THE DANISH
ACCIDENT INVESTIGATION BOARD
The Aviation Unit

Report

HCLJ510-000721

Incident involving ATR72-212A
Registration OY-CIN
Bornholm Airport (EKRN)
27 January 2010

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REPORT

HCLJ510-000721	**Incident**		
Aircraft:	ATR72-212A	Registration:	OY-CIN
Engines:	2 – PW 127F	Flight:	Scheduled flight, IFR
Crew:	4 – no injuries	Passengers:	34 – no injuries
Location:	Bornholm Airport (EKRN)	Date and time:	27.1.2010 at 18:07 UTC

All times in this report are UTC.

Synopsis

The aviation unit of the Danish Accident Investigation Board (AIB) was notified of the incident from the Area Control Centre at Copenhagen Airport, Kastrup (EKCH) on 27.1.2010 at 18:30.

The International Civil Aviation Organization (ICAO) and the French Accident Investigation Board (Le Bureau d'Enquêtes et d'Analyses – BEA) were notified on 29.1.2010. The BEA appointed an accredited representative to the investigation.

Summary

Landing under marginal crosswind conditions in combination with possible runway contamination resulted in the aircraft running off the side of the runway (runway excursion).

The incident occurred in dark night and under instrument meteorological conditions (IMC).

The investigation has not resulted in any recommendations being made.

1. Factual information

1.1 History of the flight

The incident occurred during a scheduled flight from EKCH to Bornholm Airport (EKRN). The commander was Pilot Flying (PF) and the first officer was Pilot Non Flying (PNF).

At 17:06:51 the pilots made radio contact with the control tower at EKRN. The pilots got clearance to make a VOR/DME approach to runway 29 when passing 20 nm from ROE VOR (112,000 MHz). The pilots were informed that the landing threshold to runway 29 was displaced. At the time, the available landing distance (LDA) was 1590 metres. The ILS for runway 11 and runway 29 and the Precision Approach Path Indicator (PAPI) were not available.

Weather and runway conditions were reported as being:
Wind conditions were 200° 31 knots maximum 41 knots.Visibility was 300 metres in drifting snow. Runway visual range (RVR) was 800 metres, the clouds (broken) were at 700 and 1000 feet.Temperature and dewpoint were –5°C. QNH was 1010 HPa. Transition Level (TL) was FL 55.

At approximately 17:02, the braking action coeficients on runway 29 were measured to be 48, 51 and 53. 50% of runway 29 was covered in 2 mm dry snow.

At 17:09:23, the control tower informed the pilots that the approach lights (high intensity) would be switched on for the landing but that no lights would be switched on between the original landing threshold and the displaced threshold for runway 29.

Immediately thereafter the pilots reported that due to the current RVR value of 800 metres they would fly to Fauna holding pattern (334 KHz) in order to wait for a better RVR value. Later (at 17:19:10) the pilots reported that a RVR value of 1000 metres was necessary in order for them to commence a VOR/DME approach to runway 29.

At 17:26:20, the control tower informed the pilots that the RVR to runway 29 was 1100 metres. The pilots responded that they would report back when they were ready to commence an approach.

At 17:27:50, wind conditions were reported to be 210° 30 knots maximum 38 knots. RVR to runway 29 was 1200 metres.

At 17:28:46 the pilots reported to the control tower that they were ready to commence a VOR/DME approach to runway 29. The control tower instructed them to wait since OY-CIN was number two for landing. Number one for landing was a helicopter.

Once the helicopter had landed the pilots were cleared to commence a VOR/DME approach to runway 29. During the final approach the pilots received continuous wind information. At 17:41:26 and 17:42:02, wind conditions were reported to be 210° 33 knots maximum 41 knots. The pilots decided to make a go-around.

The pilots subsequently reported to the control tower that the aircraft had a crosswind limitation of 30 knots maximum.

After being informed that wind conditions at 17:48:10 and at 17:55:53 (210° were 29 knots maximum 40 knots / 200° 29 knots maximum 37 knots), at 17:58:25, the pilots decided to attempt a new VOR/DME approach to runway 29. The final approach speed determined by the pilots (correction for icing and wind conditions) was 120 knots IAS, and the flaps of the aircraft were extended to flap position 30°. When passing radio altitude (RA) of 1000 feet, the aircraft was fully stabilized (stabilized approach).

Wind conditions were reported constantly during the aircraft's final approach:

- At 18:00:44 (when passing 1995 feet RA / 200° 28 knots maximum 34 knots)
- At 18:04:27 (when passing 1518 feet RA / 210° 26 knots maximum 37 knots). The aircraft got landing clearance.
- At 18:05:35 (when passing 951 feet RA / 210° 28 knots maximum 37 knots)
- At 18:06:44 (when passing 255 feet RA / 210° 30 knots maximum 35 knots).

During the landing roll the pilots noticed that the aircraft was beginning to veer to the left. PF corrected this so that the aircraft was guided back to the centre line of the runway. Unexpectedly, the pilots once again noticed that the aircraft was veering to the left. PF made maximum use of the wheel brakes and full reversing of both engines. The aircraft continued to veer over towards the left side of the runway. The pilots noticed that the nosewheel steering was not having any effect.

The aircraft ran over the side of the runway and came to a complete stop in the safety zone.

The pilots observed that there was no visible or noticeable damage and reported to the control tower that the aircraft had run over the side of the runway and had remained in the safety zone.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal			
Serious			
Minor/None	4	34	

1.3 Damage to aircraft

There was no damage to the aircraft.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Statement of the commander’s flying time

	Previous 24 hours	Previous 90 days	Total
All types:	3.2 hours	152 hours	5725 hours
This class/type:	3.2 hours	152 hours	4725 hours
Number of landings (this class/type)	2 landings	189 landings	3838 landings

1.5.2 License held by the commander

The commander was in possession of a valid Airline Transport Pilot License (ATPL (A)) with appurtenant valid medical cerificate. The commander's JAR-FCL ATR 72 rating was valid until 31.1.2011.

1.5.3 The flight and duty time of the pilots (data selected by the AIB)

1.5.3.1 The commander

Period (year/month)	Duty Hrs	Block Hrs
201001	128:43	52:58
200912	126:43	46:53
200911	120:18	40:59
200910	109:59	43:00
200909	77:02	26:31
200908	94:12	27:54
200907	134:49	44:30
200906	96:19	34:36
200905	101:05	20:02
200904	103:30	40:57
200903	105:57	32:40
200902	120:26	43:51

1.5.3.2 The first officer

Period (year/month)	Duty Hrs	Block Hrs
201001	130:18	40:24
200912	108:54	46:20
200911	131:42	49:00
200910	110:17	44:27
200909	99:06	39:09
200908	70:29	31:39
200907	124:29	51:04
200906	102:13	41:42
200905	116:59	46:31

1.6 Aircraft information

1.6.1 ATC flight plan (IDLA – Individual Delay (message)/27 1648)

The AIB has removed the operator's name, the aircraft's call sign and contact data (replaced with X)

Scheduled departure – EKCH: At 14:45

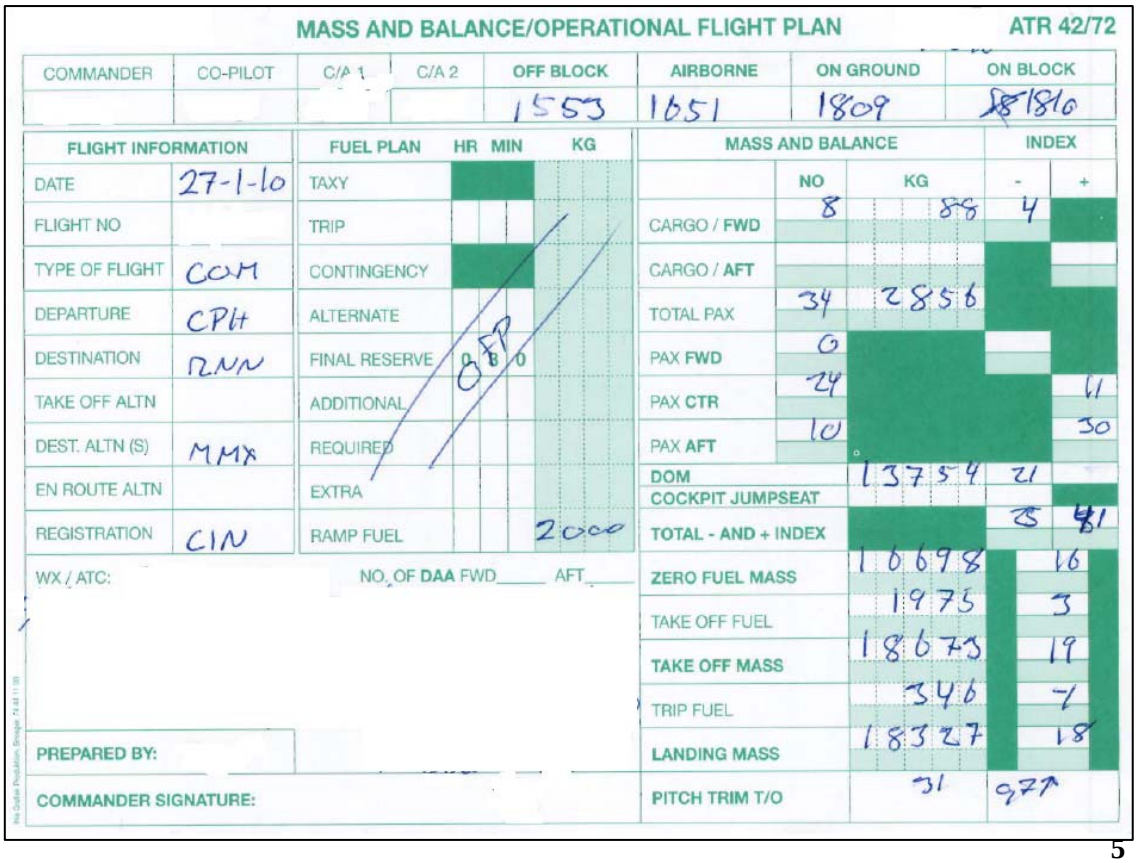
Scheduled arrival – EKRN: At 15:20

"NAV 908 271648 FF EKDKZQZE 271648 EUCHZMFP IFPLID AA75563373 EOBD 100127
IDLA CLS XXXXXX TYP AT72 /M RUL IS ADEP EKCH EOBT 1650 ADES EKRN
CEQPT SRY SEQPT S EET 0026
TAS N0283 RFL F130 ROUTE N0283F130 BALOX L983 ROE DCT
STS .....
RMK CONTACT NUMBER XXXXXXXXXX
NAV .....
ALTRNT1 ESMS
OPR XXX
ORIGIN -NETWORKTYPE AFTN -FAC XXXXXXXX
REG OYCIN
RVR 300"

1.6.2 Mass and balance

1.6.2.1 Mass and balance sheet.

The mass and balance sheet below was prepared by the pilots prior to starting at EKCH. The AIB has removed the operator's name, the aircraft's call sign and personal information.



MASS AND BALANCE/OPERATIONAL FLIGHT PLAN — ATR 42/72

COMMANDER	CO-PILOT	C/A 1	C/A 2	OFF BLOCK	AIRBORNE	ON GROUND	ON BLOCK
				1553	1651	1809	~~1818~~ 1816

FLIGHT INFORMATION		FUEL PLAN	HR	MIN	KG
DATE	27-1-16	TAXY			
FLIGHT NO		TRIP			
TYPE OF FLIGHT	COM	CONTINGENCY			
DEPARTURE	CPH	ALTERNATE			
DESTINATION	RNN	FINAL RESERVE	0	30	
TAKE OFF ALTN		ADDITIONAL			
DEST. ALTN (S)	MMX	REQUIRED			
EN ROUTE ALTN		EXTRA			
REGISTRATION	OYCIN	RAMP FUEL			2000

WX / ATC: NO. OF DAA FWD____ AFT____

PREPARED BY:

COMMANDER SIGNATURE:

MASS AND BALANCE	NO	KG	INDEX -	INDEX +
CARGO / FWD	8	88	4	
CARGO / AFT				
TOTAL PAX	34	2856		
PAX FWD	0			
PAX CTR	24			11
PAX AFT	10			30
DOM		13754	21	
COCKPIT JUMPSEAT				
TOTAL - AND + INDEX			~~35~~ 35	~~81~~ 81
ZERO FUEL MASS		16698		16
TAKE OFF FUEL		1975		3
TAKE OFF MASS		18673		19
TRIP FUEL		346		1
LANDING MASS		18327		18
PITCH TRIM T/O		31	9,7	

1.6.2.2 Centre of gravity limitations

For the flight in question, the pilots gave the centre of gravity limitations as being 14-37% MAC. The actual centre of gravity, cf. the mass and balance sheet, was calculated as being 31% MAC.

1.6.3 Operational flight plan (extract)

The AIB has removed the aircraft's call sign and personal information.

FLT/DAY	ORG /DEST	TTL NAM	ROUTE	AVG WIND /AVG.ISA TEMP
/100127	EKCH/EKRN	102	CPH-RNN-72	39 KTS TAIL -5

	E.FUEL Kg	A.FUEL	E.TIME	NM	NAM	FL
TRIP EKRN	346	... ..	0:28	120	102	130
CONT 5%	50	... ..	0:05			
ALT ESMS	324	... ..	0:25	81		80
FINAL RESERVE	300	... ..	0:30			
COMPANY FUEL	0	... ..	0:00			
TAXI	25	CORR.	+ / -			
REQUIRED	1044	... ..	1:28			
EXTRA	956	... ..	1:35 1:58			
BLOCK FUEL	2000	2000	3:03 ~~3:26~~	CAPT SIGN		

FUEL BURN ADJUSTMENT FOR 1000KGS INCREASE/DECREASE IN TO : 3

	E.M Kg	CORR.	OP. LIMIT	STRUC. REASON FOR OP.LIMIT
DOM BASIC DOI/-21	13754	... ..		
PAX(38)	3610	... ..		
EZFM	17364	... ..	OZFM	20300 /. . . . .
TOF	1975	... ..		
ETOM	19339	... ..	OTOM	22500 /. . . . .
TRIP	346	... ..		
ELAM	18994	... ..	OLAM	22350 /. . . . .

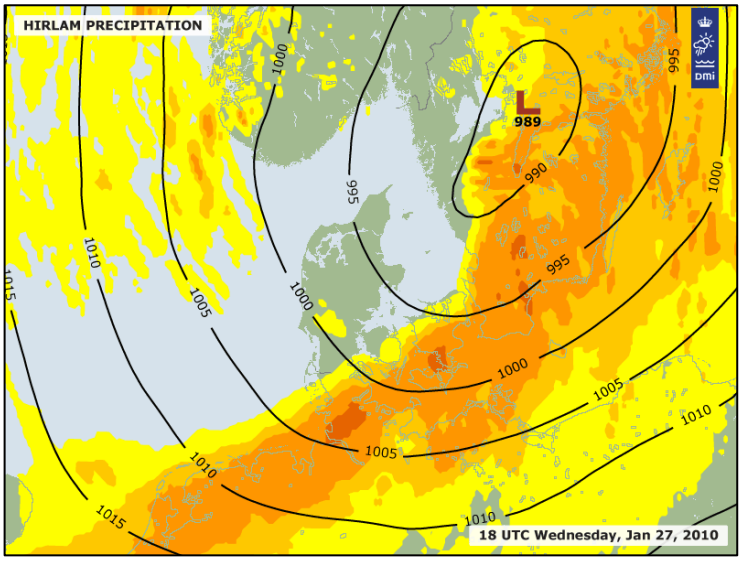
STA 15:20Z	ON BLOCK . 1810.	LDG . 1809.	
STD 14:45Z	OFF BLOCK . 1553.	T/O . 1651.	SCHED. FLT TIME 0:35
RETA. . . .	TIME . 2:17.	TIME . 1:18.	
DELAY CODE		BURN OFF	

IDENT	FREQ	AWY	MORA	TEMP	TAS	GS	MCSE	DIST	TIME	ETA/ATA	REMAINING
EKCH	17ft		FL	SR	WIND				CTIME	/	1975 AFRM
BALOX			27	-16	283	319	141	59	14	/	1779
BALOX			130	0	299/ 40				0:14	/	
ROE	112.00	DCT	27	-16	177	217	087	46	10	/	1665
RONNE			DSC	0	299/ 40				0:24	/	
EKRN	52ft	DCT	20	-16	177	217	055	15	4	/	1629
					299/ 40				0:28	/	
ESMS	236ft		27	-9	274	240	300	81	25	/	1306
			80		284/ 36				0:53	/	

1.7 Meteorological information

1.7.1 General

A cold front with extensive snow moved in from the west over Bornholm during the period. On the front (east side) of the weather front there was a strong wind coming from the south west.

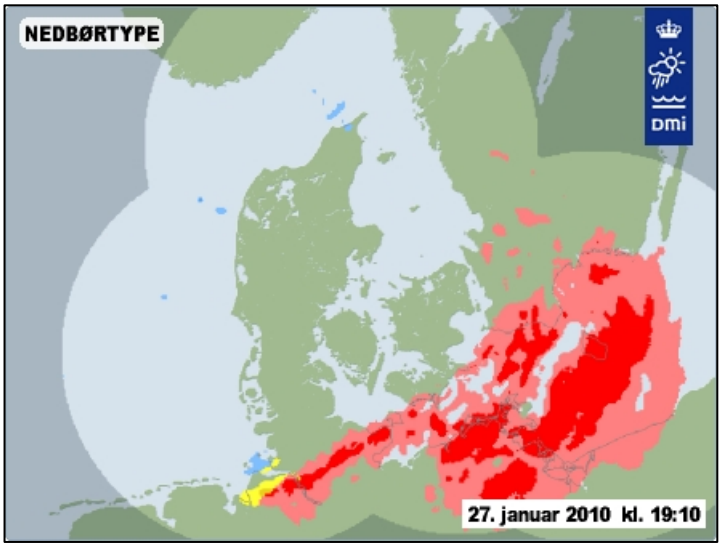


Weather

Dense snow fall and, due to the wind, drifting snow.

Radar (local time)

The picture indicates moderate snow fall at EKRN, but no CB activity. No lightning was registered.



Visibility

0200-0800 metres in snow/drifting snow.

Clouds

Dense frontal clouds, presumably with their base at around 100 feet, but, periodically vertical visibility 400-800 feet in snow fall. The top of the clouds was estimated to be at FL 180.

Icing

Light to moderate in clouds (i.e. 1000 feet to FL 100-120). Zero degrees on the surface.

Turbulence

Light to moderate mechanical turbulence below approximately 3000 feet. The low level turbulence was primarily generated by the narrow strip of land/coast between the Baltic Sea and southern Bornholm. Thus, the wind came from the water with the result that the flow was usually really laminar and not particularly turbulent. However, the wind picked up on Bornholm's southern coast over the cliffs and could easily have caused turbulence locally at EKRN during the approach to both runways 11 and 29.

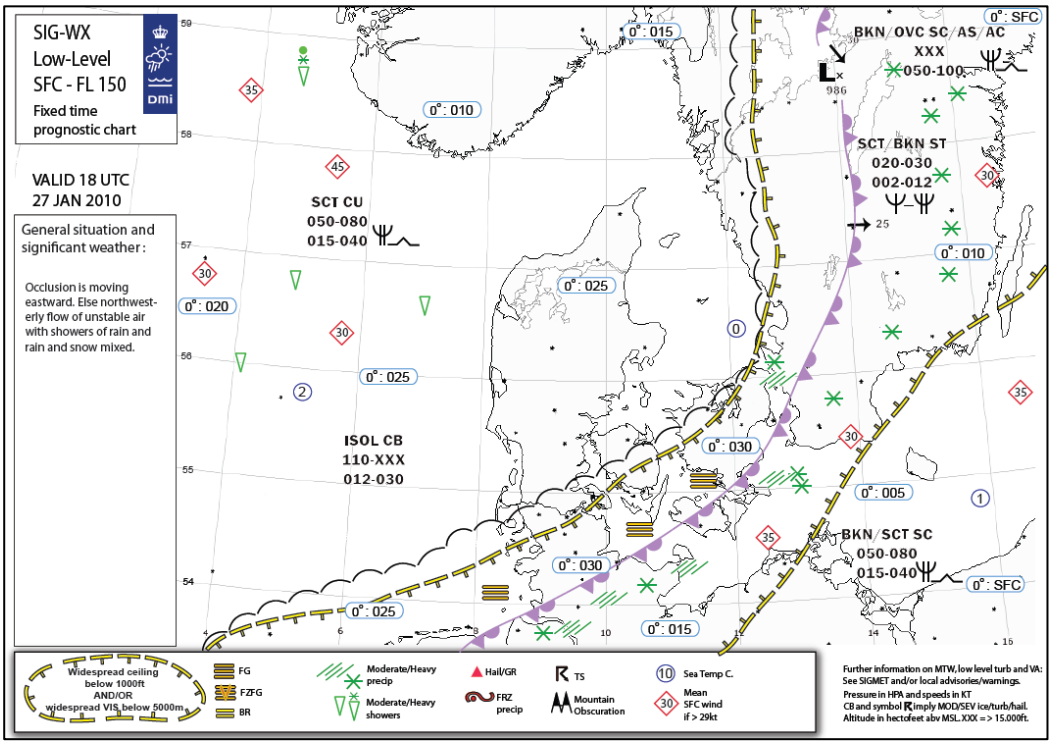
Windshear

The wind at approximately 2000 feet is estimated to be 220 degrees 45 knots. The mean wind speed measured at EKRN was 24-26 knots. Thus, there was a windshear but not of a sufficient strength that would normally cause problems. However, the periods between gusts/lulls at EKRN could have given the impression of windshear conditions.

Ground wind

210 degrees, 24-26 knots, with wind gusts up to 40 knots.

1.7.2 Significant Weather Chart



1.7.3 TAF

Text in blue indicates extracts from weather information used in flight planning, obtained by the pilots at 14:21:55.

1.7.3.1 TAF for EKRN

271100 TAF-FC
ekrn 271140z 2712/2721 24018kt 0600 -fzra bkn004 tempo 2712/2713 24018g30kt 3000 br -sn bkn010 becmg 2713/2715 22030kt 0800 sn blsn bkn006 tempo 2715/2718 22030g40kt 3000 -sn bkn015=

271400 TAF-FC
ekrn 271440z 2715/2722 24022g35kt 0600 sn blsn vv004 tempo 2715/2720 23030g40kt 3000 -fzdz br bkn010 becmg 2720/2722 1200 rasn br ovc002=

271400 TAF-FC AMD ekrn
271620z 2716/2722 24022g35kt 0500 sn blsn vv004 tempo 2716/2720 23030g40kt 3000 -fzdz br bkn010 becmg 2720/2722 1200 rasn br ovc002=

271400 TAF-FC AMD ekrn
271655z 2716/2722 24022g35kt 0200 sn blsn vv004 tempo 2716/2720 23030g40kt 3000 -fzdz br bkn010 becmg 2720/2722 1200 rasn br ovc002=

271700 TAF-FC ekrn
271740z 2718/2722 24022g35kt 0500 sn blsn vv004 tempo 2718/2720 23030g40kt 3000 -fzdz br bkn010 becmg 2720/2722 1200 rasn br ovc002=

1.7.3.2 TAF for ESMS.

271130z 2712/28/12 23015G30KT 5000 –sn bkn010 tempo 2712/2722 0800 sn vv004 prob30 2712/2718 –fzdz becmg 2721/2723 29020kt bkn015 tempo 2723/2803 bkn006=

1.7.4 METAR

Text in blue indicates extracts from weather information used in flight planning, obtained by the pilots at 14:21:55.

1.7.4.1 METAR for EKRN

271350z cor 22023kt 2100 –sn drsn bkn006 ovc012 m04/m04 q1012 11951027=

271420 METAR ekrn 271420z 22025g36kt 0900 r11/p1500n r29/1100vp1500u -sn drsn bkn007 ovc014 m04/m04 q1009 11950243=

271520 METAR ekrn 271520z 21025g35kt 0500 r11/1100n r29/0600v0900n sn drsn bkn006 bkn016 m04/m04 q1007 99950243=

271550 METAR ekrn 271550z 20025kt 0500 r11/p1500n r29/1100vp1500u sn blsn bkn006 bkn012 m04/m04 q1005 11540247=

271620 METAR ekrn 271620z 21026g39kt 0400 r11/p1500n r29/0800v1200d sn blsn bkn006 bkn012 m05/m05 q1003 99540247=

271650 METAR ekrn 271650z 21026g39kt 0300 r11/1200d r29/0700v1100n sn blsn bkn007 bkn010 m05/m05 q1002 99540247=

271720 METAR ekrn 271720z 21026g38kt 0400 r11/1000n r29/0700v1000u sn blsn vv004 m05/m05 q1001 99540247=

271750 METAR ekrn 271750z 21026g37kt 0500 r11/1300n r29/1100n sn blsn vv004 m05/m05 q0999 99540247=

271850 METAR ekrn 271850z 22024g36kt 0800 r11/p1500n r29/p1500u -sn blsn bkn004 ovc008 m04/m04 q0995 99540247=

271920 METAR ekrn 271920z 22023kt 0600 r11/p1500n r29/p1500n -sn blsn bkn004 ovc008 m03/m03 q0994 99540247=

271950 METAR ekrn 271950z 23028g40kt 0600 r11/p1500n r29/p1500u -sn blsn bkn005 ovc013 m03/m03 q0992 11//////=

1.7.4.2 METAR for ESMS

271350z 22021kt 2100 sn few005 sct007 bkn020 m04/m04 q1008 r17/450147=

1.7.5 SNOWTAM

Text in blue indicates extracts from weather information obtained by the pilots at 14:21:55 for use in flight planning.

SNOWTAM 0060

A) EKRN
B) 01270735
C) 11
F) 7/7/7
G) 02/02/02
H) 39/36/37 SFH
N) 79
R) 70
T) RWY COVERED 100 PER CENT ICE.CHEMICALS HAVE BEEN SPREAD.
TWY C AND E CLOSED DUE TO SNOW.
OTHER TWY AND APRON B/A ESTIMATED MEDIUM

SNOWTAM 0061

A) EKRN
B) 11271150
C) 11
F) 5/5/5
G) 20/20/20
H) 32/34/35 SFH
N) 5
R) 5
T) RWY COVERED 100 PER CENT SNOW.SWEEPING IN PROGRESS.
TWY C AND TWY E CLOSD DUE TO SNOW.
OTHER TWY AND APRON B/A ESTIMATED MEDIUM

SNOWTAM 0062

A) EKRN
B) 01271530
C) 11
F) 4/4/4
G) 02/02/02
H) 49/55/47 SFH
N) 4
R) 4
T) RWY COVERED 50 PERCENT DRY SNOW.
TWY C AND E CLOSED.TWY AND APRON B/A ESTIMATED POOR

1.7.6 Wind information

1.7.6.1 Wind profile data

CreationTime	2 Min Avg Dir	2 Min Avg Speed	10 Min Var Low	10 Min Var High	10 Min Gust Min	10 Min Gust Max	X-Wind	T-Wind	MX-Wind
2010-01-27 18:07:48	210	28			18	35	28		35
2010-01-27 18:07:38	210	28			18	35	28		35
2010-01-27 18:07:28	210	29			18	35	28		35
2010-01-27 18:07:18	210	28			18	35	28		35
2010-01-27 18:07:08	210	29			18	35	28		35

1.7.6.2 ATC reported wind information for OY-CIN

Time	Wind information
17:07:26	200°31 knots maximum 41 knots
17:27:50	210°30 knots maximum 38 knots
17:34:06	210°29 knots maximum 38 knots
17:35:19	210°29 knots maximum 37 knots
17:39:31	210°31 knots maximum 37 knots
17:40:38	210°33 knots maximum 40 knots
17:41:26	210°33 knots maximum 40 knots
17:42:02	210°33 knots maximum 40 knots
17:48:10	210°29 knots maximum 40 knots
17:55:53	200°29 knots maximum 37 knots
18:00:44	200°28 knots maximum 34 knots
18:04:27	210°26 knots maximum 37 knots
(When passing 1518 feet RA)	
18:05:35	210°28 knots maximum 37 knots
(When passing 951 feet RA)	
18:06:44	210°30 knots maksimum 35 knots
(When passing 255 feet RA)	

Note

The wind conditions reported by ATC were average data relating to the previous two minutes.

1.7.6.3 Calculated instanteneous crosswind during the final approach to runway 29
The instantenous crosswind is calculated at height intervals from 678 feet (digital Flight Data Recorder (DFDR)) RA to 27 feet DFDR. The prerequisites for the calculation are:

"Wind is not a recorded parameter in the DFDR.It is computed from 'TAS', 'GS', 'True Heading', 'DA', 'True QFU' and sideslip 'beta'.

TAS is not recorded but computed from 'CAS', 'SAT' and 'Baro Altitude'.
SAT is not recorded but computed from 'TAT', 'CAS' and 'Baro Altitude'.
Beta is not recorded.
DA= Track true – Heading true

The Wind vector is the difference between groundspeed and airspeed vectors.

The projection of the wind vector along the Runway axis gives the following longitudinal component:

$$We = GS \times \cos(QFU_{True} - Heading_{True} - DA) - TAS \times \cos(QFU_{true} - Heading_{true} - beta)$$

The projection of the wind vector along the axis perpendicular to the QFU axis gives the following lateral component:

$$Wt = GS \times \sin(QFU_{true} - Heading_{true} - DA) - TAS \times \sin(QFU_{true} - Heading_{true} - beta)$$

As the sideslip angle 'beta' is not recorded, we assume that there is no sideslip.Then,

$$We = GS \times \cos(QFU_{True} - Heading_{True} - DA) - TAS \times \cos(QFU_{true} - Heading_{true})$$

$$Wt = GS \times \sin(QFU_{true} - Heading_{true} - DA) - TAS \times \sin(QFU_{true} - Heading_{true})$$

Comments:

- The assumption is made that there is no sideslip. As a result, the wind calculation is not very accurate when the sideslip is no more negligible (decrabing phase or ground roll for example). However, in the air, the yaw damper system will generally keep the sideslip at zero, if active."

RH	TAS	IAS	GS	MH	TH	CW	AW
678	122	123	105	277	274	-44	-15
674	120	121	104	276	273	-44	-16
666	122	123	105	277	274	-44	-15
656	122	123	106	277	274	-43	-15
642	123	124	105	276	273	-43	-16
627	122	123	105	276	273	-44	-15
614	121	122	105	275	272	-44	-15
600	122	123	105	275	272	-45	-14
593	121	122	104	275	272	-45	-15
584	122	123	105	275	272	-45	-14
574	121	122	105	275	272	-45	-15
561	123	124	106	275	272	-45	-14
553	120	121	105	275	272	-44	-14
545	119	120	105	275	272	-44	-12
532	118	119	105	275	272	-44	-11
528	119	120	105	275	272	-44	-11
530	119	120	105	275	272	-45	-12
520	125	126	106	276	273	-44	-13
528	118	119	107	277	274	-43	-13
537	120	121	106	278	275	-40	-12
540	122	123	106	278	275	-39	-14
529	122	123	106	279	276	-38	-15
520	122	123	107	280	277	-36	-15
513	119	120	107	281	278	-34	-14
471	122	123	107	282	279	-32	-14
482	118	119	107	282	279	-32	-13
472	119	120	108	282	279	-32	-11
464	123	124	108	282	279	-33	-13
456	123	124	109	282	279	-33	-14
445	124	125	109	281	278	-34	-14
434	119	120	109	280	277	-35	-13
427	124	125	109	279	276	-37	-12
418	127	128	110	279	276	-39	-14
410	129	130	111	279	276	-40	-16
391	127	128	111	279	276	-40	-16
352	124	125	111	278	275	-39	-14
330	122	123	111	279	276	-38	-11
314	126	127	111	278	275	-38	-11

RH	TAS	IAS	GS	MH	TH	CW	AW
295	129	131	110	278	275	-39	-16
289	128	130	112	278	275	-39	-16
276	127	129	112	278	275	-39	-15
280	124	126	112	279	276	-38	-13
269	119	120	110	279	276	-37	-11
255	126	128	110	279	276	-37	-11
244	124	126	110	278	275	-37	-15
229	120	122	110	277	274	-37	-11
218	122	124	109	276	273	-38	-10
208	124	126	108	276	273	-39	-12
200	128	130	109	276	273	-40	-14
189	129	131	109	276	273	-41	-17
182	125	127	109	276	273	-41	-16
174	125	127	110	276	273	-40	-13
166	122	124	109	275	272	-40	-12
159	117	119	109	275	272	-39	-9
152	111	113	108	275	272	-39	-4
146	117	119	108	275	272	-39	-3
135	119	121	107	275	272	-40	-8
130	113	115	107	275	272	-40	-7
123	116	118	107	275	272	-39	-5
116	113	115	106	276	273	-38	-6
107	111	113	106	276	273	-37	-4
99	117	119	106	277	274	-36	-6
93	121	123	106	279	276	-35	-12
87	116	118	105	279	276	-34	-13
83	117	119	105	279	276	-32	-10
79	112	114	105	279	276	-31	-9
73	125	127	105	279	276	-31	-11
68	116	118	105	279	276	-31	-15
64	109	111	109	278	275	-30	-3
57	115	117	102	278	275	-29	-8
45	120	122	103	278	275	-31	-12
35	109	111	103	279	276	-31	-11
27	108	110	105	279	276	-30	-3

1.8 Aids to navigation

Due to work in progress on the runway, NOTAM was issued for EKRN. The work in progress on the runway meant that, for instance, the ILS for runways 11 and 29 were withdrawn. See NOTAM under 1.10.

1.9 Communications

A transcript of the voice communication for the EKRN control tower (118.325 MHz) was prepared. The voice communication was of a good quality and was used in the investigation.

1.10 Aerodrome information

1.10.1 Overview of EKRN Airport (extract from AIP Denmark)
See enclosure 8.

1.10.2 Approval of an arrester gear installation at EKRN
On 7.1.2010, Bornholm Airport submitted a request to the CAA-DK for permission to initiate establishment of an arrester gear installation. The issue of NOTAM was a sub-element of the work activities.

Below is an extract of the airport's application. The CAA-DK approved the establishment activities on 8.1.2010. The approval was conditional upon the measures to be taken by the airport, cf. letter of 7.1.2010 and BL 3-12 being complied with.

The below text is translated into English by the Danish AIB.

" *NOTAM is issued in connection with the work activity.*

Threshold RWY 11 displaced 335 m due to WIP.
Declared distance:
RWY 11 TORA TODA ASDA LDA 1590 M
RWY 29 TORA TODA ASDA LDA 1590 M
ILS RWY 11 and approach lights and PAPI RWY 11 withdrawn
ILS RWY 29 withdrawn.

Threshold RWY 29 displaced 410 m due to WIP.
Declared distance:
RWY 29 TORA TODA ASDA LDA 1665 M
RWY 11 TORA TODA ASDA 1725 M LDA 1665 M
ILS RWY 29 and approach lights and PAPI RWY 29 withdrawn
ILS RWY 11 withdrawn.

The lighting system is to be adapted so that all lighting behind the displaced threshold in question is either dimmed or interrupted, just as the ILS segment is interrupted.

The displaced threshold will consist of 2 rows with 5 high intensity threshold/runway end lights, placed in such a way that there is a gap of 22 metres between the two rows.

The lights are to be distributed evenly beyond the shoulders (3 on the runway, 2 in the grass). Further to this, red/white day markings indicating the threshold are to be placed in the grass.

White cross lines are to be established to mark the displaced threshold. A white cross is to be painted on to camouflage the existing threshold which must not be used, just as other markings are to be blurred to the extent necessary. The shortened portion of runway 29 is to be marked with a white cross. With regard to runway 11, arrow markings are to be used in accordance with Annex 14, point 5,2,4,10.

The condition of the runway will be checked according to the normal runway inspection sheet."

1.10.3 NOTAM (extract)

The NOTAM below was included as a sub-element of the pilot's flight planning.

```
B137/10 NOTAMN
Q) ESAA/QMRLT/IV/B/A/0/999/
A) EKRN B) 1001250600 C) 1002222200
E) THRESHOLD RWY 29 DISPLACED 410M DUE WIP DECLARED DISTANCE
RWY 29 TORA TODA ASDA LDA 1590M
RWY 11 TORA TODA ASDA 1650M LDA 1590M

B138/10 NOTAMN
Q) ESAA/QLAAS/IV/B/A/0/999/
A) EKRN B) 1001250600 C) 1002222200
E) APPROACH LIGHTS RWY 29 WITHDRAWN

B139/10 NOTAMN
Q) ESAA/QICAS/I/B/A/0/999/
A) EKRN B) 1001250600 C) 1002222200
E) ILS RWY 29 WITHDRAWN

B140/10 NOTAMN
Q) ESAA/QLPAS/IV/BO/A/0/999/
A) EKRN B) 1001250600 C) 1002222200
E) PAPI RWY 29 WITHDRAWN

B141/10 NOTAMN
Q) ESAA/QICAS/I/BO/A/0/999/
A) EKRN B) 1001250600 C) 1002222200
E) ILS RWY 11 WITHDRAWN

B1963/09 NOTAMN
Q) ESAA/QFAAH/IV/B/A/0/999/
A) EKRN B) 0911010001 C) 1003312359
E) CHANGE IN OPERATING HOURS FOR 091101-100331:
SUN: 0900-2145 (0800-2045)

B2630/09 NOTAMR B2118/09
Q) ESAA/QFWAS/V/M/A/0/999/
A) EKRN B) 0912292045 C) 1003311200EST
E) WDI RWY 29 OUT OF SERVICE
```

1.10.4 The operator's approach chart (VOR/DME approach to runway 29)

See enclosure 9.

1.10.5 Guidelines for the airport's winter service (EKRN)

See enclosure 10.

1.11 Flight recorders

Data from the aircraft's Digital Flight Data Recorder (DFDR) and Cockpit Voice Recorder was read out. The data was of a good quality and was used in the investigation. Extract of DFDR data, see enclosure 1 to enclosure 7.

DFDR time is given in the enclosures. On the basis of the ATC voice communication, the AIB has corrected the times indicated from DFDR time to ATC time. The DFDR touch-down time was 18:03:17. The ATC-corrected touch-down time was 18:07:18.

1.12 Place of incident

The aircraft came to a complete stop 830 metres after the displaced threshold to runway 29 and approximately 25 metres into the safety zone. See enclosure 8.

1.13 Medical and pathological information

Not relevant.

1.14 Fire

There was no fire.

1.15 Survival aspects

There were no injuries to persons.

1.16 Tests and research

The AIB has not used any special investigative methods.

1.17 Organisational and management information

1.17.1 The Operator's Operations Manual Part A (extract)

8.1.2.4.2 Two destination alternates

Two (2) destination alternates must be selected when:

(a) the appropriate weather reports or forecasts or any combination of these for the destination indicate that from 1 hour before until 1 hour after the aeroplane's ETA the weather conditions will be below the applicable planning minima; or

(b) when no meteorological information is available

All required alternates must be specified in the operational flight plan (OFP).

8.1.3.1.2 Destination Aerodrome

For selection as a destination an aerodrome must satisfy the following conditions:

(a) Meteorological reports and/or forecasts must indicate that the weather at the aerodrome will be at or above the applicable planning minima as specified in (i) & (ii) below for ± 1 hour of the aeroplane's ETA:

(i) RVR/Visibility in accordance with para 8.1.3.2; and

(ii) for a non-precision or circling approach the ceiling must be at or above MDH

Note 1: Forecasted Meteorological Visibility, converted to RVR according to table 5, shall be used in the planning phase. Any RVR values given in METAR shall be disregarded.

Note 2: Table 5 **cannot** be used when planning on a category 2/3 precision approach. The forecasted meteorological visibility must in this case be equal to or better than the RVR value required for the category 2/3 approach.

8.1.3.2.7 Runway Visual Range (Non-precision approach)

The minimum RVR for a non-precision approach depends on the MDA and on the approach lighting and runway lighting/marking available as shown in Table 4, below. For night operations at least runway edge threshold and runway end lights must be on.

Table 4 Non-Precision Approach Minimum RVR (m)

MDH	Full facilities (note 1, 5, 6, 7) CAT B+C / CAT D	Intermediate facilities (note 2, 5, 6, 7) CAT B+C / CAD	Basic facilities (note 3, 5, 6, 7) CAT B+C / CATD	Nil Approach Light facilities (note 4, 5, 6, 7) CAT B+C / CATD
250 ft – 299 ft	800m / 1200m	1100m / 1400m	1300m / 1600m	1500m / 1800m
300 ft – 449 ft	1000m / 1400m	1300m / 1600m	1400m / 1800m	1500m / 2000m
450 ft – 649 ft	1200m / 1600m	1500m / 1800m	1500m / 2000m	1500m / 2000m
650 ft and above	1400m / 1800m	1500m / 2000m	1500m / 2000m	1500m / 2000m

Notes:

1: Full facilities comprise runway markings, 720 meters or more of high or medium intensity (HI/MI) approach lights, runway edge lights, threshold and end lights. Lights must be on.

2: Intermediate facilities comprise runway markings, 420–719 meters of HI/MI approach lights, runway edge, threshold and end lights. Lights must be on.

3: Basic facilities comprise runway markings, <420 meters of HI/MI approach lights, runway edge, threshold and end lights. Lights must be on.

4: Nil approach light facilities comprise runway markings, runway edge, threshold and end lights or no lights at all.

5: The Table is only applicable to conventional approaches with a slope not exceeding 4°. Steeper approach angles will normally require that the visual approach slope guidance (e.g. PAPIs) is visible from the MDH.

6: The RVR values in the above Table are either reported RVR, or met visibilities converted to RVR as in Table 5 below.

7: The MDH mentioned in Table 4 refers to the initial calculation of MDH. When selecting the associated RVR there is no need to take account of a rounding up to the nearest ten feet, which may be done for operational purposes, e.g. conversion to MDA.

Table 5 Converting Reported Met Visibility to RVR

	RVR = Meteorological visibility x	
Lighting elements in operation	**DAY**	**NIGHT**
HI approach and runway lighting	1,5	2
Any type of lighting installation other than above	1	1,5
No lighting	1	N/A

Notes:

1: Table 5 may **not** be used for calculating **take-off minima** or **Category 2/3 minima**.

2: Table 5 may **not** be used when a **reported RVR** is available.

8.1.3.2.16 Commencement and Continuation of an Approach

An approach may be started irrespective of the RVR/visibility, but it may not be continued past the outer marker or equivalent position unless the reported **controlling RVR/visibility** (Note 1) is equal to or better than the applicable minima. If, after passing outer marker or equivalent position, the reported RVR / visibility falls below the applicable minima, the approach may be continued to DH/MDH. The approach may be continued below DH/MDH and the landing may be completed provided that the required visual reference has been established at the DH/MDH, and is maintained.

Where no outer marker or equivalent position exists the pilot in command must make the decision to continue or abandon the approach before descending below 1000 feet above the aerodrome on the final approach segment. If the MDH is at or above 1000 feet, shall establish a height to be used.

Note 1: The touch-down RVR is always controlling.

1.17.2 The Operator's Standard Operating Procedures (SOP) (extract)

6.7 Wind correction.

Wind correction is applied to Vapp (VmHB30) with:

- 1/3 of the headwind component or if in gusty wind by applying the gust in full.

The maximum correction is 15 kts.

6.15. Normal landing.

Standard landing technique to get a normal landing distance is based on:

- Maintaining flight path (approx. 3 Deg.) and speed Vapp until 20 feet;
- Maintain Yaw Damper engagement. Disengagement will take place when applying rudder for directional control during flare, or upon Main-wheel touchdown;
- At 20 feet, reduce to Flight Idle and flare visually as required;

When Main Landing Gear is on the ground:

- Control Nose Wheel impact;
- PNF shall check Idle Gate automatic extension. If Idle Gate fails to extend, PNF shall pull the Gate for extension.
- When Nose Wheel is on the ground - select power levers to GROUND IDLE.
- Brake as required.
- Reverse as required as soon as both LO PITCH lights are checked illuminated.

Crew Coordination Normal Landing		
Condition	**PF**	**PNF**
20 ft	Reduce to Flight Idle Flare visually as required	If no "auto RA call out" at 200' RA **"20 feet"**
LO PITCH illumination on both engines	Reverse as required	**"2 Low pitch"** If only one Lo pitch light **"No reverse"**
IAS < 70 kts.	**CM1: "Your top"** (If CM2 was PF during landing) **CM1: "My controls - your top"** Take over lateral control by the use of Nose-wheel Steering. Note. The term "Top" refers to the Control Column, which CM2 will hold, whilst the Commander has control of the aircraft.	Hold Control Column into the wind as required **CM2: "My top"** Hold Control Column into the wind as required **CM2: "Your controls-my top"** Note: It is always the commander's decision to hand over/take the controls during the take off or landing roll. In the absence of a "My controls" command from the commander the FO will retain control. The FO never hands over controls on own initiative, unless there is control difficulties.
At taxi speed	**CM1: "After Landing Checklist"**	Perform after landing checklist **CM2: "After Landing Checklist completed"**

Note:

- Max. Reverse is usable down to a full stop but this is uncomfortable and should be used only when required for safety reasons. Flight control shaking will occur. Below 40 Kts ease the power levers up to ground idle.

- Max. Braking is usable to a full stop regardless of runway condition, provided Anti-skid is operative.

6.16.1. Crosswind Landing Technique

- Fly with the Vapp+ Wind Correction to 20 ft. using crab angle;
- When "20 feet" is called, gradually reduce crab-angle with rudder and bank towards the wind keeping direction;
- Land straight and maintain direction using the rudder;
- As the speed drops the ailerons should be deflected fully into the wind;

During Final Approach keep the feet in a top-position on the Rudder Pedals. This is done to be able to apply full braking without being forced of relocate the feet prior such an action. This is essential; otherwise control of the aircraft might be lost.

1.17.3 The operator's Pilot Information Folder (PIF) (extract)
" Contaminated runway

A runway is considered contaminated when more than 25% of the runway surface area (whether in isolated area or not) within the required length and width is covered by the following:

Surface water more than 3 mm deep, or by slush, or loose snow, equivalent to 3 mm of water. When converting millimetres of loose snow to millimetres of water/slush, the factor 0.8 shall be used (Ref.ATR FCOM)

Snow, which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (Compact snow).

Ice, including wet ice.

Runway conversion table

EQUIVALENT RUNWAYS STATUS (to be used when entering QRH 4.65)		EQUIVALENT RUNWAY STATUS	
BRAKING ACTION	**FRICTION COEFFICIENT**	**TAKE-OFF**	**LANDING**
GOOD	0,40 and above	Dry runway	Dry runway
GOOD/MEDIUM	0,39 to 0,36	Wet up to 3 mm depth	Wet up to 3 mm depth
MEDIUM	0,35 to 0,30	Slush or water for depths between 3 and 6 mm / Compact snow	Slush or water for depths between 3 and 13 mm / Compact snow
MEDIUM/POOR	0,29 to 0,26	Slush or water for depths between 6 and 13 mm	Slush or water for depths between 3 and 13 mm
POOR	0,25 and below	Ice	Ice
UNRELIABLE	UNRELIABLE	Runway with high risk of hydroplaning	Runway with high risk of hydroplaning

Wind limitation for landing

ATR	MAX (demonstrated) CROSSWIND		MAX TAILWIND (actual)	
	Rwy DRY	Rwy WET	Rwy Dry or Wet	Other runway conditions
72	35	30	10	Not Permitted
42	38	30	15	Not Permitted

Note 1: When friction coefficient is below 30, the maximum crosswind is ”friction coefficient minus 10".
Note 2: The lowest of the friction coefficient given shall be used for maximum crosswind determination.If take-off can be performed within the first 2/3 of the runway, then the last third of the runway may be considered closed and the friction coefficient given for that part may be disregarded.

The operator has advised the AIB that wind gusts are not included when determining cross wind limitations.

1.17.4 ATR 72 Flight Crew Operating Manual (FCOM (extract))

ATR72 F.C.O.M.	LIMITATIONS	2.01.03		
		P 5	050	
	AIRSPEED AND OPERATIONAL PARAMETERS			SEP 07

AA

TAKE-OFF AND LANDING

TAIL WIND LIMIT : 10 KT

The maximum demonstrated cross wind on dry runway is 35 kt

ATR72 F.C.O.M.	PROCEDURES AND TECHNIQUES	2.02.08		
		P 21	001	
	ADVERSE WEATHER			JUL 98

OPERATIONS IN WIND CONDITIONS

Landing

The recommended landing flap configuration is the same as the standard landing flap setting, even with strong crosswind. Large flaps extension does not impair the controllability in any manner. Moreover it minimizes the flare duration and allows a quicker speed decrease down to the taxi speed.

LANDING

In order to minimize landing distance variations the following procedure is recommended :

- Maintain standard final approach slope (3°) and final VAPP until 20 ft is called on radioaltimeter.

- At« 20ft » call by PNF, reduce to FI and flare visually as required.

  Note : 20 ft leaves ample time for flare control from a standard 3° final slope.

  - During this flare the airspeed will necessary decrease, leading to a touch down speed of 5 to 10 kt lower than the stabilized approach speed.

- As soon as main landing gear is on ground.

  - Control nose wheel impact
R - Both PL : GI
R - Both LO PITCH lights : check illuminated.

R **CAUTION** : If a thrust dissymetry occurs or if one LO PITCH light is not
R illuminated, the use of any reverser is not allowed.
R In this case the propeller pitch change mechanism is probably locked
R at a positive blade angle, leading to a positive thrust for any PL
R position.
R Applying any reverser would result in an increased positive thrust and
R therefore in a difficulty to control lateral asymmetry.

  - use foot brakes as required
  - as speed reduces, and not later than about 40 kt (estimated) Capt takes NWS control, co-pilot hold control column fully forward.

Notes :
1. *Max reverse is usable down to full stop if required, but to minimize flight control shaking due to reverse operation at high powers, it is helpful to release slowly PL back to GI when reaching low ground speeds (below 40 kt estimated).*

2. *Max braking is usable without restriction down to full stop, whatever the runway conditions may be, provided ANTISKID is operative.*

3. *The tail bumper (with damping capabilities) effectively protect the tail in case of excessive attitude (resulting from prolonged/floating flares) provided the rate of sink at touchdown does not exceed 5 ft/sec.*

R 4. *In case of a significant bound, a go around should be considered.*

1.17.5 Aircraft Flight Manual (AFM) (extract)

6 . 01 . 04 - CROSS WIND

The maximum crosswind demonstrated is :
- Take-off : 35kt
- Landing configuration :

Braking Action	TO	LDG	Maximum Crosswind
GOOD	1	1	35 kt
GOOD/MEDIUM	2	2	28 kt
MEDIUM	3 / 6	6	22 kt
MEDIUM/POOR	4	5	16 kt
POOR	7	7	10 kt

Runway status: 1: dry runway, 2:wet up to 3mm depth, 3 (TO only): slush or water from 3 to 6mm depth, 4 (TO only):slush or water from 6 to 12.7mm depth, 5: slush or water from 3 to 12.7mm depth, 6: compact snow, 7: ice

1.18 Additional information
None.

1.19 Useful or effective investigation techniques
None.

2. Analysis
2.1 General
The pilots' licenses, the flight and duty time of the pilots, the technical status of the aircraft and the aircraft mass and balance had, in AIB's opinion, no influence on the sequence of events.

2.2. Flight planning
The pilots planned the flight from EKCH to EKRN with one destination alternate (ESMS). By comparing selected subsidiary information (EKRN) used in connection with the pilots' flight planning and the operator's flight documentation, it is AIB's opinion that weather and runway conditions at the expected time of arrival and in respect of planning necessitated the use of two destination alternates.

- ekrn 271140z 2712/2721 24018kt 0600 -fzra bkn004 tempo 2712/2713 24018g30kt 3000 br -sn bkn010 becmg 2713/2715 22030kt 0800 sn blsn bkn006 tempo 2715/2718 22030g40kt 3000 -sn bkn015=
- ekrn 271350z cor 22023kt 2100 –sn drsn bkn006 ovc012 m04/m04 q1012 11951027=

- SNOWTAM 0060

  D) EKRN
  E) 01270735
  F) 11
  F) 7/7/7
  G) 02/02/02
  H) 39/36/37 SFH
  N) 79
  R) 70
  T) RWY COVERED 100 PER CENT ICE.CHEMICALS HAVE BEEN SPREAD.
  TWY C AND E CLOSED DUE TO SNOW.
  OTHER TWY AND APRON B/A ESTIMATED MEDIUM

- NOTAM (extract)
  E APPROACH LIGHTS RWY 29 WITHDRAWN

Converted (factor 1.5) meteorological visibility (TAF at 11:40) at 800 metres at the expected time of arrival gave, with regard to planning, a RVR value of 1200 metres. The minimum RVR for a non-precision approach (VOR/DME runway 29) without approach lights facilities and with a minimum descent height (MDH) of 419 feet was, cf. the operator's Operations Manual Part A, 1500 metres.
The operator's approach chart for a VOR/DME approach to runway 29 indicated a minimum RVR value of 1000 metres. The approach chart did not give any information to the pilots regarding increased minima in the event of changed approach lighting conditions. This could have had a bearing on the pilots' decision-making process when planning the flight.

The braking action coefficient (0.27) given in METAR at 1350z compared with the mean wind speed (220° 30 knots) at the expected time of arrival limited the crosswind component to 17 knots, cf. the operator's PIF, which in AIB's view could have supported the use of two destination alternates in the flight planning.

The AIB thinks that the flight planning, including fuel calculations, had no influence on this incident. However, weather and runway conditions were atypical compared to a standard flying operation.

2.3 Approach to EKRN

During the aircraft's final approach to runway 29, the aircraft was fully stabilized (stabilized approach).

There was incongruence between, on the one hand, NOTAM issued and CAA-DK's approval of the arrester gear installation at EKRN and, on the other hand, the actual use of non-standard approach and runway lighting. The use of non-standard approach and runway lighting at EKRN, in AIB's opinion,

supported the pilots' decision to use a runway visual range for a VOR/DME approach to runway 29 of 1000 metres as shown in the operator's approach chart.

The pilots subsequently reported to the control tower that the aircraft had a crosswind limitation of 30 knots maximum. Viewed in relation to the reported runway conditions (The braking action coefficients on runway 29 were, at approximately 17:02, measured to be 48, 51 and 53. 50% of runway 29 was covered by two mm of dry snow), the crosswind limitation of 30 knots given by the pilots was more restrictive than that indicated in the operator's flight documentation (35 knots).

The operator's flight documentation stated that wind gusts should not be included when determining crosswind limitations. During the second final approach to runway 29, the ATC reported crosswind component (210° 30 knots maximum 35 knots) was within the crosswind limitation of 30 knots reported by the pilots. The theoretical calculations for instanteneous crosswinds applying to the final approach showed that crosswind conditions were marginal (from 99 feet RA to 27 feet RA – an average of 33 knots) but the crosswind components were within the aircraft's certified limitation of 35 knots.

2.4 Landing at EKRN

With regard to the indications of time given below, the AIB has decided to give the DFDR times as a reference. See enclosure 2 for general corrections to ATC time.

18:03:13	PF started to reduce the crab angle (correction for crosswind). The magnetic heading increased from 276° to 285°.
18:03:17	Touch-down of the main landing gear. The aircraft banked 3° to the right. The aircraft touched down to the left of the centre line. The magnetic track was 290° and decreasing slightly whilst the magnetic heading increased. The nose of the aircraft moved to the right.
18:03:18	The main landing gear was no longer compressed. PF began to apply rudder input towards the left. Full rudder deflection to the left was reached approximately two seconds later.
18:03:19	The magnetic heading was rapidly decreasing. The nose and main landing gear sensors recorded that the aircraft was on the ground. The aircraft's IAS was 90 knots.
18:03:20	A full rudder deflection to the right was recorded. The magnetic heading increased. PF applied left aileron and pushed the control column forward.

18:03:21	PF began to apply reverse on the engines. The magnetic heading continued to increase.
18:03:24	A full rudder deflection to the left was recorded. The magnetic heading started to decrease.
18:03:26-18:03:30	The magnetic heading rapidly decreased from 295° to 275° with full rudder deflection to the right. The aircraft's IAS was below 50 knots.
18:03:30	PF applied brakes, full rudder deflection to the right and the control column (aileron and elevator position) upwards towards the wind. The aircraft's IAS was 30 knots. The magnetic heading continued to decrease.
18:03:31	The aircraft ran over the side of the landing runway.

The attitude of the aircraft, the airspeed and the load factors were normal at the time of touch-down. The landing technique at touch-down was in accordance with the operator and the manufacturer's procedures. The pilots applied reverse on both engines after touchdown. No asymmetry of reverse power was recorded

In AIB's opinion, a combination of several conditions had influence on the sequence of events:

a) During the landing roll, the external visual references were limited because it was dark and snow drifting. The snow drift from the south to the north may have led to an optical illusion that the aircraft drifted to the north at first touch-down. In addition to the marginal crosswind conditions leading to a significant increase in the magnetic heading , intensified by a 3° bank to the right, an optical illusion may have led to the first full rudder deflection to the left during the first touch-down.

b) The subsequent full rudder deflections during the landing roll might, in AIB's opinion, be seen as pilot reactions to the combination of lateral accelerations and heading augmentation during marginal crosswind conditions.

c) The speed during the landing roll was decreasing gradually leading to a decrease of rudder effectiveness which, in marginal crosswind conditions, made it all the more difficult for the pilots to re-establish directional control.

d) As a result of the marginal crosswind conditions, during the last part of the landing roll, it is likely that the aircraft was exposed to the weathercock effect, which intensified the aircraft's trajectory over the side of the landing runway.

It has not been possible for the AIB to reconstruct the exact runway contamination figures. However, it is AIB's general view that the braking action coefficients are, in general, a guideline only and that there could be considerable differences between the measured and the actual braking action coefficients.

e) At the time, this incident occurred; the reported braking action coefficients figures were just over an hour old. During a snowstorm, the AIB considers it appropriate that both pilots and airports request increased frequency of runway inspections in order to optimise the decision-making processes of all concerned.

The AIB finds it likely that the contamination of the landing runway during the aircraft's landing roll could have had a bearing on the effectiveness of the aircraft's wheel brakes and nose wheel steering.

3. Conclusion

3.1 Findings

- The pilots were properly licensed.
- The pilots' flight and duty time had no influence on the sequence of events.
- The weather and runway conditions at the expected time of arrival and in respect of planning necessitated the use of two destination alternates.
- The approach chart did not give any information to the pilots regarding increased minima in the event of changed approach lighting conditions
- The aircraft's technical status, including mass and balance had no influence on the sequence of events.
- The pilots' flight planning, including fuel calculations had no influence on the sequence of events.
- The pilots' reported crosswind limitation for the aircraft during the prevailing weather conditions was 30 knots.
- The operator's stated crosswind limitation for the aircraft during the prevailing weather conditions was 35 knots.
- The reported braking action coefficient figures at the time of the incident were just over an hour old.
- The operator's flight documentation stated that wind gusts should not be included when determining crosswind limitations.
- The crosswind component reported by ATC during the second approach was within the crosswind limitation determined by the pilots.
- The theoretical crosswind calculations showed that the crosswind conditions were marginal but that, however, were within the aircraft's certified limitations.
- During the final approach to runway 29, the aircraft was fully stabilized (stabilized approach).

- There was incongruence between, on the one hand, NOTAM issued and CAA-DK's approval of an arrester gear installation at EKRN and, on the other hand, the actual use of non-standard approach and runway lighting.
- The use of non-standard approach and runway lighting at EKRN, in AIB's opinion, supported the pilots' decision to use a runway visual range for a VOR/DME approach to runway 29 of 1000 metres as shown in the operator's approach chart.
- The attitude of the aircraft, the airspeed and the load factors were normal at the time of touchdown.
- The pilot landing technique at touchdown was in accordance with the operator's procedures.
- No asymmetry of reverse power was recorded.
- During the landing roll, the external visual references were limited because it was dark and snow drifting.
- Full rudder deflections during the landing roll may, in AIBs opinion, be seen as pilot reactions to the combination of lateral accelerations and heading augmentation during marginal crosswind conditions.
- The speed during the landing roll was decreasing gradually leading to a decrease of rudder effectiveness, which, in marginal crosswind conditions, made it all the more difficult for the pilots to re-establish directional control.
- As a result of the marginal crosswind conditions, during the last part of the landing roll, it is likely that the aircraft was exposed to the weathercock effect, which intensified the aircraft's trajectory over the side of the landing runway.
- The contamination of the landing runway during the aircraft's landing roll could have had a bearing on the effectiveness of the aircraft's wheel brakes and nose wheel steering.
- Landing under marginal crosswind conditions in combination with possible runway contamination resulted in the aircraft running off the side of the runway (runway excursion).

3.2 Factors

- Landing under marginal crosswind conditions in combination with possible runway contamination resulted in the aircraft running off the side of the runway (runway excursion).

3.3 Summary

Landing under marginal cross wind conditions in combination with possible runway contamination resulted in the aircraft running off the side of the runway (runway excursion).

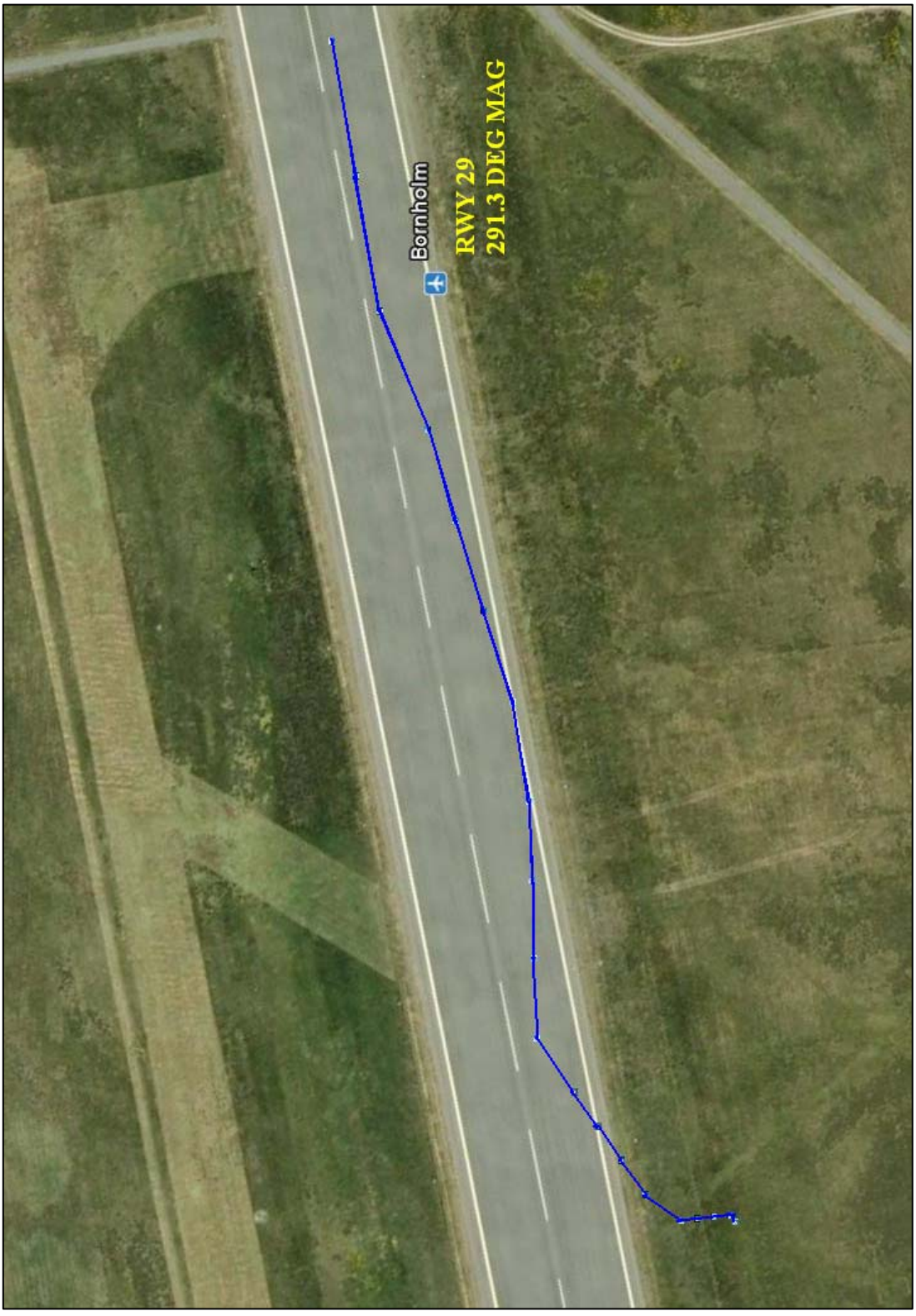
4. Recommendations

The investigation has not resulted in any recommendations being made.

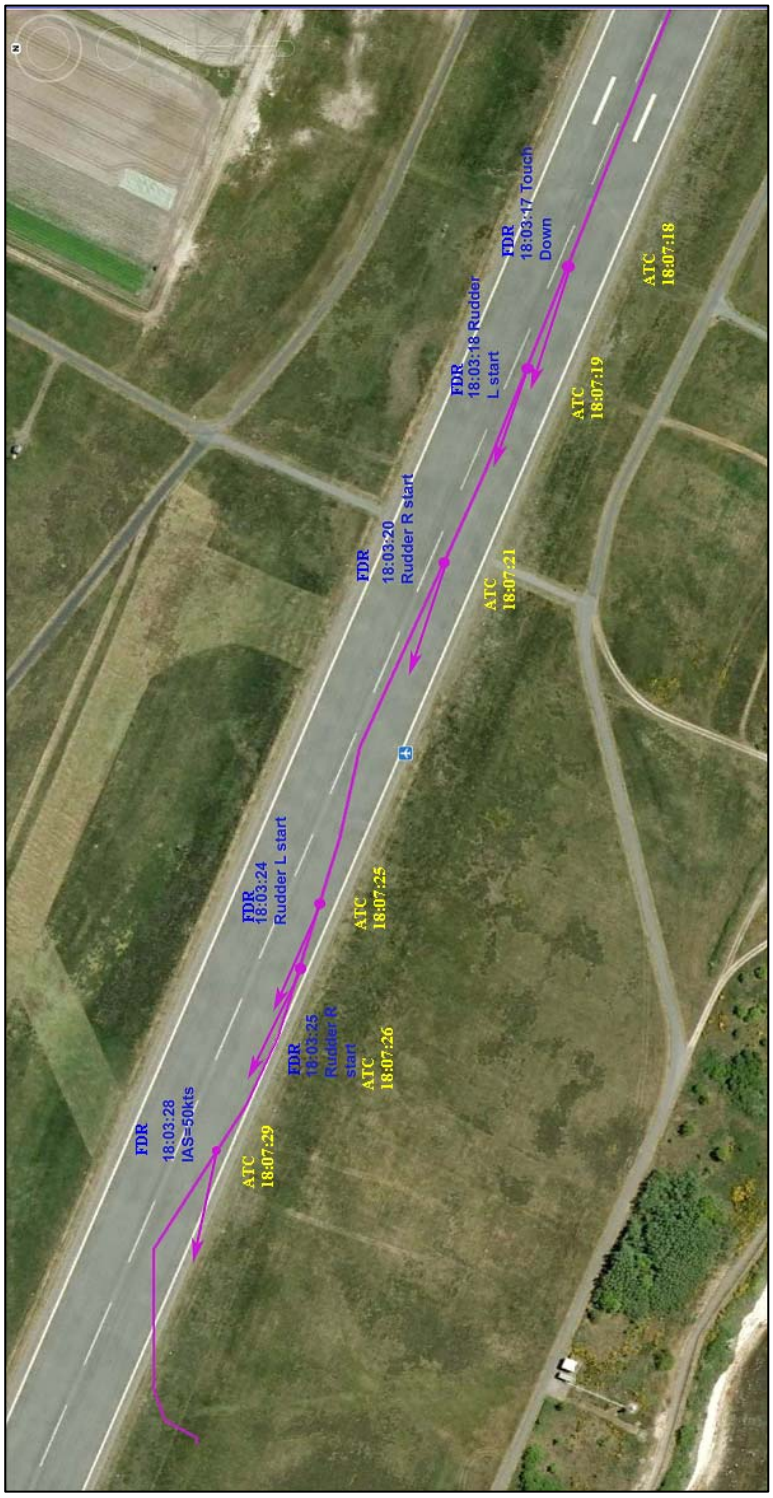
5. Enclosures

1. Landing roll (overview picture)
2. Landing roll (DFDR/ATC time)
3. DFDR readout
4. DFDR readout
5. DFDR readout
6. DFDR readout
7. DFDR readout
8. EKRN overview picture (extract of AIP Denmark)
9. The operator's approach chart (VOR/DME RWY 29)
10. EKRN's Guidelines for winter service

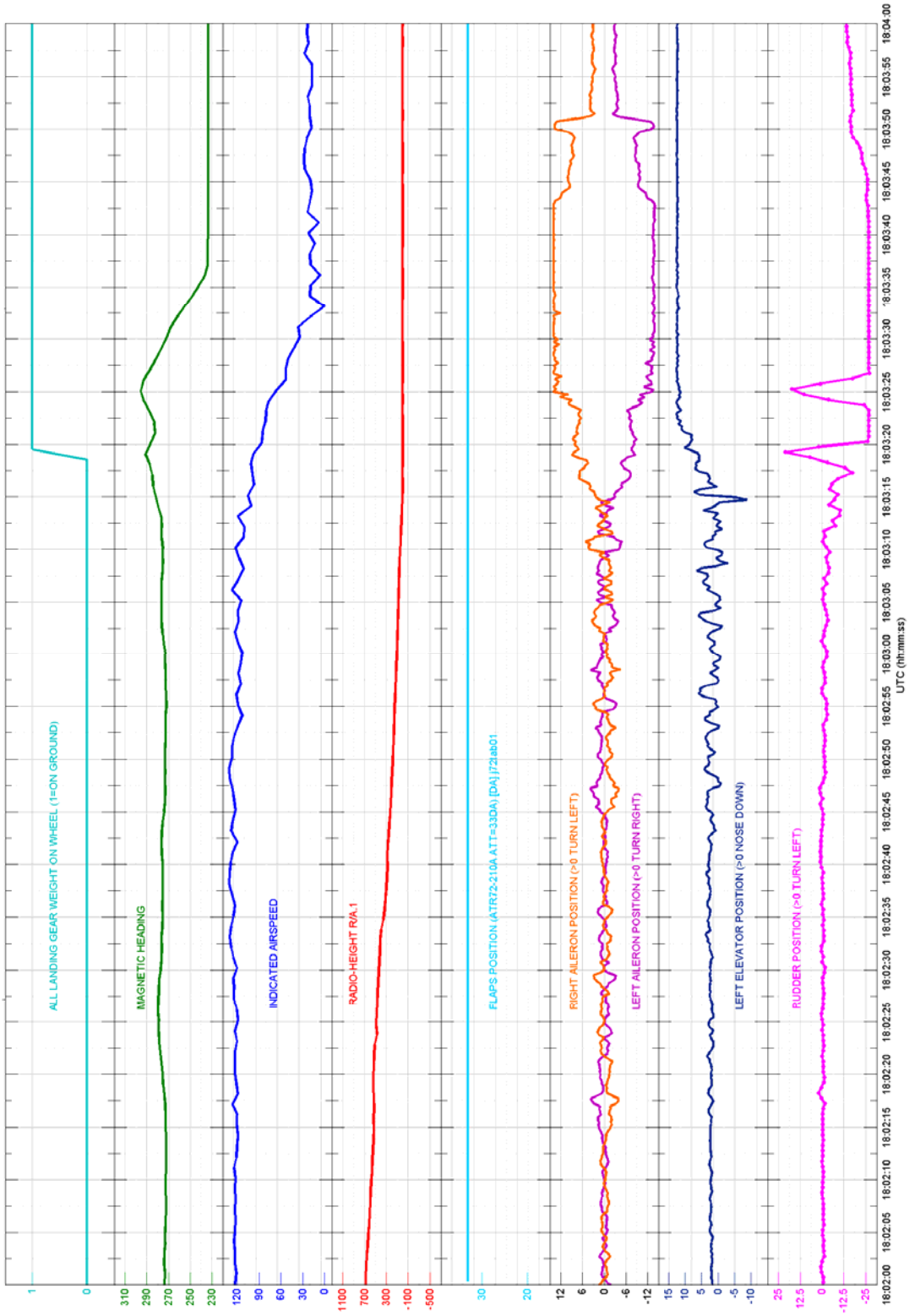
Enclosure 1 - Landing roll (overview picture)



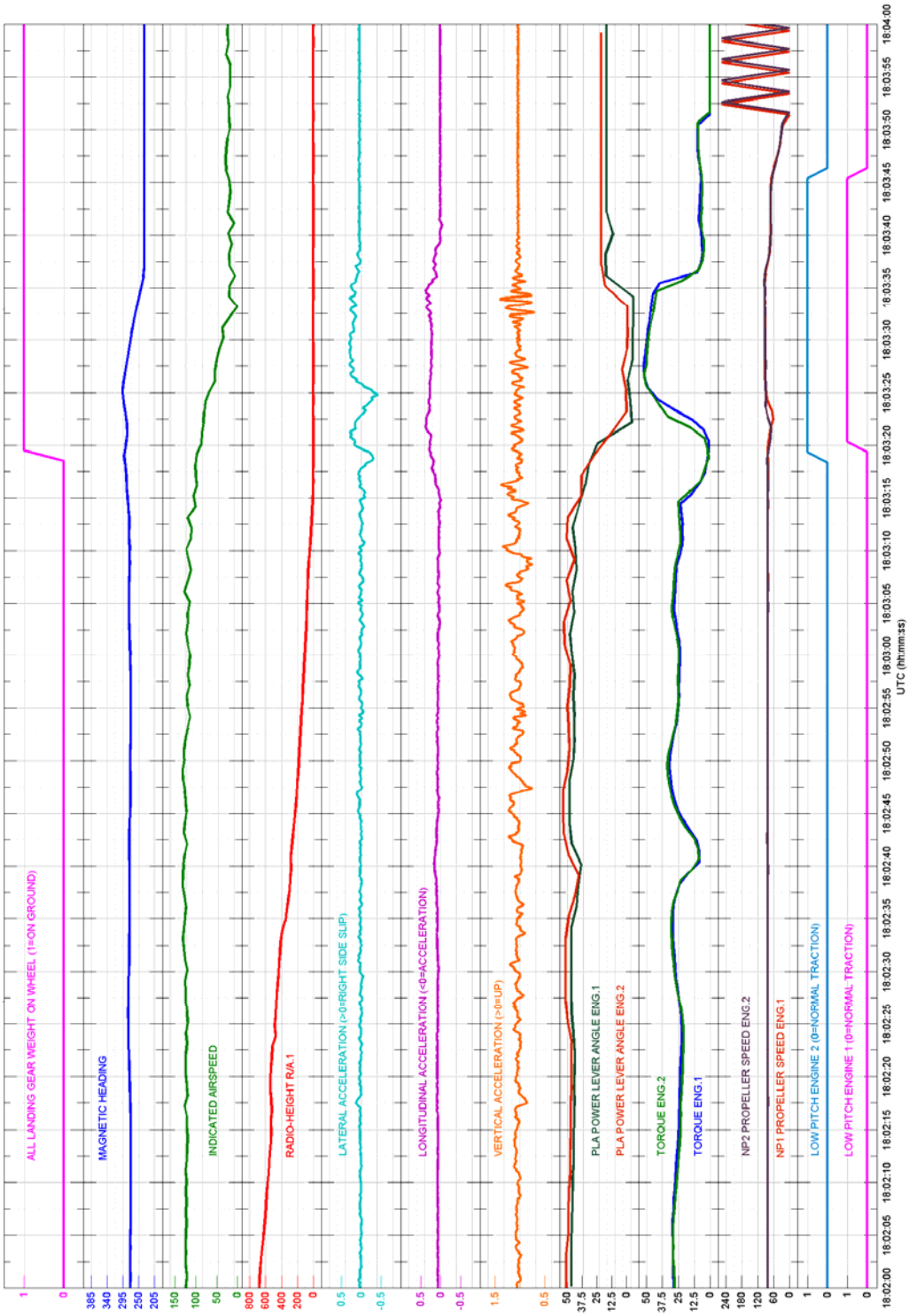
Enclosure 2 - Landing roll (DFDR/ATC time)



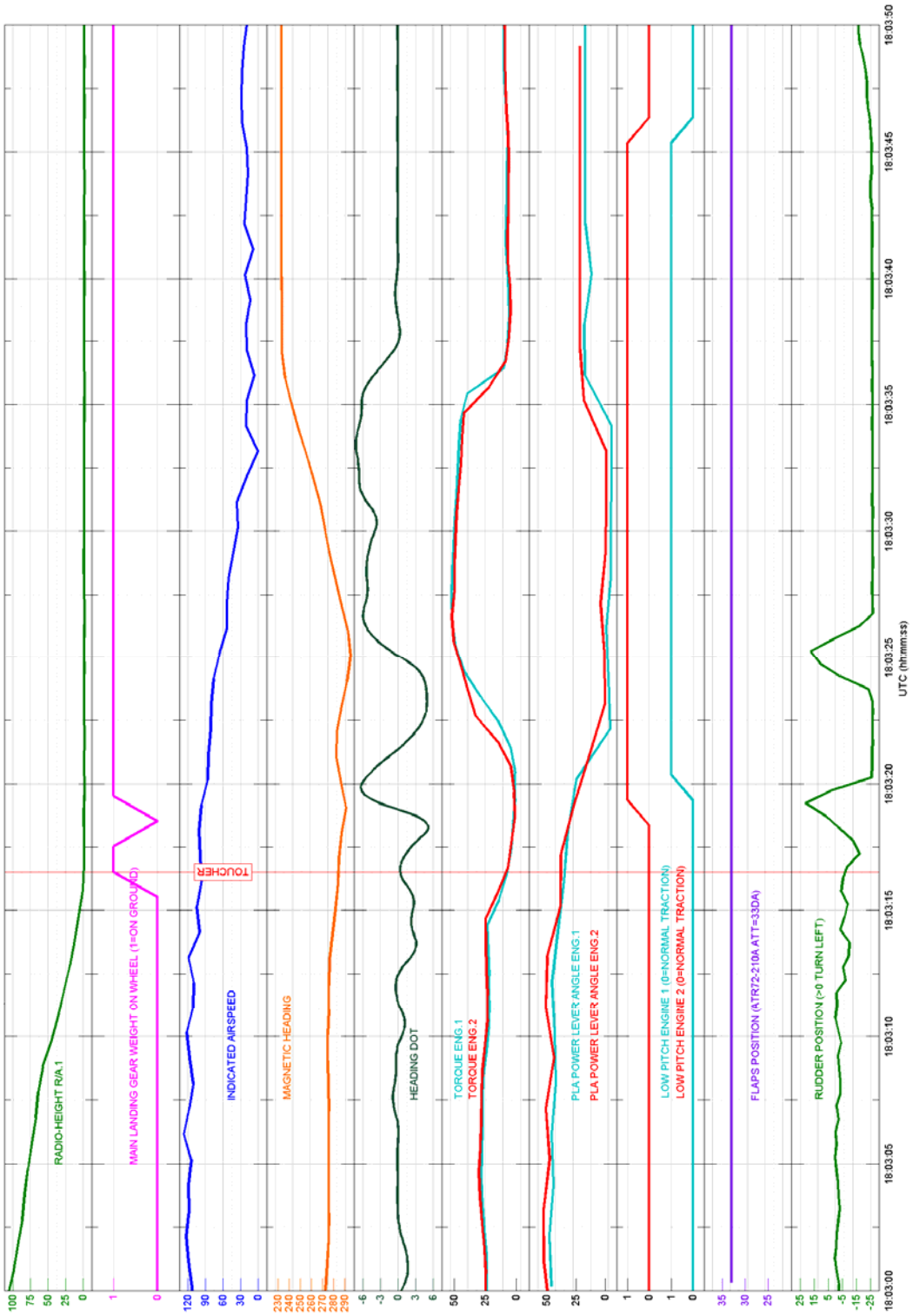
Enclosure 3 - DFDR read out



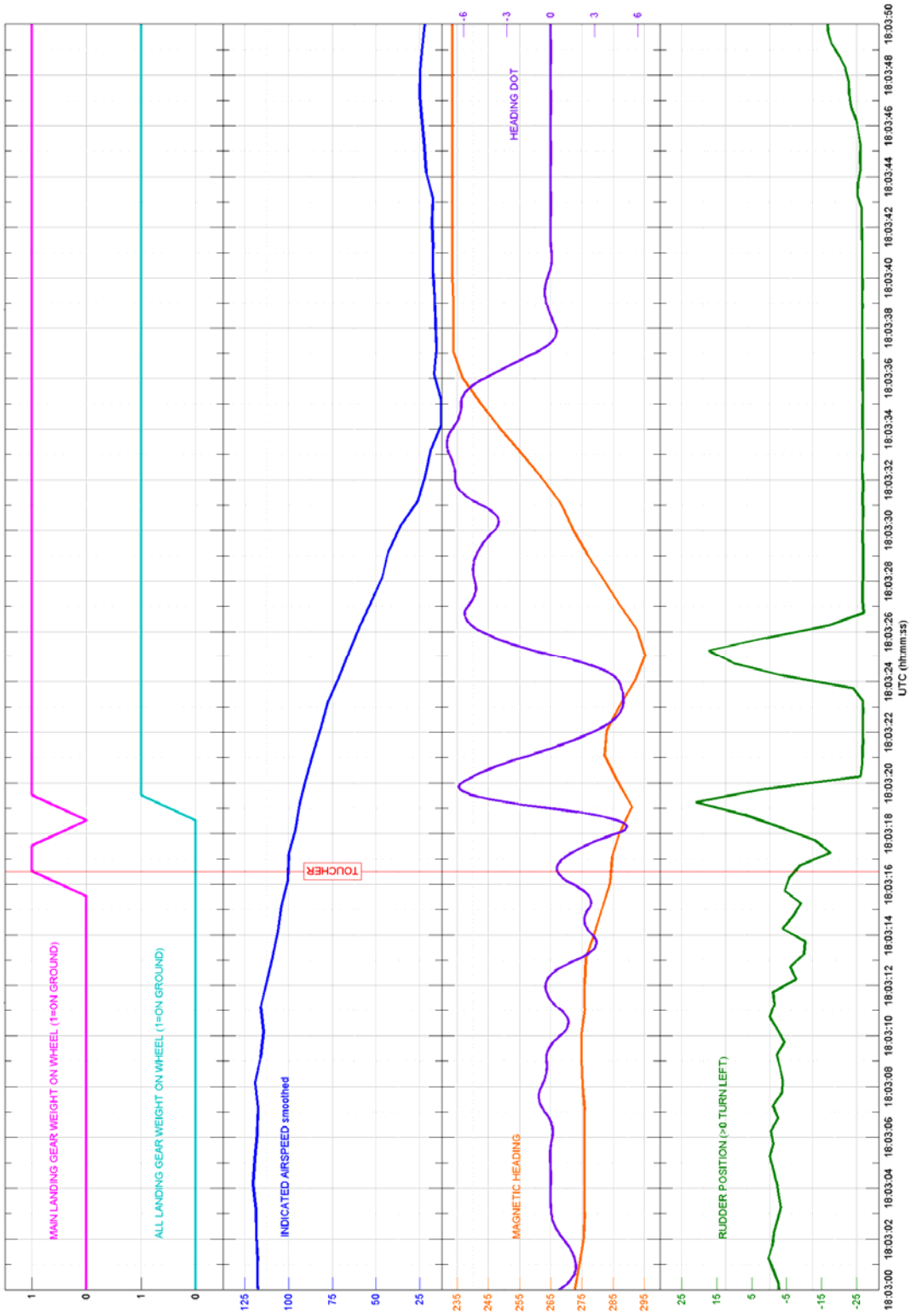
Enclosure 4 - DFDR readout



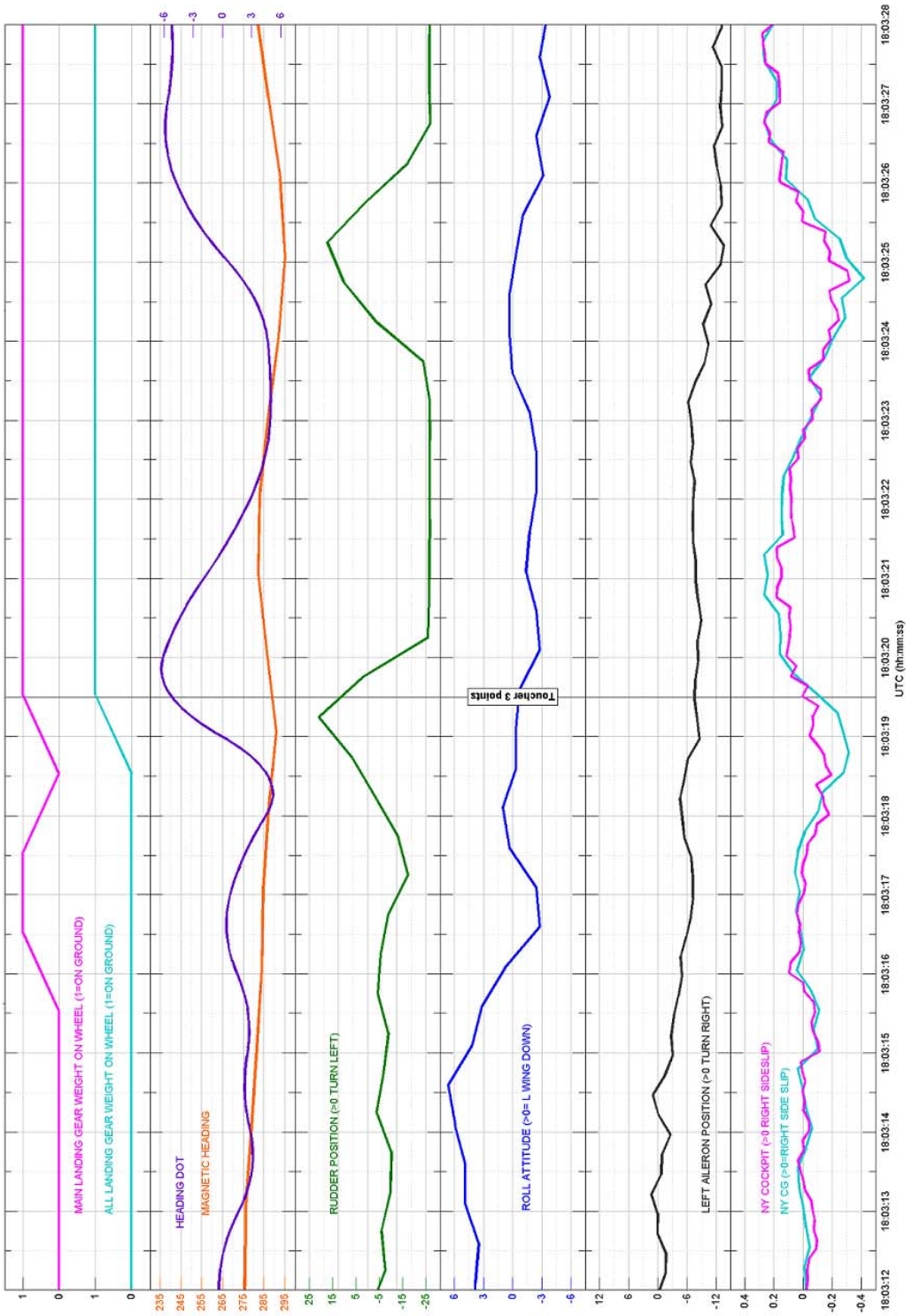
Enclosure 5 - DFDR readout



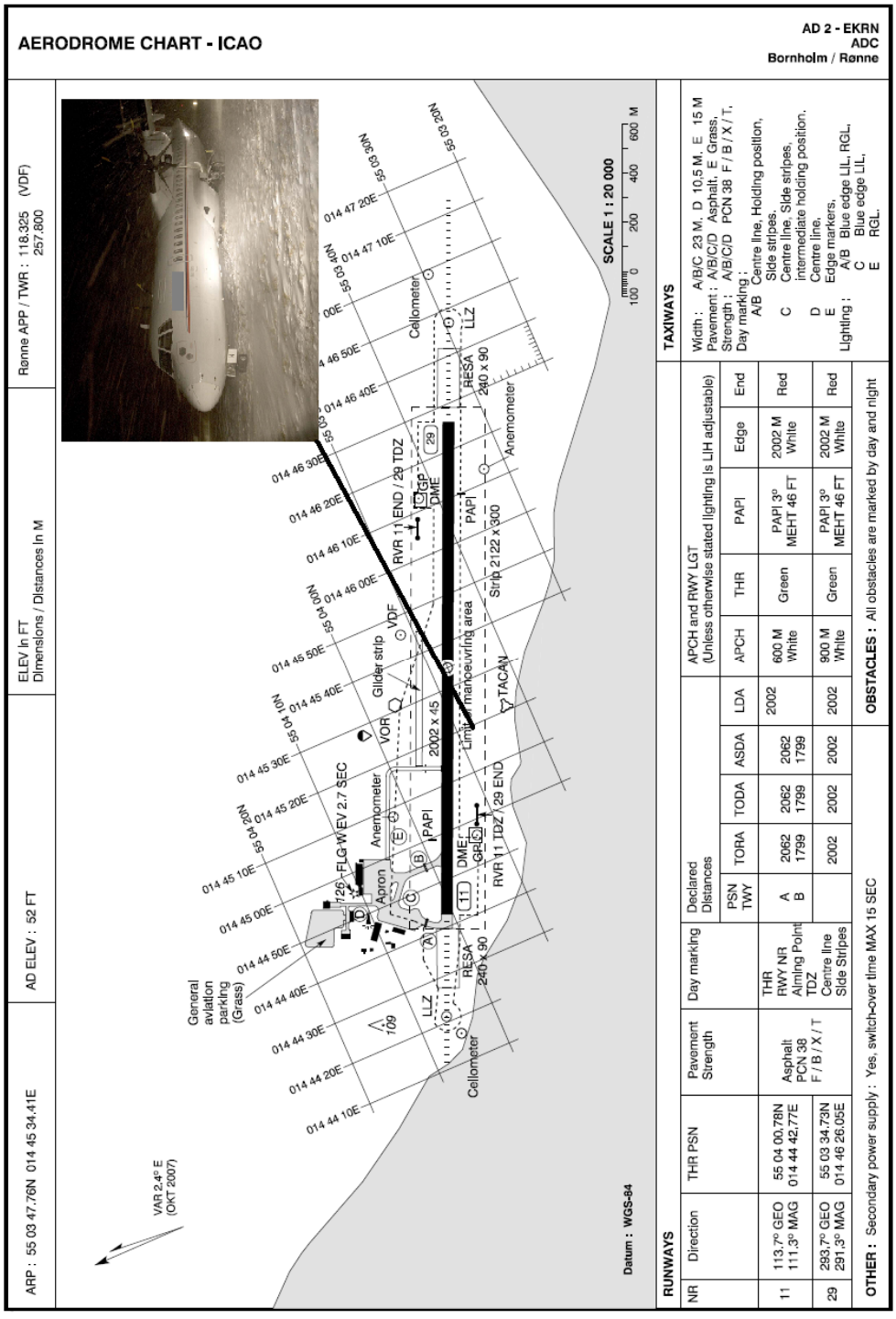
Enclosure 6 - DFDR readout



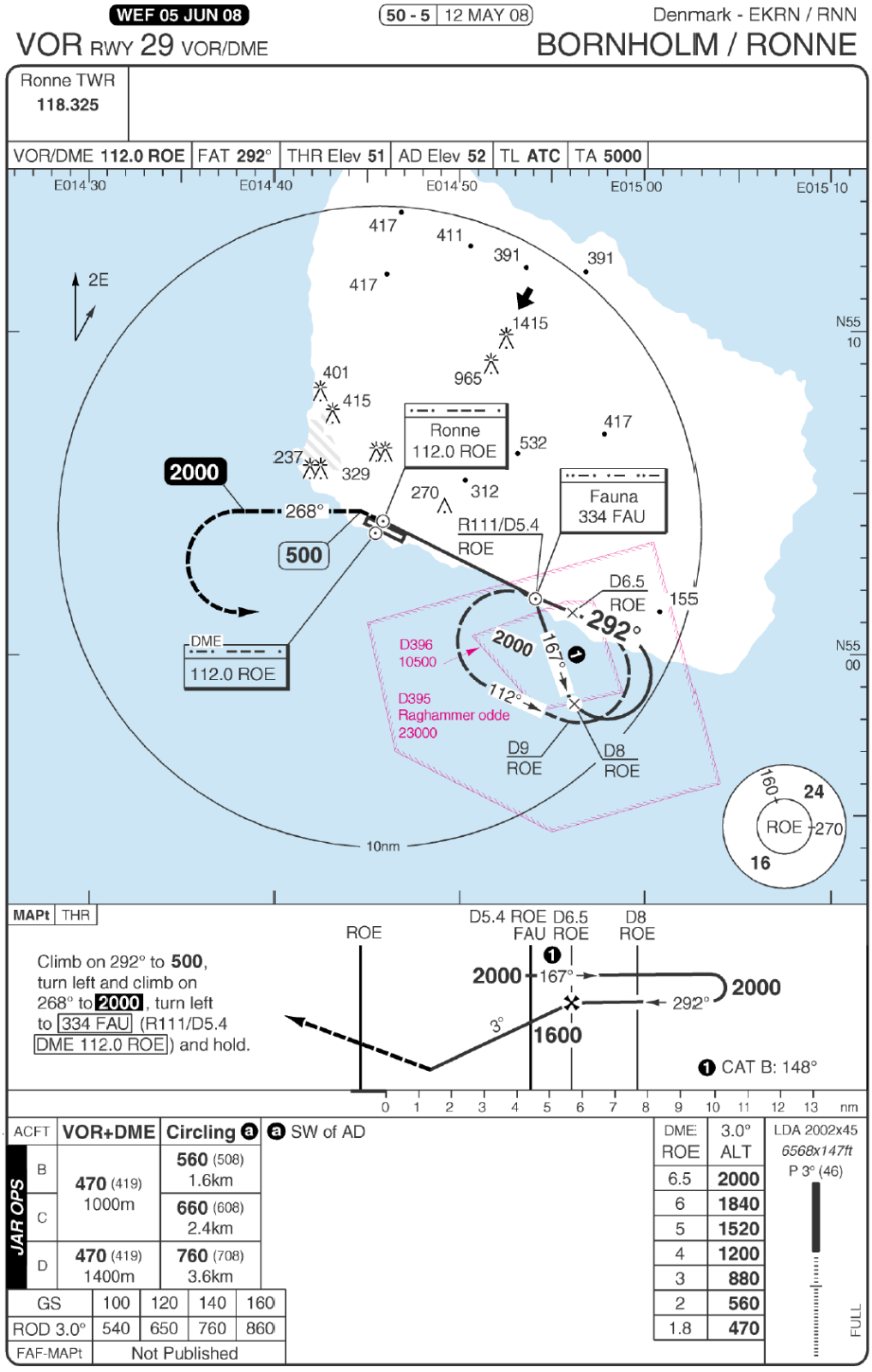
Enclosure 7 - DFDR readout



Enclosure 8 - EKRN overview picture (extract from AIP Denmark)



Enclosure 9 - The operator's approach chart (VOR/DME RWY 29)



Enclosure 10 - EKRN guidelines for winter service

The text is translated into English by the Danish AIB

GUIDELINES FOR WINTER SERVICE	*Supplement 2*
	Section 2
Routine Inspection	*Date: 01-06-05*
	Page 1 of 1

A. *In the morning, the inspection and reporting of ice and snowfall must take place immediately prior to the start of the working day and the results of measurements taken must be in the hands of the Air Traffic Controller on duty no later than 05:15 local time.*

B. *It is the responsibility of those on duty to keep themselves constantly informed of the weather situation via contact with the Air Traffic Controller on duty and to carry out inspections of runways, taxiways and aprons when the weather situation is such that this is required.*

C. *Runway inspections and the reporting of ice and snowfall must always be coordinated with the Air Traffic Controller on duty.*

D. *During snow clearing, chemical spreading etc. indicators on all vehicles involved must be fully functional and the frequency at which they are to be used must be listened to.*

E. *Any conditions observed during inspections are to be noted on the special sheet (Snowtam Form) cf. Supplement 2, Appendix 1.*

F. *The measurement of sleet and snow thickness is to be conducted with a ruler.*

G. *Critical banks of snow along the edge of departure runways and taxiways must be reported and the height and extent of these is to be entered in point (J) of the sheet referred to in point E. In the case of critical banks of snow, those in the immediate vicinity of runway lighting are also to be included.*

H. *Whenever there are ice, snow or slush, the estimated extent is to be indicated in Snowtam point T, using the following values:*

10%, less than 10% of the runway is covered
25%, 11-25% of the runway is covered
50%, 26-50% of the runway is covered
100%, more than 50% of the runway is covered.

I. *A new "Snowtam Form" must be completed when any significant change to conditions in relation to the most recently issued "Snowtam" are observed.*

J. *With regard to completing the "Snowtam Form", refer to AIP Denmark AD 1.2-1 to AD 1.2-3.*

K. *The Air Traffic Controller on duty may request that a runway inspection be carried out and ice and snowfall are reported if he/she considers - or the experience of pilots proves this necessary.*