, in the AIB's opinion, no influence on the sequence of events.

The AIB considered the pilot to be an experienced PC-12 pilot.

The observed weather conditions in the area around EKRK were equivalent to the forecasted weather conditions. At an early stage of the final approach to EKRK, the pilot got visual contact with the runway, which to a certain extent reduced the overall pilot workload during the sequence of events.

Though, the pilot experienced light to moderate icing during the descent inbound EKRK, the AIB does not consider icing as contributing to the sequence of events.

Stick shaker operation in flight

On final approach, inbound EKRK, the aircraft operated in pusher ice mode. However, the activation of the stall warning system, including the stick shaker operation in flight, occurred at an angle of attack below (during descent at a negative pitch angle) and at an airspeed (radar presented GS of 153 knots and a headwind component of approximately 19 knots at 2000 feet) significantly above the stall parameters.

An AIB technical investigation of the stall warning system did not reveal the root cause for the non-commanded repetitive activation of the stall warning system and the non-commanded repetitive stick shaker operation in flight.

However, the AIB finds that appropriate general risk controls (the emergency checklist and pilot training) were available and would mitigate risks in consequence of a non-commanded repetitive stick shaker operation in flight.

The AIB considers the repetitive activation of the stall warning system and the repetitive stick shaker operation in flight to be non-commanded.

Consequential operational side effects

A combination of the following independent events increased pilot workload to such an extent that it, in the opinion of the AIB, resulted in pilot cognitive tunnelling impacting pilot perception of the environment and the pilot decision making process:

- Incorrect pilot selection of the primary navigation source, when approaching the localizer to runway 11, prohibited an AFCS approach mode engagement
- A non-commanded and repetitive activation of the stall warning system including a non-commanded and repetitive stick shaker operation in flight.
- A non-available autopilot because of the non-commanded and repetitive activation of the stall warning system.
- Pilot system understanding of the control wheel pusher interrupt push switch functionality contradicted aircraft system design. Pilot use of the control wheel pusher interrupt push switch, designed to disengage the stick pusher actuator in the event of a non-commanded operation, had no effect on non-commanded stick shaker operation in flight.
- Pilot perception of the landing gear not being down and locked, though the landing gear actually was down and locked.
- Leaving out adherence to the appropriate aircraft emergency procedure on non-commanded stick shaker operation in flight limited pilot operational options and most likely mentally forced the pilot to focus on visual maneuvering overhead and close to runway 11 and landing at EKRK as soon as possible.

Non-commanded and repetitive stall warnings and stick shaker operation in flight made it difficult for the pilot to maintain stabilized flight parameters (airspeed and pitch angle) on the last part of the figure eight visual maneuvering approach to runway 11.

Comparing flight parameters like airspeed and pitch angle on the last part of the final approach to EGBB and the last part of the visual maneuvering approach to EKRK, the AIB finds that non-stabilized flight parameters most likely resulted in the subsequent bounced landing and the runway excursion.

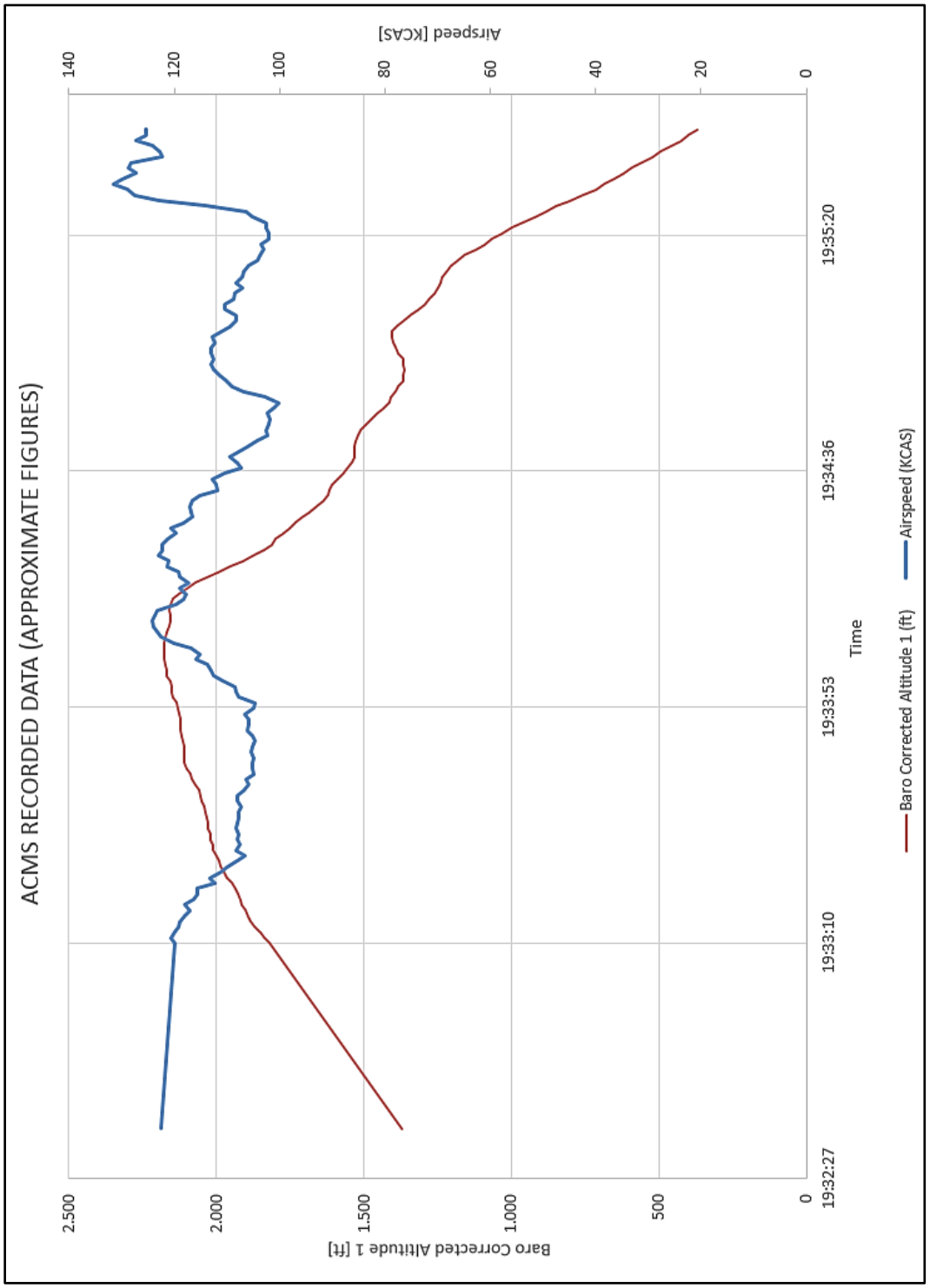
CONCLUSIONS

Non-commanded and repetitive activation of the stall warning system including stick shaker operation in flight in combination with non-adherence to the appropriate aircraft emergency procedure increased pilot workload to such an extent that it resulted in pilot cognitive tunnelling impacting pilot perception of the environment and the pilot decision making process.

Non-stabilized flight parameters during the last part of the visual maneuvering approach to EKRK most likely led to a subsequent bounced landing and the runway excursion

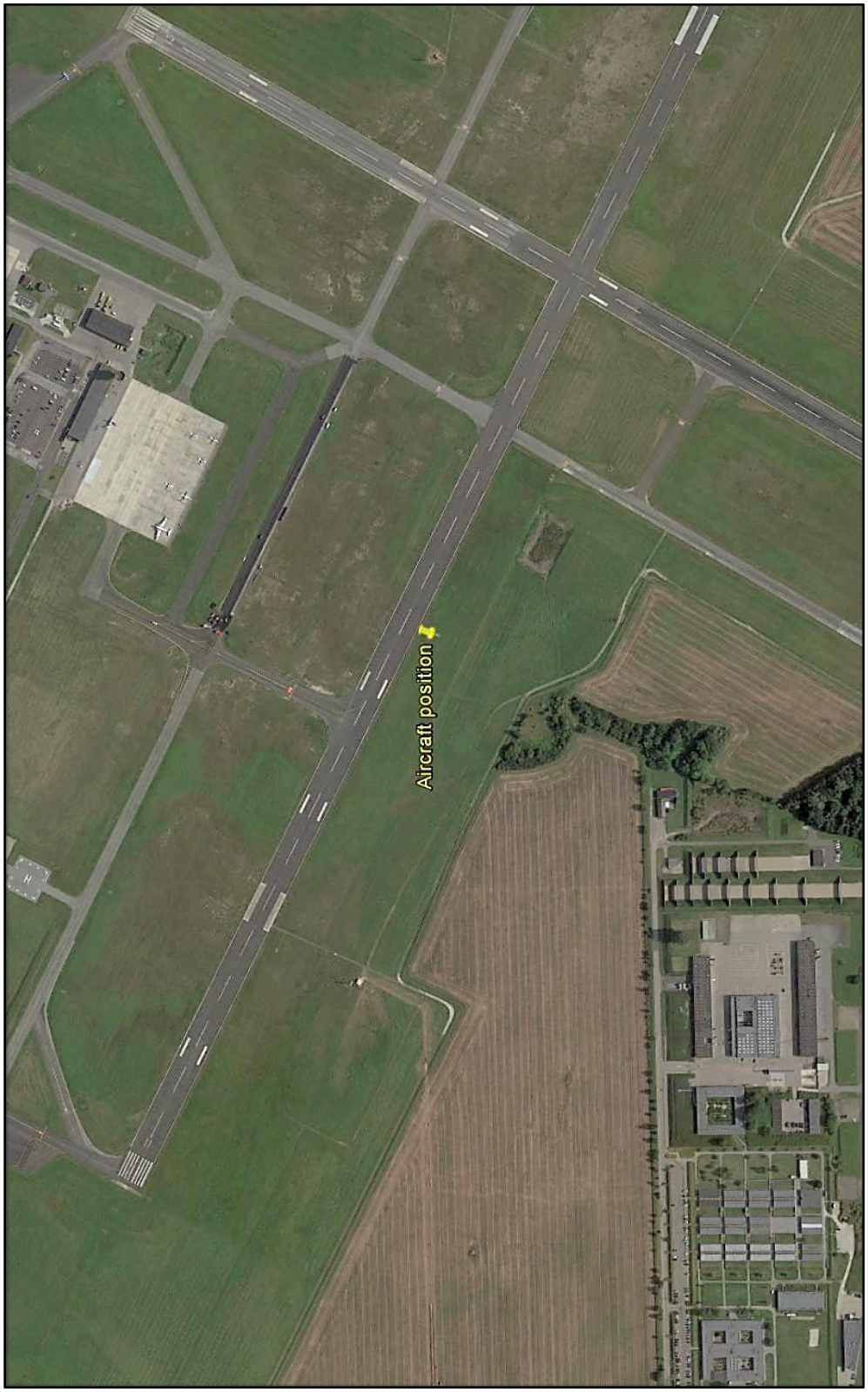
APPENDIX 1

Return to history of the flight



APPENDIX 2

Return to history of the flight



APPENDIX 3

Return to emergency procedure

3.13.2 SHAKER

Indication: Non-commanded shaker operation.

1.	**AOA**	**Decrease**
2.	**IAS**	**Increase**

If shaker continues to operate:

3.	**STALL WARN 1 circuit breaker (Essential Bus $_L$K3)**	**Pull**
4.	**STALL WARN 2 circuit breaker (Main Bus $_R$H3)**	**Pull**

WARNING

THE AIRCRAFT IS NOT STALL PROTECTED.

5.	**Airspeed not below 1.3 Vs for 10450 lb (4740 kg)**	**Flaps 0°**	**120 KIAS**
		Flaps 15°	**101 KIAS**
		Flaps 30°	**90 KIAS**
		Flaps 40°	**88 KIAS**

WARNING

APPROACHES TO STALLS ARE NOT WARNED AND NATURAL STALLS ARE NOT PREVENTED WITH THE STICK SHAKER INOPERATIVE.

STALLS MUST BE AVOIDED WHEN THE STICK PUSHER IS INOPERATIVE. EXCESSIVE WING DROP AND ALTITUDE LOSS MAY RESULT DURING STALL WITH FLAPS DOWN AND/OR WHEN POWER IS APPLIED.

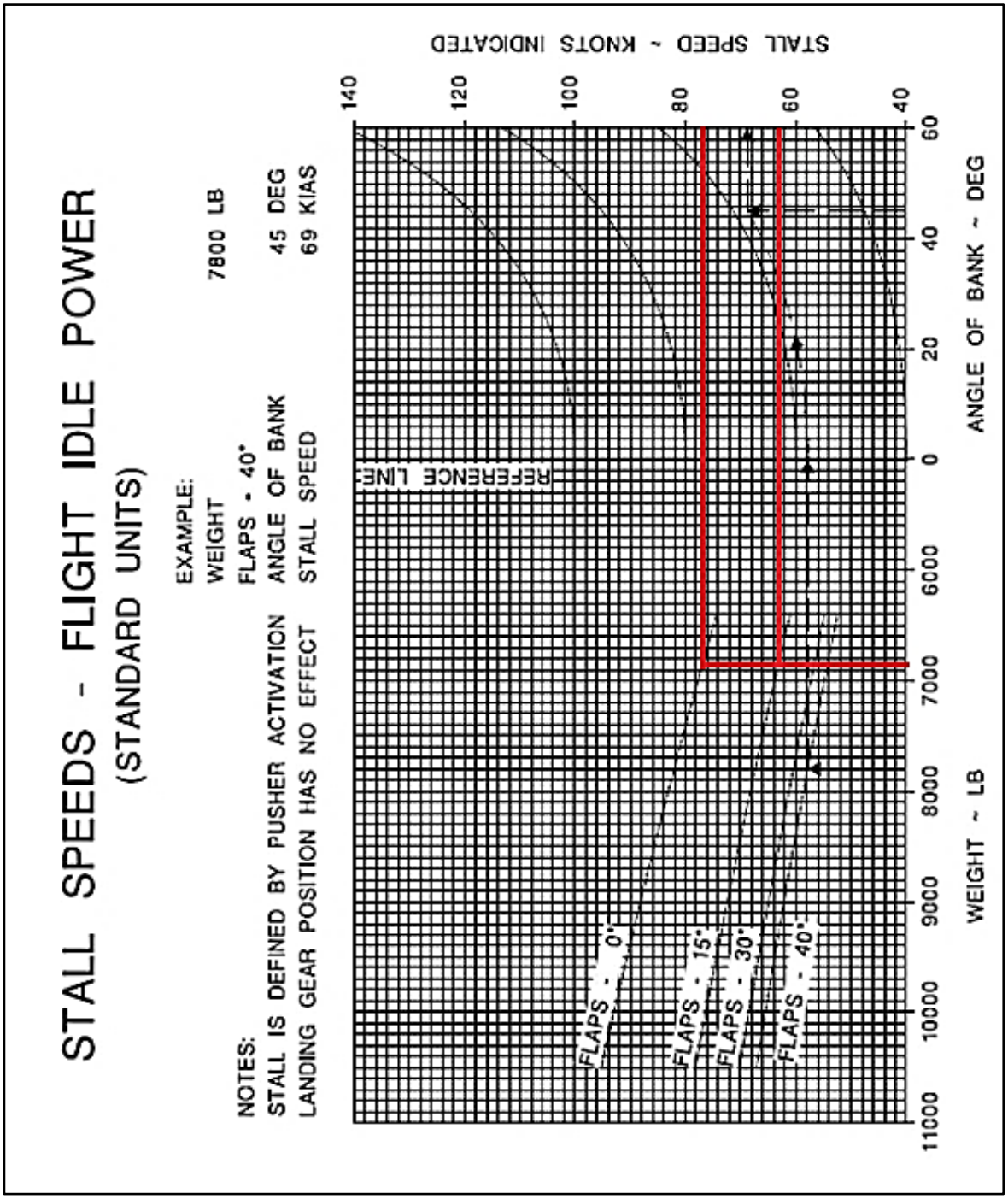
CAUTION

STALL SPEEDS IN TURNS ARE HIGHER.

AOA MAY NOT BE RELIABLE.

APPENDIX 4

Return to stall speeds



APPENDIX 5

Return to flight in icing conditions

FLIGHT IN ICING CONDITIONS

STALL SPEEDS

When operating in PUSHER ICE MODE, the stick pusher computer automatically reduces the shaker and pusher settings, as measured by the angle of attack vanes, by 8°. With operational pneumatic deice boots this results in an increase of the stall speed at the maximum takeoff weight of 12 kts with 0° flaps and 9 kts with 15° flaps.

NOTE

Flap position is limited to maximum 15° in icing conditions with operational pneumatic deice boots.

With failed pneumatic deice boots and ice accretion on the lifting surfaces an increase of the stall speed at the maximum takeoff weight of 15 kts with 0° flaps is to be expected.

NOTE

Flap position is limited to maximum 0° in icing conditions with failed pneumatic deice boots.

The wings level stall speeds at the maximum takeoff weight of 10450 lb (4740 kg) and with flight idle power are summarized in the following table:

FLAPS	STALL SPEED (PUSHER ACTIVATION) AT MTOW - KIAS	
0°	Non-icing	95
	Icing conditions (STICK PUSHER ICE MODE)	107
	Pneumatic de-ice boots failure (unprotected)	110
15°	Non-icing	78
	Icing conditions (STICK PUSHER ICE MODE)	87

APPENDIX 6

Return to stall warning / stick pusher system

STALL WARNING / STICK PUSHER SYSTEM

GENERAL

The airplane is equipped with a stick shaker-pusher system to improve aircraft handling in the low speed flight regime by preventing the airplane from inadvertently entering a stall condition. The stick shaker-pusher system contains two Angle-of-Attack (AOA) sensors, two computers, a single stick shaker and a single stick pusher. The two computers are connected in such a way that either computer can, independently, provide stall warning (stick shaker and stall warning) but both computers are required to actuate the stick pusher.

DESCRIPTION

Refer to Figure 7-21-1, Stall Warning/Stick Pusher System, for system operation.

The left and right hand Stick Pusher Computers are each provided power from the Essential and Main bus. Each computer receives inputs from its respective AOA vane and AIR/GND relay. Both computers receive inputs from the engine torque, flap position, and self test. From these various inputs, each computer independently determines the "Defined Angle of Attack" for stall warning (stall warning and stick shaker activation), stick pusher activation, and stick pusher disengagement following an actual push. A digital serial output, from the left and right computers, provide data to the Modular Avionics Unit (MAU) for the Fast/Slow pointer on the Attitude Direction Indicator (ADI) or the Dynamic Speed Bug (DSB) (Primus APEX Build 8 or higher) on the airspeed tape of the Primary Flight Display(s) (PFD's). It is also used for the display of the Low Speed Awareness Indication adjacent to the Air Speed Tape.

The stick pusher, shaker, the Flight Alerting System (FAS) visual "Stall" and aural "Stall" warnings are disabled on the ground through the AIR/GND inputs, except for the self test function. The stick pusher is inhibited for 5 seconds after lift-off. The shaker and the stall warning are operative immediately after lift-off.

The stick pusher actuator has a built-in g-switch which inhibits the stick-pusher when the airplane's normal acceleration becomes less than 0.5 g. The output torque of the stick-pusher actuator is electronically-limited to have a force of 60 to 65 lbf on the control wheel. A slip-clutch on the stick-pusher capstan allows control on the elevator with a force of 85 to 90 lbf on the control wheel, in the event of stick-pusher jam. The force on the control wheel is defined when the longitudinal control is pulled to 3/4 of its travel. This allows the pilot or copilot to override the stick-pusher in the instance of an inadvertent operation.

Each outboard control wheel horn is equipped with a PUSHER INTR push switch providing a means to quickly disengage the stick pusher actuator in the event of an inadvertent operation.

Return to stall warning / stick pusher system

When operated in pusher Ice Mode (to provide protection in icing conditions), all the shaker and pusher actuating points measured by the angle of attack vanes are reduced by 8°. The pusher Ice Mode is set when the propeller de-icing system is switched ON and the inertial separator is set to OPEN. When both pusher computers are set in Ice Mode, a green PUSHER ICE MODE advisory is shown in the ICE PROTECTION window of the systems MFD. If only one computer is set in Ice Mode, or if no computer is set in Ice Mode while conditions for ice mode are present, the amber PUSHER caution is activated.

The system is provided with a self test function that can be activated at any time by pressing and holding the STICK PUSHER switch located on the SYSTEM TEST section of the overhead panel. The green PUSHER ICE MODE advisory is illuminated during the self test after the pusher is first activated. The amber Pusher caution on the CAS will remain illuminated until the self test is passed.

After engine start on the ground, the CAS Pusher caution will illuminate until the system test has been successfully tested. The test must be done before takeoff. The engine must be operating at a minimum of 5 psi torque, the flaps set to 15°, then press and hold the STICK PUSHER switch to initiate the test. If the test switch is pressed and the test sequence does not occur and/or the CAS Pusher caution remains illuminated, the system has failed the self test and further flight before maintenance is not approved. If the test switch is pressed without the engine operating above 5 psi torque and the flaps are not set to 15°, the PUSHER annunciator will remain illuminated, the "Stall" warning and the test sequence will not occur.

The system function may be tested in the air anytime the engine is operating with the flaps at any setting. Press and hold the test switch and observe the following sequence; PUSHER ICE MODE advisory, "Stall" warning with stick shaker for 2 seconds followed by a 1 second pause, and "Stall" warning with stick shaker for 2 seconds. The pusher will not activate when the system is tested in flight. If the test switch is pushed and the test sequence does not occur and/or the CAS PUSHER caution remains illuminated, the system has failed the self test.

WARNING

STALLS MUST BE AVOIDED WHEN THE STICK PUSHER IS INOPERATIVE. EXCESSIVE WING DROP AND ALTITUDE LOSS MAY RESULT DURING STALL WITH FLAPS DOWN AND/OR WHEN POWER IS APPLIED.

The AOA vanes and mounting plates are electrically heated by internal heating elements. AOA vane and mounting plate heat is controlled by the PROBES switch located on the ICE PROTECTION switch panel. Refer to Figure 7-21-1, Stall Warning/Stick Pusher System for system schematic.

Return to stall warning / stick pusher system

OPERATION

The vane attached to the AOA probe aligns itself with the relative airflow. As it moves, it positions a wiper unit in the probe. This wiper unit adjusts the electrical output to its respective pusher computer. As the airplane approaches the artificial stall (5 to 10 knots before pusher actuator), the stick shaker and the "Stall" warning will activate when one of the AOA pusher computers senses the defined angle of attack for stall warning/stick shaker activation. If the "Stall" warnings are ignored and the approach to stall is continued, the stick pusher will activate when both AOA pusher computers sense the defined angle of attack for stick pusher activation. The stick shaker and "Stall" warning remain active during pusher operation.

Pusher operation will be stopped when either AOA computer senses an angle of attack lower than the angle of attack required to active the pusher or when the airplane acceleration is less than 0.5 g.

If an inadvertent operation of the stick pusher occurs, push the PUSHER INTR switch on the control wheel outer horn to quickly disengage the stick pusher actuator.

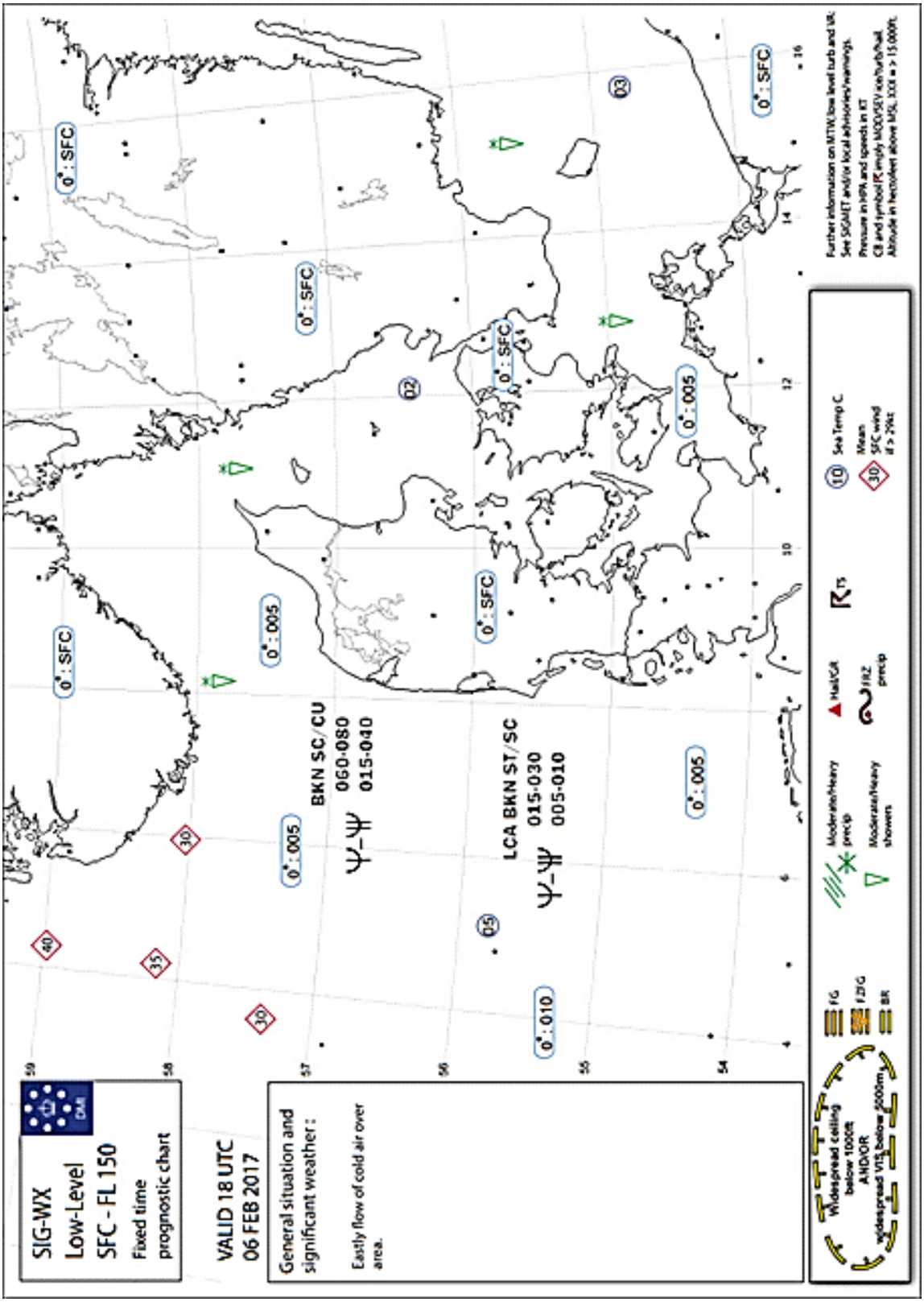
Activation of the stick shaker disengages the autopilot if engaged, in order to give full authority to a possible stick pusher activation. The autopilot can be manually reconnected after the angle of attack is reduced and the stick shaker has ceased operation.

WARNING

IF ACCELERATED STALLS ARE PERFORMED IN THE LANDING CONFIGURATION WITH HIGH POWER AND SIDESLIP, A RAPID PITCH-DOWN MAY RESULT WITH AN ALTITUDE LOSS OF UP TO 500 FEET.

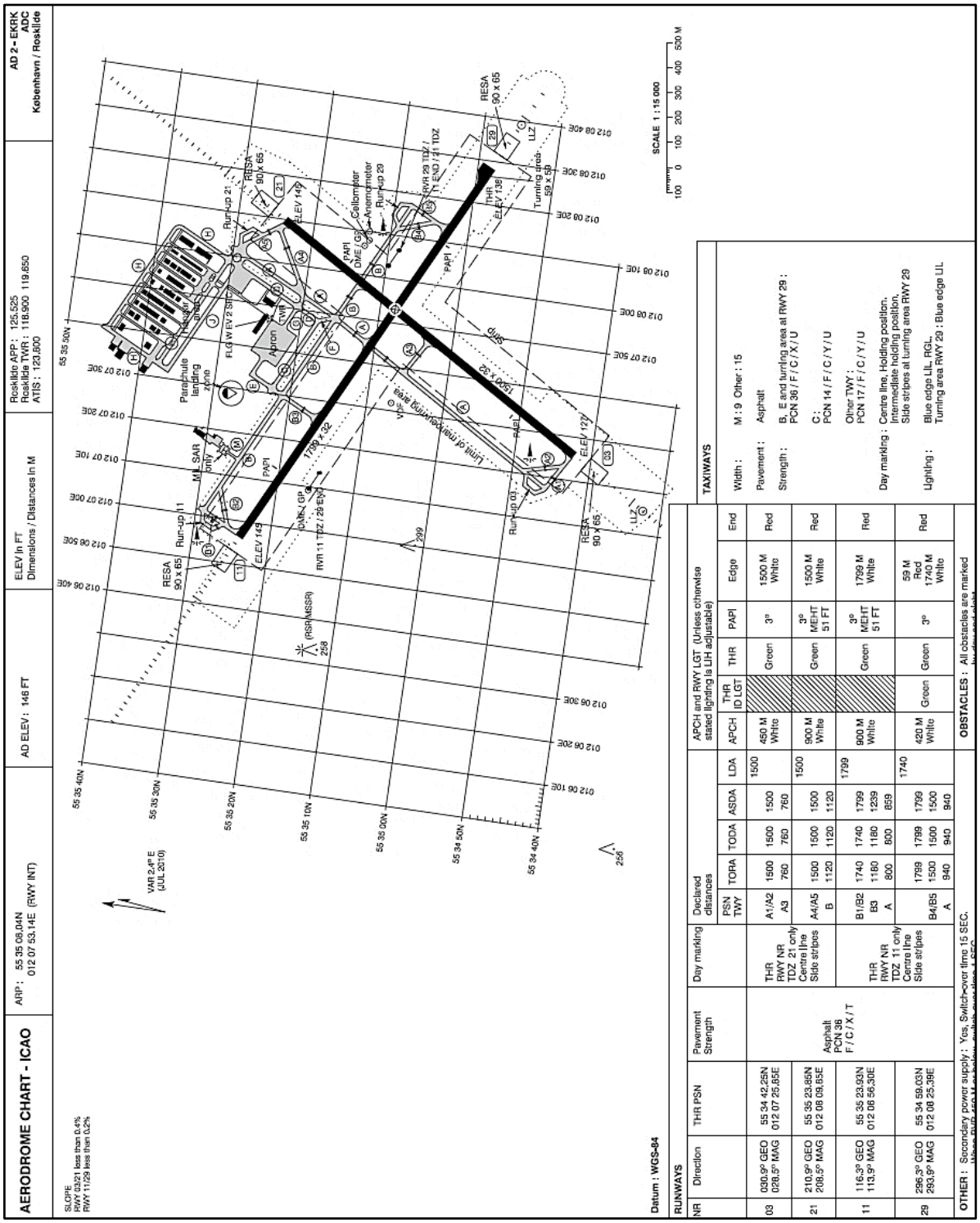
APPENDIX 7

Return to meteorological information



APPENDIX 8

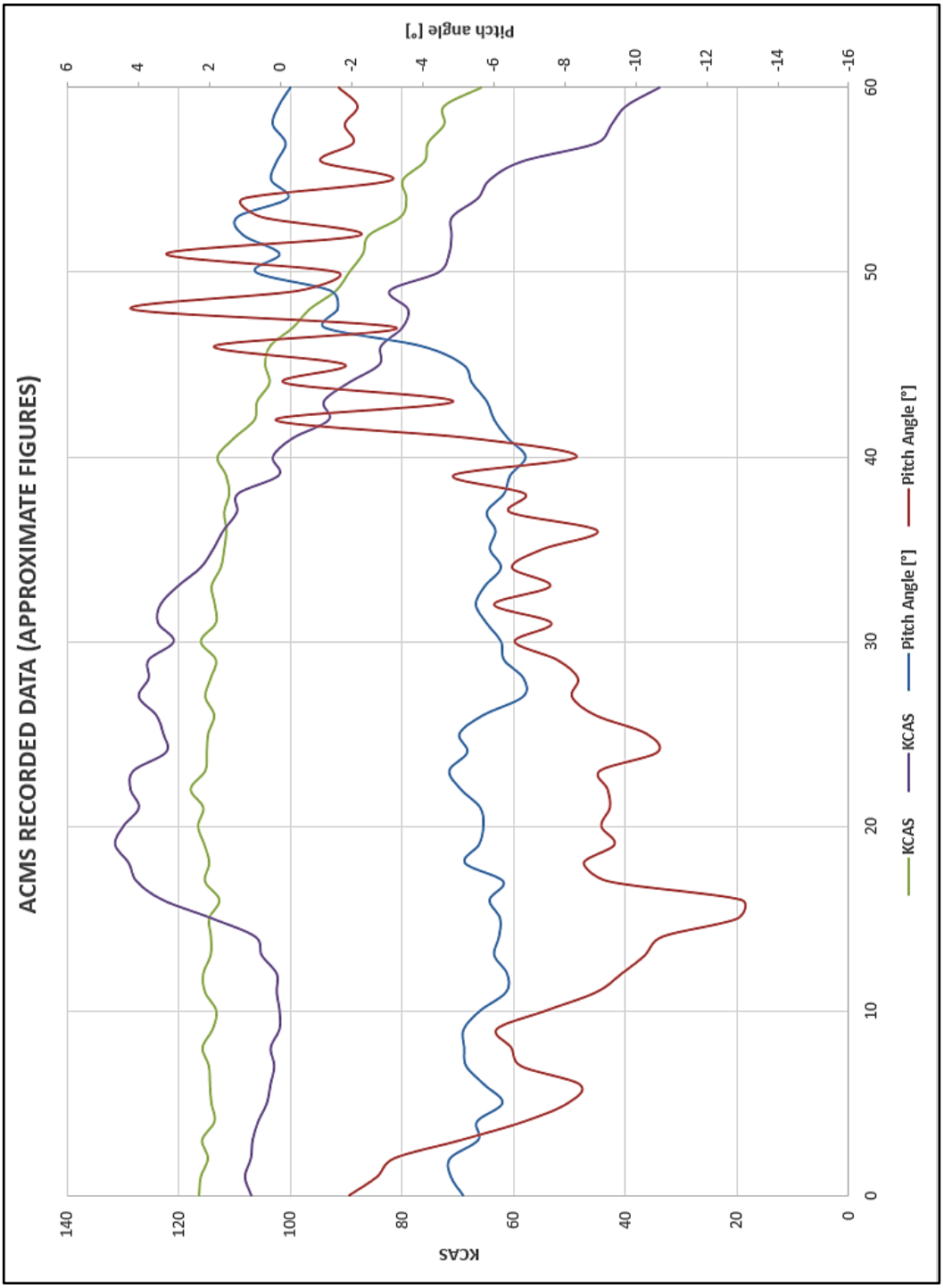
Return to aerodrome information



NR	Direction	THR PSN	Pavement Strength	Day marking	Declared distances PSN TWY	TORA	TODA	ASDA	LDA	APCH and RWY LGT (Unless otherwise stated lighting is LIH adjustable) APCH	THR ID LGT	THR	PAPI	Edge	End
03	030.9° GEO 028.5° MAG	55 34 42.25N 012 07 25.85E	Asphalt PCN 36 F / C / X / T	THR RWY NR TDZ 21 only Centre line Side stripes	A1/A2 A3	1500 760	1500 760	1500 760	1500	450 M White		Green	3°	1500 M White	Red
21	210.9° GEO 208.5° MAG	55 35 23.85N 012 08 09.85E			A4/A5 B	1500 1120	1500 1120	1500 1120	1500	900 M White		Green	3° MEHT 51 FT	1500 M White	Red
11	116.3° GEO 113.9° MAG	55 35 23.93N 012 08 56.30E		THR RWY NR TDZ 11 only Centre line Side stripes	B1/B2 B3 A	1740 1180 800	1740 1180 800	1799 1239 859	1799	900 M White		Green	3° MEHT 51 FT	1799 M White	Red
29	296.3° GEO 293.9° MAG	55 34 59.03N 012 08 25.39E			B4/B5 A	1799 1500 940	1799 1500 940	1799 1500 940	1740	420 M White		Green	3°	59 M Red 1740 M White	Red

APPENDIX 9

Return to operational safety investigation

Final approach to EGBB (the previous flight)

Final approach to EKRK (the serious incident flight)