(Translation of the German original context)

Federal Transport and Energy Department

Nr. 1990/57
1457

Final Report of the Federal Aircraft Accidents Inquiry Board

concerning the Accident of the aircraft DC-9-32, ALITALIA, Flight No AZ 404, I-ATJA
on the Stadlerberg, Weiach/ZH, of 14 November 1990

The legal assessment of the accident is no concern of the investigation and the investigation reports (Art. 2, Par. 2 of the Ordinance of 20th August 1980 relating to aircraft accident investigations).

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PREFACE

According to Annex 13 of the International Civil Aviation Convention, paragraph 3.1 the purpose of aircraft accident investigation is the prevention of accidents. It is not the purpose of the aircraft accident investigation and the investigation report to apportion blame or to assign responsibility. This basic rule is also contained in the Federal Ordinance for Aircraft Accident Investigation of 20 August 1980 Art. 2 (VFU).

SUMMARY OF ABBREVIATIONS

ADF	Automatic Direction Finding Equipment
ADI	Attitude Director Indicator
AFM	Aircraft Flight Manual
AMSL	Above mean sea level
AGL	Above ground level
AIP	Aeronautical Information Publication
AND	Attitude nose down
ANU	Attitude nose up
AP	Autopilot
APP	Approach Control
COM	Communications
CVR	Cockpit Voice Recorder
DME	Distance-Measuring-Equipment
DFDR	Digital Flight Data Recorder
FAP	Final Approach Point
FD	Flight Director
FL	Flight Level
FOM	Flight Operations Manual
FVL	Air Traffic Controller
GP	Glide Path
GPWS	Ground Proximity Warning System
HDG	Heading
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LOC	Localizer
LT	Local time
MSA	Minimum safe altitude
NAV	Navigation receiver
NDB	Non-directional radio beacon
NSU	Nav switching unit
PAPI	Precision Approach Path Indicator
RMI	Radio Magnetic Indicator
QFE	Atmospheric pressure at aerodrome elevation or at runway threshold
QNE	Altimeter subscale to 1013.2 hectopascals
QNH	Corrected mean sea level pressure
VASIS	Visual approach slope indicator system
VHF	Very high frequency
VOLMET	Meteorological information for aircraft in flight

0. SYNOPSIS

0.1 Summary

Flight AZ 404 departed from Milan - Linate airport on the 14th November 1990 at 1836 hrs*) with the destination Zürich. After a problem free flight, the crew were cleared by Zürich Approach to descend to 4000 ft (QNH) and to make an approach on the ILS 14.

At 14 NM from the threshold of RWY 14, the aircraft captured the localiser 14 and at about 11.5 NM descended through the cleared altitude of 4000 ft, instead of, as prescribed, leaving it when intercepting the glide path at 8 NM.

The aircraft descended with a constant rate of descent during the whole final approach, about 1400 ft below the correct glide path. At 1911 hrs, 5.2 NM from runway 14, the aircraft first struck the trees, and then the surface of the wooded north-face of the Stadlerberg.

After the collision a fire started. The 40 passengers and 6 crew members were fatally injured, the aircraft was destroyed. There was also considerable damage to the forest.

0.2 Investigation

The accident occurred at 1911 hrs. It was reported to the Aircraft Accident Investigation Bureau (AAIB) at 2050 hrs. Subsequently, this led to the first meeting in Berne where, in accordance with the Ordinance of the Federal Council for Aircraft Accident Investigation, the designated investigation team was alerted. The chairman of the Operations working group viewed the recording of radar data during the night at the Air Traffic Control Centre in Zürich. The following morning, the remainder of the team was called to the site at Weiach, organised by the police of the Kanton of Zürich. An earlier call to the accident site was not practical as the Police had first to secure the site, and the Fire Brigades were still fighting the fire. During this time, having arrived during the night, the Investigator in Charge and his team tried to obtain an overview.

The first meetings of the investigation team were held at Weiach, and subsequently, after the clearance of the accident site, at Zürich Airport.

In accordance with Annex 13 of the ICAO convention on International Civil Aviation, the state of registry and the state where the aircraft was manufactured have the right to send an accredited representative to the investigation.
Italy as the state of registry and the USA as the state of manufacture, both made use of this facility. In addition, the manufacturer of the aircraft, McDonnell Douglas USA, and the operator ALITALIA actively assisted, producing important

*) All times are UTC (local time -1 hour) unless specified otherwise

data without which the report could not have been completed. The Flight Data Recorder and the Cockpit Voice Recorder were found early on. The opening of the respective cassettes and the reading out of the data was done by the British Air Accidents Investigation Branch (AAIB) in Farnborough GB.

The investigating team was comprised as follows (only chairmen of the working groups):

Investigator in Charge:	K. Lier - Chief Inspector Aircraft Accident Investigation Bureau (AAIB) of the Federal Transport and Energy Department
Operations:	H.-P. Graf - Investigator AAIB
Weather:	K.H. Hack - Aviation Meteorological Office Zürich
Air Traffic Control:	H.-P. Hulliger - Federal Office for Military Airfields
Witness Statements:	Dr P. Oswald - Lawyer
Human Factors:	Dr U. Baumann - Medical Doctor
Technical Groups:	J. Overney - Investigator AAIB
Structure:	K. Kaiser and R. Eberhard - Federal Office for Military Airfields
Power Plant:	M. Häfliger - Federal Office for Military Airfields
Systems:	J. Overney - AAIB
Flight Recorders:	H. Keller - SWISSAIR
Forensic Analysis:	Dr M. Hubmann, Dr R. Pfister, M. Signer, M. Jenni - all from the Scientific Service (WD) of the Zürich City Police
Accredited Representatives:	
State of Registry (Italy):	Dr A. Di Giulio, Head of the Ufficio Sicurezza Volo of the Italian Ministry of Transport, Rome
State of Manufacture (USA):	R. Benzon - Investigator, National Transportation Safety Board, Washington DC

The investigation was supported by the Zürich Kantonspolizei (statements, photographies, and measurements) and by the Public Prosecutor of Dielsdorf.

The preliminary investigation was closed when the Investigation report and the Specialist Group reports of 9 December 1991 were presented to the President of the Commission on 17 January 1992.

In accordance with the standards of ICAO Annex 13, the report will be translated into an ICAO language namely English. In consideration of the State of Registry, an Italian translation of the final report will also be published.

The public hearing as required by the VFU article 32, was held on 10 March 1992 at the Federal Institute of Technology in Zürich.

On several meetings the Board established a final report dated 24 June 1992 and sent it to the interested parties. Their reconsiderations and a letter from the accredited representative of USA were debated on a meeting on 27 January 1993. At this date the final report was closed.

1. FACTUAL INFORMATION

1.0 Background

The cockpit crew of ALITALIA flight AZ 404 had a layover of 15:20 hrs in an hotel. They had already flown a rotation together on the day prior to the accident.

On the 14th November 1990, the crew checked in for flight duty at Milan-Linate at 1300 hrs. They were rostered for a return flight Milan-Linate (LIN) to Frankfurt (FRA), followed by LIN to Zürich (ZRH) and back. DC-9-32 I-ATJA was planned for all four legs.

The aircraft arrived in LIN from Düsseldorf (DUS) at 0927 hrs. The inbound crew who had flown I-ATJA to LIN left the following entries in the Technical Logbook (Quaderno tecnico di Bordo) on page 22, Flight DUS-LIN:

"1. *VHF NAV 2: In Radio Selector position Radio 2 VHF-NAV 2 does not give a TO-FROM indication on HSI 2. In position Approach no TO-FROM indication on HSI 2."*

"2. *CAT II Simul. Appr. At 200 feet the autopilot had a tendency to fly under the glide path then to return to it followed by a accentuated "dive". The autopilot was switched off and we continued manually."*

The take off in LIN for FRA was at 1407 hrs with a Captain (PIC) and a First Officer (COPI) as the cockpit crew. In FRA, apart from changing a Ground Flood Light no maintenance was undertaken on I-ATJA.

After the flight FRA - LIN, the PIC made no entry in the Technical Logbook. The PIC explained the technical situation to the mechanic verbally: The Failure had now been observed in position "RADIO 1". As a result of these observations, both VHF-NAV receivers were replaced. The crew were asked to make a "Simulated CAT II" approach in ZRH so that the aircraft could gain its full CAT II status for the return flight to LIN. The weather situation indicated a tendency towards CAT II conditions for the landing in LIN.

1.1 **History of the Flight**

The history of the flight could be determined on the basis of the Radar, DFDR and the CVR recordings. (Appendices 2, 3, 4, 5, 6 and 6a).

On the 14th November 1990 ALITALIA flight 404, aircraft type DC-9-32 registration I-ATJA, took off from runway 36R at LIN bound for ZRH. The flight was a scheduled commercial flight. The clearance was to the destination airport Zürich, via a CANNE 1C departure to Flight Level 120, the transponder code 0302. The PIC assumed the duties of assisting pilot and dealt with the radio-telephony. The First Officer was the handling pilot. The take-off was at 1836 hrs. The standard climb via CANNE towards Airway A9 to the cruising flight level of 200 was trouble free.

About 2 minutes after reaching Flight Level 200 the crew listened to Zürich VOLMET. From this they gathered that the surface wind at Zürich was 240/08 kt. This led the PIC forsee a landing on runway 28. Having heard from the ATIS that the landing runway was 14, the crew still discussed a right hand circling approach for a landing on runway 28. The discussion continued considering a left hand circling to runway 28.

At 1852.53 hrs, from a QNH of 1019 hPa the crew worked out a QFE of 970 hPa. During the descent, the crew discussed the approach procedure for runway 14, where the Copilot mentioned the Outer Marker height for runway 16. After the discussion about the setting of the navigation aids, they also discussed the procedure to be followed in the event of a communications failure. The crew were instructed that following radar vectors they should fly an ILS approach to runway 14. At 1900.01 hrs the Copilot said "We perform a CAT II (approach)". The PIC was in agreement because the navigation equipment had to be checked. Whilst verifying the decision height, it transpired that the Copilot was still consulting the approach chart for runway 16. Further lengthy discussions about the setting of the required navigation aids followed. As the aircraft passed abeam Zürich descending to Flight Level 90, the PIC noted: "We are by KLOTEN, FL 90. He is bringing us in high". Clearance to descend to Flight Level 60 followed at 1902.28 hrs. At 1902.50 hrs ALITALIA 404 was instructed to fly heading 325. VHF NAV 1 was tuned to Trasadingen VOR (TRA), VHF NAV 2 to Kloten VOR (KLO). To define the fix at EKRON, the course 068 was also set. At 1904.32 hrs the PIC repeated "The outer marker is at 1200 ft (QFE), it can be verified by 3.8 [NM] from Kloten. Rhein (RHI NDB) 5.6 [NM]...". At 1905.15 hrs a new heading was required which the PIC confirmed. The identification of the ILS - 14 was registered on the CVR at 1905.32 hrs. At 1906.20 hrs, together with the approach clearance to runway 14, a new heading of 110, descent to 4000 ft and

the QNH of 1019 hPa was given. The PIC confirmed this clearance, however the heading was read back as 120. The incorrect readback of the clearance by the PIC caused the Copilot some uncertainty of the required heading to be flown. The PIC confirmed the approach clearance and the cleared altitude 4000 ft to the COPI, whereby the COPI ordered "RADIO APPROACH...". At this point an altitude of about 5000 ft (QNH) was passed. One of the pilots asked the other whether he had a Glide Path indication. The aircraft position was just before interception of the Localiser passing an altitude of about 4700 ft (QNH) (according to radar and DFDR). It was already about 1300 ft below the Glide Path. Answering the question about the Glide Path, the other pilot replied (hardly understandable) "On 1...I don't have...." Consequently the PIC said: "Good, so let's do it on 1". The COPI then ordered "RADIO 1". The flaps were probably set to 15°. In the mean time, the aircraft had passed through the localiser and was now slightly east of it. About the same time as the PIC said "Capture LOC capture glide path capture - so we are on the localiser, a little off track but..." (translated from Italian) the aircraft descended through 4000 ft (QNH) (about 11.5 NM from the threshold runway 14). It was thus about 1200 ft below the glide path. The QFE 970 hPa was also set by the COPI. About 5 seconds later the Altitude Exit Alert was heard (Descent through 3700 ft [QNH]). The PIC cancelled the warning by setting 5000 ft (Go Around Altitude) on the Altitude Preselect. The PIC said to the COPI: "There is another one (Finnair 863) in front quite close. You can reduce even further to 150 (kt) otherwise we'll end up with a "go around".

A discussion followed about possible icing. After this the flaps were set to 25 during which no Landing Gear horn was heard. At this point the aircraft was established on the localiser. The altitude was about 3000 ft QNH - ca. 1200 ft below the glide path. The PIC: "Outer Marker check is at 1250 ft [QFE]". The height was now about 1600 ft QFE. 10 seconds after Flaps 25, the flaps were set to 50. The Outer Marker height of 1250 ft QFE was now passed. The PIC said "Bravo" followed by sounds of switching. At 8 NM final the PIC mentioned "3.8 almost 4 miles". At about 7 NM final, (15 seconds after the PIC's words "Almost 4 miles") the COPI asked "... haven't we passed it?". After a further 12 seconds the COPI asked once again "Didn't we pass the outer marker?" The height was now 670 ft QFE. The PIC's answer was "No no it hasn't changed yet ...". At 6.6 NM final the PIC said "Oh it shows 7 ...". The crew was now ordered by Zürich ARR to change frequency to Zürich TWR. At 6.25 NM final the pilots conversed as follows: "... That doesn't make sense to me ...". "Nor to me ...". 2 seconds after this conversation the PIC called out "Pull, pull, pull, pull!" Simultaneously autopilot disconnection could be heard. The position was now about 500 ft AGL overhead Weiach - about 350 ft QFE. 2 seconds later the COPI called out "GO AROUND", the PIC responded with "No no no no ... catch the glide". At this point the DFDR shows a pitch change from -2° [AND] to +5.4° [ANU]. At the same time the thrust was increased from 1.3 to 1.7 EPR. The sink rate decreased from 1100 ft/min. to 190 ft/min. After 11 seconds (the pitch oscillated at +1° [ANU]) the PIC asked "Can you hold it?" to which the COPI replied "Yes". One second after the COPI's answer the Radio Altimeter warning (pip pip pip) indicating 200 ft/AGL could be heard. During this, the PIC said "Hold on let's try to ...". At 1911.18 hrs the aircraft struck the northern slope of the Stadlerberg at a altitude of 1660 ft QNH.

Grid Reference: 675 900/266 600. (= E008° 26' 51''/N047° 32' 50''). Elevation: 510 metres AMSL.

Location of the accident site: Map 1:25 000m Sheet No 1051, EGLISAU.

1.2 **Injuries to Persons**

	Crew	Passengers	Others
Fatal	6	40	---

1.3 **Damage to Aircraft**

Destroyed.

1.4 **Other Damage**

Considerable damage to about 600 m^2 forest due to impact and fire.

1.5 **Personnel Information**

1.5.1 Pilots

1.5.1.1 Captain (PIC)

+Italian citizen, born 1943.

ATPL issued by the Italian CAA valid until 28th December 1990.

IFR Checks (DC-9 - 32):

Simulator:	27 FEB 1990 inc. CAT II
Simulator (Base Check):	29 AUG 1990 inc. CAT II and emergency procedures
Line:	20 NOV 1989 GVA/FCO/CDG/PSA/TRN/BCN
Qualification:	All passed as PIC

Flying Experience

Total:	10193 hrs
On accident type:	3194 hrs
As PIC:	1193 hrs
Last 90 days:	116 hrs 03 min
Last 30 days:	41 hrs 38 min
Last 24 Hrs:	4 hrs 03 min (Before the accident flight)

He entered service with ALITALIA on 15th May 1970. His military flying experience was about 1200 hrs. He had flown about 8000 hrs as COPI on DC-8, DC-9 and B-727 aircraft, and had been operating as Captain (PIC) on DC-9 -30 since 15th March 1988.

The last licence medical check on 26 June 1990 found him fit without restrictions.

His last landing in ZRH was on 31st May 1990 with AZ 414 LIN-ZRH.

1.5.1.2 First Officer (COPI)

+Italian citizen, born 1962.

ATPL issued by the Italian CAA, valid until 18th April 1991.

IFR Checks (DC-9 - 32):	
Simulator:	11 FEB 1990 inc. CAT ll
Simulator (Base Check):	16 AUG 1990 Emergency procedures CAT ll 24 AUG 1990 (although officially incorrectly recorded)
Line:	11 JAN 1990 FCO/VRN/TRN/PAR/BOA
CAT II expired:	11 AUG 90
Qualification:	All passed as COPI

Flying Experience

Total:	831 hrs
On accident type:	621 hrs (as COPI)
Last 90 days:	108 hrs 10 min
Last 30 days:	28 hrs 08 min
Last 24 Hrs:	4 hrs 03 min (Before the accident flight)

He received his pilot training from ALITALIA, after which he was employed as a DC-9-32 Copilot as of 15th July 1989. The last licence medical check on 1st June 1990 found him fit without restrictions.

His last landing in ZRH was on 16 OCT 1990, Flight AZ 400 FCO-ZRH.

1.5.1.3 Flight Duty and Rest Time of the Pilots

PIC:	Flight Time	Duty Time	Rest Time
14 NOV 1990	3:07	5:14	15:20
13 NOV 1990	4:03	7:35	---

COPI:	Flight Time	Duty Time	Rest Time
14 NOV 1990	3:07	5:14	15:20
13 NOV 1990	4:03	7:35	---

The pilots flew together the day prior to that of the accident. Before these two working days, both pilots had more than 48 hrs off duty.

1.5.2 Cabin Crew

+Italian citizen, born 1947.
+Italian citizen, born 1954.
+Italian citizen, born 1960.
+Italian citizen, born 1967.

1.5.3 Air Traffic Controller

Swiss Citizen born 1951, Air Traffic Controller, at the time of the accident Approach Controller, Air Traffic Controller's Licence issued by FOCA 4th September 1980, last renewal 4th September 1990 valid until 4th September 1991.

1.5.4 Passengers

There were 40 passengers on board.

1.6 **Aircraft I-ATJA**

Airframe:

Type:	DC-9-32
Manufacturer:	Mc Donnell Douglas, USA
Serial No:	47641
Airframe No:	746
Construction Year:	1974
Stick Hours:	33886 hrs
Block Time:	43894 hrs
Cycles:	43452

Maintenance Record:

Check	Interval	Last Check	Hours since last check	Next Check
ISA	100 hrs	4.11.99 LHR	60	40
ISB	470 hrs	21.10.90 FCO	148	322
ISC	1800 hrs	2.6.90 NAP	1026	774
RED	12000 hrs 62monts*	7.10.88 FCO	4438	7561 hrs/ 7.12.93*

* Whichever occurs first

Maintenance handover from ATI to AZ: 6.11.89 31632 hrs and 41487 cycles

Last renewal airworthiness certificate: 18.6.90

Power Plant:

Manufacturer:	Pratt and Whitney
Type:	JT8D-9A
Take Off Thrust:	14500 lbs
Maximum Continuous:	12600 lbs
Cruise:	11400 lbs

Engine: Serial No. 667030 (Left)

Installed in I-ATJA: 30.09.90

Engine operating times at the time of the accident:

Time since installation (TSI):	270 Hrs
Total "Stick Hours" (TT):	31423 Hrs
Total "Block Hours:	40393 Hrs
Total Cycles (TC):	38994

Service times of the modules at the time of the accident:

Mod No.	Serial No.	TT	TC	TSO	CSO
1	167033	31432	34706	5149	4573
2	267033	31481	34127	5419	4573
3	366734	35748	39649	270	227
4	467102	27523	30964	270	227
5	566787	37247	40103	2865	2843

TT = TOTAL TIME
TC = TOTAL CYCLES
TSO = TIME SINCE OVERHAUL
CSO = CYCLES SINCE OVERHAUL

Engine: Serial No. 656952 (right)

Installed in I-ATJA: 11.02.89

Engine operating times at the time of the accident:

Time since installation (TSI):	3749 hrs
Total "Stick Hours" (TT):	37931 hrs
Total "Block Hours":	47484 hrs
Total Cycles (TC):	41170

Service times of the modules at the time of the accident:

Mod No.	Serial No.	TT	TC	TSO	CSO
1	156952	35919	37983	3749	3552
2	266784	37179	42819	3749	3552
3	366890	35696	37908	3749	3552
4	466724	38052	44042	3749	3552
5	566717	35454	34386	8833	8704

TT = TOTAL TIME
TC = TOTAL CYCLES
TSO = TIME SINCE OVERHAUL
CSO = CYCLES SINCE OVERHAUL

Engine Maintenance

Module No. 1, 2 and 3: 9000 CSO
Module No. 4: 5500 CSO
Module No. 5: 11000 CSO

Repair and overhaul work on the ALITALIA JT8D-9A is undertaken by Alfa Romeo, Aviation Division (ARAVIO) in Naples.

Last maintenance works by ARAVIO

Engine, Serial No. 667030

From 01.05.90 to 08.09.90 the following works were done on this engine:

Module No. 1	Extensive disassembly and check, and repair of sub-assemblies
Module No. 2	- " -
Module No. 3	Complete overhaul
Module No. 4	- " -
Module No. 5	Repairs

Engine, Serial No. 656952

From 22.09.88 to 28.01.89 the following works were done on this engine:

Module No. 1	Complete overhaul
Module No. 2	- " -
Module No. 3	- " -
Module No. 4	- " -
Module No. 5	Repairs with extensive disassembly and checks

Next Planned Work

Engine Serial No. 667030

The ND Turbine disc, stage 2 was due to be exchanged after a further 9470 cycles (residual life). The work was planned for 1995.

Engine Serial No. 656952

The outer combustion chamber housing was to be removed after a further 10442 cycles (residual Life) for FPI/FMPI in accordance with ASB 5676-AD87-11-07R1. The work would have been due in 1996.

Significant faults and defects since installation in aircraft I-ATJA

No significant events were registered in either engine.

Certificates and admission

Certificate of Airworthiness:	No: 9207/b issued by the Italian authorities on 26th September 1974.
Applicable Category:	Public Transport (n-I/TTP-TPm-La)
Minimum Crew:	1 Pilot and 1 Copilot, 4 Cabin Crewmembers
Passengers:	107
Maximum Take Off Weight:	48989 kg

At the time of the accident, 5160 kg of fuel was on board.

According to the Loadsheet, the All Up Weight and Centre of Gravity were within certified limits.

1.7 **Weather**

1.7.1 During the departure phase, the line flight AZ 404 on 14th November 1990 (LIN - ZRH) passed through a cloud mass associated with an occlusion lying over northern Italy, in which there were no significant meteorological phenomena.

Over the Alps, the aircraft gradually entered the cold air mass which was moving in behind the occlusion. At Flight Level 200 the aircraft was occasionally out of the clouds (Tops 18000 - 20000 ft AMSL) which had formed behind the occlusion.

During the descent over northern Switzerland, the aircraft was flying mainly in cloud. Light icing was possible in this phase. Between 4400 ft and 3900 ft AMSL the aircraft came clear of the cloud.

Other aircraft on approach during the same period had the approach and runway lighting almost continuously in sight.

In the final phase it could be that the approach and runway lighting of Zürich Airport may have been obscured for an aircraft flying too low, by a cloud cap on the Stadlerberg.

1.7.2 ATIS on 128.520 MHz

Zürich information ECHO
Landing RWY 14
Take off RWY 28
Met report Zürich 1850
240 degrees 4 kts,
Final RWY 14 and 16 250 degrees 7 kts
Lift Off RWY 16 240 degrees 4 kts
visibility 10 Km
Mist
2/8 1500 ft
5/8 3000 ft
7/8 4000 ft
Temperature 9 dew point 8
QNH 1019, NOSIG
Transition Level 50

1.8 **Navigation - Ground Equipment** (Zürich Airport)

ILS 14 and other NAV-aids

The following aids are available for approaches to runway 14 at Zürich Airport and at the time of the accident were serviceable:

Type of Aid	Callsign	Frequency
ILS 14, CAT I/II/IIIa with DME (co-lacated with the GP: Distance 0 at THR 14), OM/MM	IKL	108.3 MHz
VOR/DME	KLO	116.4 MHz
VOR	ZUE	115.0 MHz
VOR/DME	TRA	114.3 MHz
NDB	RHI	332.0 KHz
NDB	SHA	371.5 KHz
NDB	WAL	360.0 KHz

Simultaneous use of the ILS by other aircraft

According to the radar recording, at the time of the accident, two other airliners were on approach - IBE 588 and FIN 863. There were no reports from these aircraft relating to problems with the ILS.

Checks before the Accident

Last calibration in flight

Last calibration: Glide Path 27 July 1990
Localiser 30 July 1990

These calibrations were conducted using equipment from the Austrian Civil Aviation Authority. An agreement between Switzerland and Austria enables this mutual service.
Result: ILS 14 is certified for CAT III operations.

Last ground calibration

Last ground calibration: 14th November 1990 (afternoon)
Result: The check showed no irregularities.

Check after Accident

At 2150 hrs lt the head of the Technical Navigation Services asked that the head of the Operations Service suspend approaches on the ILS 14.

About two hours after the accident a ground check of the 14 ILS installation was carried out by the responsible technical service under the supervision of a neutral intermediary.
Result: No irregularities were found.

On the 15th November between 0100 LT and 0300 LT the Airborne Calibration Unit (IAN) of the Federal Office for Civil Aviation (FOCA) executed a flight check of the most important parameters. Everything was found to be in order, so at 0400 LT the equipment was released for further service. Using this opportunity, all the other navigational approach aids were checked and found to be serviceable.

On the 16th November 1990 the Calibration Unit (IAN) executed a full in flight calibration of the 14 ILS installation.
Result: All parameters were found to be in order and the authorisation for the equipment to be returned to CAT III service without limitations was confirmed.

Remarks:

1. All measurements mentioned above were made without making any adjustments to the installations.

2. Weather conditions precluded a complete calibration of the installation before 16.11.90.

Calibration by Helicopter

On the 20th March 1991 an IFR equipped helicopter followed and recorded the actual flight path flown by AZ 404. As a result it could be determined that the GP signal could be received (Valid) until shortly before the accident site.

Communications Equipment

From the evidence of the Air Traffic Controllers involved, having listened to the voice recordings and from data from the Technical Service, the communications equipment (VHF- COM/ATIS) was found to be functioning satisfactorily at the time of the accident. This was also the case for all internal Air Traffic Control connections (Intercom, telephones).

The data from the VHF DF on the Holberg was available at the work stations and could be superimposed on the radar screens.

There was no evidence that the communications equipment had any influence leading to the accident.

Radar Equipment and Radar Displays

The Air Traffic Controllers have access to area displays based on one of many radar receivers. Data from the radar installations situated on the Lägern (Primary/Secondary), Holberg (only Analog Primary/Secondary), La Dôle (Primary/Secondary) and Gosheim, Germany, (Secondary) can be used for this purpose.

Information from the Lägern is the prime source for the Area Control Centre (ACC), whereas that of the Holberg is used by the Approach Control.

The following information is presented on '21 inch' Screens:

- Actual position of the aircraft (identified by a symbol) and its previous position
- Flight Number (or Callsign)
- Altitude (Mode C, Corrected to QNH below Transition Altitude)
- Ground Speed
- Primary radar returns can be displayed due to a phosphorous layer on the APP screens which allows a long after-glow.

In the TWR there is a limited distance presentation on a television (Bright Display).

Data from the Albis weather radar was presented on a separate display in the ACC and APP. All equipment referred to was functioning correctly according to the Air Traffic Controllers and the Technical Monitors.

An automatic "Minimum Safe Altitude" Warning system (MSA), standard in the USA, is not available.

Recordings

The following data is permanently recorded:

- All VHF radio channels
  (Multi-channel recording units and cassette recorders (short term recording) at certain stations)

- All land lines between work stations (Intercom)
  (Multi-channel recording units)

- All telephone conversations at the work stations
  (multi-channel recording units)

- Radar tracking data: Radar returns and runway returns of the Multi radar sytems.
  (Magnetic tape recording, including two VHF channels - display on radar screens or hard copy on paper)

- Data from the TWR 'Bright Displays', analog and synthetic radar data
  (Video cassette, sequential recording - display on the 'Bright Display or hard copy on paper)

- The status of the navigation aids (ANIS - monitoring system, computer print-out)

- The status of the radar installations and the data processing systems (Computer print-out)

- Conversations in the radar room were not recorded by an area microphone.

- All sources of information and documentation were at the disposal of the ATC working group. All recordings confirmed the correct operation of the technical ground equipment.

Additional note

No faults were reported by other aircraft crews either prior to or following the accident.

1.9 Radio Traffic

The radio communications of AZ 404 with the Air traffic Controllers involved, presented no difficulties during the whole flight. The mutual comprehension was constantly good. The communications equipment on the ground and on board the aircraft was serviceable.

1.10 **Airport Equipment**

Runway 14 is not equipped with VASI (Visual Approach Slope Indication Systems) or with PAPI (Precision Approach Path Indicating Systems). The 637 m/AMSL high Stadlerberg which lies on the approach axis of runway 14 has no obstruction lighting.

1.11 **Fligh Recorder**

The aircraft was equipped with a Digital flight data recorder (DFDR) and a Cockpit Voice Recorder (CVR).

1.11.1 DFDR

Manufactured by Sunstrand, the digital flight data recorder had the following parameters:

- Vertical acceleration
- Magnetic heading
- Pitch attitude
- Roll attitude
- EPR 1
- EPR 2
- VHF 1
- VHF 2
- Airspeed
- Pressure altitude

The casing showed fire damage, the interior had no signs of damage. The tape was dismantled and transposed both digitally and graphically by the British Air Accidents Investigation Branch at Farnborough GB. The graphic evaluation is attached as Annex 7.

1.11.2 CVR

A magnetic tape, manufactured by Sunstrand. As the casing had suffered physical damage, it had to be cut open. The protective cassette, electronics and the tape were damaged. Three tracks were used, namely VHF-COM Captain, VHF-COM Copilot and the Area Microphone. As the pilots did not make use of the headsets (including microphones), the cockpit conversations were taken entirely from the Area Mike (Installed in the overhead panel of the cockpit). The original tape was transferred to standard cassettes by the British authorities. The cockpit noise level, together with that of the ATC voice traffic on the cockpit speakers which were set to a high volume, impaired the interpretation of the conversations between the pilots which were held in the Italian language. In an effort to optimise the interpretation of these conversations, the facilities of both the Federal German Accident Investigation Branch at Braunschweig and the Laboratory of the Directorate of Research and Development of the Swiss PTT in Berne were used.

The transcript of the recordings, both in the original Italian language and an English translation, are attached to the report as Annexes 6 and 6a.

1.12 **Wreckage and Impact Information**

The accident site was situated on the northern slope of the Stadlerberg, a wooded hill (highest elevation 637 m/AMSL, -200 m above the immediate surroundings).

The right engine, which was severely damaged, lay at the edge of the main wreckage area separated from the aircraft tail unit. The left engine was still attached to the tail unit and was largely intact.

By using the impact/damage trail the final Flight Phase could be determined:

The aircraft contacted the first trees in an essentially level flight path and with no roll angle, mainly with the right wing and forward fuselage. This is evident from parts found near the first trees to be damaged: wing leading edge/slat, parts of the green position light cover on the outer right wing and the rear nose-gear door. At this point essential parts of the control systems (electronics) were probably damaged. As a result of the destruction, particularly in the right wing area, the aircraft received an asymmetric lift force which lead to the next impact point with the trees having a considerable right wing low attitude. The aircraft turned itself further about its longitudinal axis to the right until it struck the ground, where the right engine was torn off before the tail unit finally separated, and the fuselage (together with the occupants) impacted the steep hillside.

1.13 **Medical and Pathological Information**

The mortal remains of the pilots were given a post mortem where possible by the Zürich Pathological Institute (GMI). The cause of death in both cases was injuries received during the accident and the effects of fire. There was no evidence of any relevant pre-existing health problems.

Samples were taken from the bodies of both pilots and were subjected to chemical and toxicological tests. In summary the Chemical Service of GMI Zürich records that:

"In the case of the Captain, there is no evidence of significant toxic substances."

There were no signs of the presence of medicaments or drugs in the Copilot. However various levels of Ethyl Alcohol concentration between 0.02 0/00 and 0.38 0/00 were found in the body tissue and blood. It can not be proven whether this alcohol presence was caused by alcohol consumption whilst alive or the effects of bacteriological production after death."

1.14 **Fire**

The aircraft caught fire immediately after the accident. This spread rapidly although not over the immediate surroundings. The fire brigades from Weiach, Bülach, Dielsdorf, Glattfelden (all Zürich) and from Hohentengen (Germany), and in addition

the Airport Fire Service from Zürich and the Company Fire Service from Swissair, were all soon at the scene where they immediately began fighting the fire, thus preventing a serious forest fire from starting. The fire could only be completely extinguished towards the evening of the following day, as the first fire fighting was done using water spray in order to prevent unnecessary damage to the debris for the investigation.

Amongst other reasons, the cause and the duration of the fire can be traced back to the 5160 kg (6450 l) kerosine in the wing tanks.

1.15 **Survivability**

Those aircraft occupants who were not fatally injured in the accident, died from burns or from smoke poisoning. The accident was not survivable.

Had there been some survivors, optimal medical support was available due to the close proximity of the airport and the trained Airport First Aid Service.

1.16 **Tests and Research**

1.16.1 Investigation of the navigation System in the Aircraft (NAV - DME, GPWS)

From the CVR recordings it was evident that as the aircraft intercepted the localiser, the crew at first had difficulties in receiving the glide path signal and selected mode RADIO 1 for the final approach whereby, at about 12 - 13 NM (distance from the runway), they received a glide path signal. The PIC reported "capture LOC, capture glide path capture, so we are on the beam a little off track, but....". Accordingly the crew were of the opinion that the aircraft was on the ILS, a little offset to the east (this small initial offset caused by a slight overshoot of the LOC, is confirmed by the radar recording). The aircraft was in fact on the localiser however it was about 1300 ft beneath the glide path. This is also evident from the radar recording.

A reconstruction was made on the 9th March 1991 using an aircraft of the same type (same equipment) belonging to ALITALIA (similarly the AZ 404), where the flight path was followed exactly down to an altitude of 4000 ft QNH. As a result it was determined that until GP interception, the glide path needles on all four instruments was in the fully UP position; that is out of sight. On the 20th March 1991, using an IFR equipped helicopter, approaches were made right down to the accident site following data from the accident flight. The glide path indications remained in the fully UP position although in one instrument no warning flag appeared and in the other a flag appeared at a distance of 6.8 NM ILS/DME.

Because, on the one hand the PIC reported the presence of a glide path signal to his Copilot, although this was at a distance and height where no such glide path should occur, and on the other hand the test of the ILS installation undertaken immediately after the accident confirmed its correct operation, particular attention was focused on the aircraft's NAV equipment.

1.16.1.1 The Navigation Systems and their Indications

The DC-9-32, I-ATJA was equipped as follows:

- 3 COM - set (radio)
- 2 NAV receivers (VOR+ILS+GS)
- 2 DME, receiver frequencies controlled via NAV receivers
- 2 ADF
- 2 Flight Directors
- 2 Radio Altimeters
- 1 Autopilot
- 1 Marker receiver
- 2 Servo compasses (slaved gyros)

The Ground Proximity Warning System (GPWS) was not found.

The NAV equipment produced the following indications:

- The VOR signal was presented on 2 HSI and on 2 RMI with double pointers
- The DME distances were presented on the two HSI
- Both ADF on the two HSI
- The Flight Director controlled indications in the Artificial Horizons (ADI)
- Each pilot had a Radio Altimeter indication
- The GPWS gives an aural alarm and an order with a computer generated voice
- The marker receiver shows the position in the final approach with three lights and on behalf of acoustic signals
- Glide path and localiser are presented both on the artificial horizons and on the HSI
- The slaved gyros give the heading on the HSI and RMI and can be coupled to the Flight Director.

1.16.1.2 NAV receivers

1.16.1.2.1 History of the NAV receivers at ALITALIA

ALITALIA took over a number of DC-9-32 aircraft from ATI (Aero Transporti Italiani), amongst them I-ATJA. The ATI aircraft were equipped with KING receivers. The aircraft of the same type with ALITALIA were equipped with COLLINS units. The COLLINS and the KING receivers are completely interchangeable. In time these units became fully intermixed.

1.16.1.2.2 Monitoring of the Output Signal of the NAV Receiver

A major disadvantage of the analog ILS systems is that when no output signal is produced by the NAV receiver (GS and LOC) the same indication is given as in the "On Course" or "On Glide Slope" case. This situation could occur with a short circuit or a signal break between the receiver output and the indicator (eg: HSI, ADI).

A monitored receiver (eg: COLLINS -**109**) is able to detect this type of failure and to present a failure flag.

The KING KNR 6030 NAV receiver is essentially not monitored in this way.

The accident aircraft DC-9-32, I-ATJA was fitted with one KING KNR 6030 and one COLLINS 51RV-2B (P/N 522-4280-**108**) NAV receiver, that is equipped with two unmonitored units.

1.16.1.2.3 Description of the Glide Slope (GS) Receivers KING KNR 6030

The gilde slope reception unit consists primarily of:

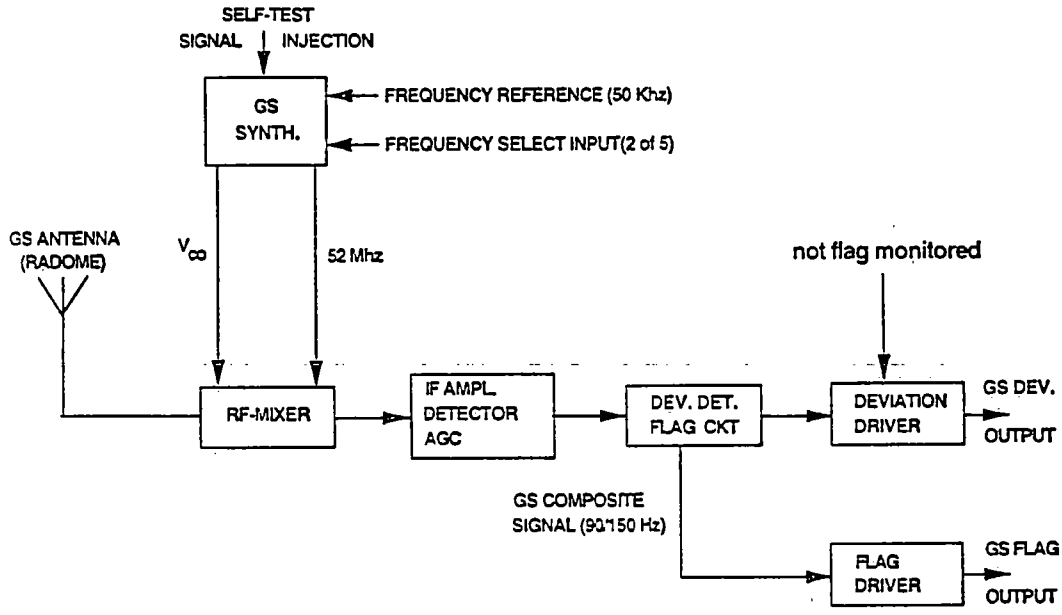
- HF-receiver
- Mixer 1st and 2nd
- Synthesiser (phase locked loop)
- IF (Intermediate Frequency Stage)
- Demodulator (150/90 Hz composite signal)
- Automatic Amplification Regulator

In the circuit, the Deviation Detector derives the GS deviation signal from the composite GS signal and presents the information on the cockpit instruments via a deviation driver. The glide slope signal is passed from the Deviation Driver (printed circuit board) via a "Motherboard" (also a printed circuit board) and a cable loom to a rear-mounted equipment plug.

The flag circuit monitors the receiver part and the deviation detector. The deviation driver together with the subsequent signal routing then remains unmonitored. A valid signal (Warning flag in the instrument out of view) means that an adequate signal (more than 10 micro volts) is available at the entry port, and that the modulation (150/90 MHz) lies within tolerance.

The frequency is selected by means of the NAV/DME control panel on the glareshield. With the Flight Director Control selector in position RADIO 1 or RADIO 2, the frequency of NAV receiver 1 will be set by the left NAV/DME control panel, and that of the NAV receiver 2 by the right control panel. However in the position APP, both NAV receivers will be tuned to the frequency on the left NAV/DME control panel.

By using a self test, both the localiser and the glide slope receivers can be tested simultaneously. As a result, an internally produced test signal will be fed to the second mixer stage of the respective receiver. With the exception of the antenna and the first mixer stage, practically the whole receiver will be checked during a self-test. On the instruments, the indicator needles will move to the position of the self-test button - either UP/LEFT or DOWN/RIGHT. The warning flag disappears momentarily and reappears as long as the test button is pushed.



Block Diagram KING KNR 6030 GS Receiver

1.16.1.2.4 Previous History of the NAV receivers fitted ot I-ATJA

On the flights immediately prior to the accident flight, there were complaints about the TO/FROM indication on the Copilot's HSI. This was during a flight from DUS to LIN. In LIN the NAV units were swapped. After a crew change, I-ATJA flew to FRA. Following the swap the fault was identified. There was also a complaint about oscillations on the glide slope during a coupled approach (ca. 200 ft). This complaint was most probably attributed to the autopilot. I-ATJA then flew back to LIN.

1.16.1.2.5 Unit exchange in LIN

Having landed after the flight from FRA, I-ATJA was parked on position 16 at LIN. Two ALITALIA employees changed both NAV receivers for a KING receiver KNR 6030, S/N 2256 in the NAV system 1, and a COLLINS 51RV-2B in the NAV system 2. A self test was conducted on both systems. Following this both technicians checked the functioning of the equipment in the NAV mode, in that they switched off the signals of the LIN VOR and that of the LIN localiser. However it was not possible to test the reception of the ILS glide slope signals due to the parking position of the aircraft.

This is how, I-ATJA was released to service, with the status COUPLED APPROACH CHECK. This status could be proven after the accident as the STATUS MODE INDICATOR was recovered. According to ALITALIA procedures, the pilots are required to execute a automatic approach in weather conditions of CAT I or better so that the status COUPLED APPROACH ALLOWED can be achieved.

1.16.1.2.6 Workshop History of NAV receiver KING KNR 6030

Based on documentation produced by ALITALIA, it can be assumed that the NAV receiver KING KNR 6030 S/N 2256 fitted before the accident flight was serviced in the workshop in accordance with standard procedures. The prior history of the receiver gave no negative indications.

1.16.1.2.7 Investigation of NAV receiver KING KNR 6030

Based on the cockpit conversations, it can be assumed that the crew believed that there was a problem with GS Signal No 2, and therefore switched from APPROACH to RADIO 1. Based on the flight progress, it must be assumed that GS indication No 1 was unreliable. Therefore the investigation was concentrated on NAV receiver No 1.

The receiver KING KNR 6030, S/N 2256 was recovered from the accident site in a badly damaged condition. The unit was considerably deformed and had fire damage. The aircraft plug had been ripped from the cable loom, and separated from the radio rack and was found on the receiver unit. There was no sign of pre-accident damage on this plug.

In the NAV receiver itself, the glide slope deviation signal circuit was followed from the rear mounted unit plug until the interface board. At the transfer between the cable loom and the mother-board a break was detected at the connections E2644 and E2648. The specialists from the Zürich Police Scientific Service (WD) determined that no pre-accident damage was present at this connection. The circuits on both the mother-board and the interface-board were intact.

The condenser C2914 on the interface-board was destroyed and could not be tested. The same is valid for CR2901.

The IC I 2903 in the glide slope deviation driver was missing. The IC I 2904 in the VOR/LOC deviation driver was found loose in the unit. The Scientific Service specialists determined that both IC must have been pulled from their respective receptacles by acceleration forces.

A detailed examination of the interface-board was not possible due to the high degree of damage. It is noted however, that a fault in an electronic component on this board would tend to have caused a hard-over, rather than a centred indicator needle.

The examination of the NAV receiver KING KNR 6030 gave no firm indications of a pre-crash deficiency. It can not, however, be excluded that this unit could have accounted for a "frozen" centred glide slope indication.

1.16.1.2.8 Information from ALITALIA

On the 12th June 1991 ALITALIA informed the Investigator in Charge that:

During an approach a centred LOC indication without a warning flag had been reported. The defective KING KNR 6030 receiver had been removed. The defect could be verified in the workshop. A cold solder in the deviation driver circuit could be identified as the cause of the "frozen" indication.

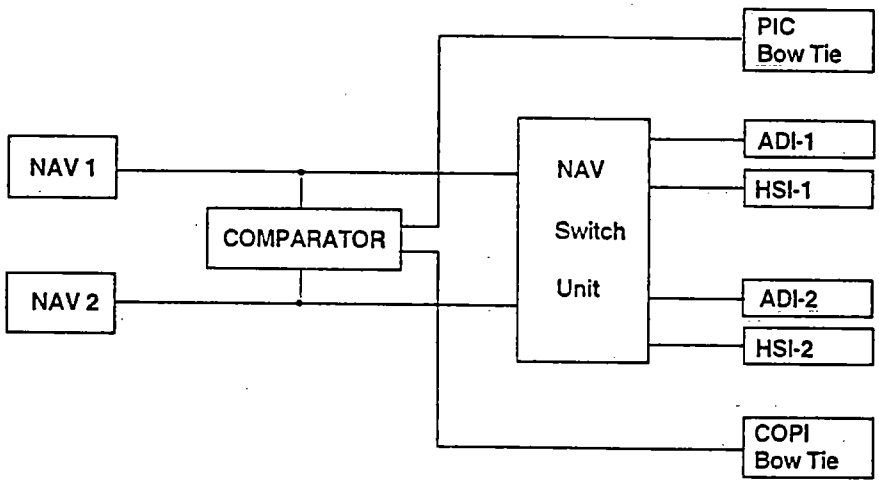
It can not be excluded that a similar fault in the GS deviation driver unit could lead to a "frozen" GS indication.

1.16.1.3 NAV receiver Switching Unit (NSU)

The ALITALIA DC-9-32 has, as already mentioned, two NAV receiver units. The pilots have the choice of selecting as a source for their indicating instruments (HSI 1 + 2, ADI 1 + 2) NAV receiver 1, 2 or separated, as desired. This switching is effected by a NAV Switching Unit between the NAV receivers and the indicating instruments.

1.16.1.3.1 Description of the NAV Switching Unit

The NSU consists of a number of rotary switches which are positioned by a motor. The motor receives its control signals from a RADIO switch which is located on the Flight Director Control Panel.



Block Diagram of the NAV System

The RADIO switch has three positions (Annex 8 + 9):

- RADIO 1: All indicators (HSI 1 + 2, ADI 1+2) receive signals from the output of NAV receiver 1.

- RADIO 2: All indicators (HSI 1 + 2, ADI 1+2) receive signals from the output of NAV receiver 2.

- APP: HSI 1 and ADI 2 are fed from NAV receiver 1.
  HSI 2 and ADI 1 are fed from NAV receiver 2.

The selected frequencies are also changed by the same NSU.

- RADIO 1: NAV receiver 1 = frequency selector pos. 1

- RADIO 2: NAV receiver 2 = frequency selector pos. 2

- APP: NAV receiver 1 + 2 = frequency selector pos. 1

The frequency selection of the DMEs is not influenced by the NAV switching unit.

The NSU is located in the avionics compartment.

1.16.1.3.2 Manufacturer's Information

On the 22nd July 1984 the aircraft manufacturer DOUGLAS issued an ALL OPERATOR LETTER. In this letter, the possibility of a "frozen" glide or localiser indication without a warning flag was described.

DOUGLAS specified two NAV receiver groups:

1. Receivers which did not have a localiser and glide slope output signal monitor.

2. Receivers with the respective monitoring.

In the group of monitored units, DOUGLAS assumed that all COLLINS 51RV-2B units had been modified to **-109** (With Monitoring) status, as COLLINS had previously recommended in 1975. The false assumption by DOUGLAS about the COLLINS units, may have led to certain DOUGLAS customers as with ALITALIA not being alerted, and thus continuing to operate with unmonitored (**-108**) units.

At ALITALIA, the COLLINS receivers were not modified and at the time of the accident were still of **-108** status.

On the 17th April 1985 DOUGLAS conducted a seminar in the USA on the subject: "HSI/GLIDE SLOPE UNFLAGGED FAILURES"

Amongst others, Captains from ALITALIA and ATI took part in this seminar. During this seminar attention was once again drawn to the dangers of "unflagged glide slope failure" in connection with NAV switching.

1.16.1.3.3 Examination of the NSU of I-ATJA

The NSU from I-ATJA, P/N 600 916-101, S/N 222 (series 002) manufactured by Butler National, was recovered from the accident site.

The condition of this unit allowed closer examination. As the rotary switch is positioned by an electric motor, it could not change position during the impact. The examination of the NSU showed that the switch position was undoubtedly RADIO 1.

Contrary to this, the RADIO switch on the Flight Director panel was recovered in the position APP. It must therefore be assumed that either one of the pilots moved the switch shortly before impact or it was shifted by mechanical force.

Finding the NSU in position RADIO 1 undoubtedly confirms the position which the pilots selected for the approach according to the cockpit conversations (CVR). During a routine approach with ALITALIA, the position APP would be used.

1.16.1.4 Examination of the Captain's HSI

The HSI was subjected to a trace examination by the Scientific Service (WD). As a result, a concentration of heavy impressions from the GP needle was found on the GP scale about 1/3 of a dot above the centre mark. A microscopic comparison of the impressions with a new GP needle confirmed this fact.

In addition it was also be found that at the time of the impact no warning flags were in the pilots' field of view.

The concentration of impressions about 1/3 of a dot above the centre mark can be explained as follows:

Before contacting the hillside, DC-9-32 I-ATJA first struck some trees. As a result it was turned against the hill face and only then struck the solid surface. In the accident the collision was a relatively long event. This had the result that during the whole collision, the GP needle vibrated both ways, i.e. vertically and horizontally. It can be assumed that the collision with the first trees moved the GP needle out of the centre position which would explain the concentration of impressions referred to.

1.16.1.5 Comparator

1.16.1.5.1 Description (see Annexes 8 and 9)

The ALITALIA DC-9-32 is equipped with a NAV instrument comparator. This compares, amongst other things, the deviation signals of the GP and LOC. It produces an optical warning for the pilot on the so called "Bow tie" indicator if a discrepancy is detected above a pre-determined threshold. This comparator is only active when the RADIO selector is in the position APP, i.e. when both NAV receivers deliver valid GP and LOC signals. In addition, the signal must be valid.

In position RADIO 1 or RADIO 2, (i.e. NAV 1 or NAV 2) the comparator is not active.

1.16.1.5.2 Examination of the Comparator

The comparator of I-ATJA was recovered from the accident in a considerably damaged state. A closer examination of this unit was impossible. There is a slight possibility that a short circuit in the GP signal input of the comparator could have caused a centred GP 1 indication (without warning flag).

1.16.1.6 Ground Proximity Warning System (GPWS)

ALITALIA DC-9-32 aircraft are equipped with GPWS. According to the ALITALIA documentation, a Sunstrand Mark II GPWS P/N 965-0476-088, S/N 5127 was installed. The GPWS belonging to I-ATJA was not recovered from the accident site and thus could not be examined.

The sound of a GPWS warning is never audible on the CVR. This played a significant role in the accident sequence.

1.16.1.6.1 Functional Analysis of the GPWS on the Accident Flight

In the final phase of the accident flight the following warning modes might apply due to the aircraft configuration (gear down, flaps down):

- Mode 1: Excessive sink rate
- Mode 2b: Excessive terrain closure rate
- Mode 5: Excessively below glide slope

Mode 1

As the sink rate was within the specified limits at all times, this warning can be ruled out.

Mode 2

Whilst overflying the Küssaberg Mode 2a was still active. At this point a closure rate of about 4000 ft/min would have been necessary for a warning to be triggered.

Having crossed the Rhein the flaps were extended to more than 15 so the GPWS changed to mode 2b. The fact that the "Terrain" warning did not occur could be traced back to a combination of flight profile and terrain profile.

Mode 5

As long as the landing gear was extended whilst overflying the Küssaberg, the GPWS should, at that point, have given a "BELOW GP" warning. In the region of Weiach, all conditions required for a warning were definitely fulfilled.

Possible reasons for the failure to occur:

- GPWS respectively GPWS computer defect
- False glide slope indication (centred!).

The GPWS was thus unable to give a warning.

1.16.1.7 Distance Measuring Equipment (DME)

1.16.1.7.1 Description of the DME

ALITALIA DC-9-32s are fitted with two DME interrogators. The distances are displayed on both the PIC's and the COPI's HSI, which means that for each pilot two independent DME readings are available. The frequency selection is independent of the position of the RADIO switch on the flight director control panel. DME 1 depends on the NAV 1 selector and DME 2 on NAV 2 selector.

1.16.1.7.2 Examination of the DME

The PIC's HSI was recovered in a state which permitted examination. The DME indicators on the HSI showed unrealistic values which could be attributed to the fact that they were in the "search mode" at the time of the accident.

This assumption was confirmed by the test flight of 20th March 1991 (FOCA) on which the DME indications were lost at about 7 NM IKL. As it followed the flight profile of the AZ 404 the helicopter entered a reception 'shadow' due to the Stadlerberg. According to the CVR, realistic DME values were noted. We can conclude from this that until this shaded area at about 7 NM, the DME's were working normally.

DME 1 showed the selected frequency of the DME-ILS 14 (108.3 MHz) and DME 2 that of DME-KLO VOR (116.4 MHz).

1.16.1.8 Autopilot

1.16.1.8.1 Description of the Autopilot

The DC-9-32 of ALITALIA is equipped with an SPERRY SP-50A autopilot. This autopilot enables the pilots to lead the aircraft automatically to the GP and the LOC beam and to remain on these beams.

It appears from the DFDR trace that, in all probability, the aircraft captured and tracked the localiser beam with the autopilot. It is assumed that the NAV selector on the autopilot control panel was placed in the position ILS shortly before reaching the LOC beam.

In the normal case, in this position, the aircraft will continue in the same pitch mode ("Altitude Hold", "Vertical Speed", "IAS Hold"). Shortly before reaching the GP beam, the autopilot will command the aircraft to descend with a rate of descent of 700 ft/min for ten seconds and thereafter to follow the GS beam.

1.16.1.8.2 Examination

On the accident flight, on switching the NAV selector on the autopilot control panel, the aircraft was immediately commanded into a descent with a rate of 700 ft/min. It can therefore be assumed that the autopilot received an almost centred signal from NAV receiver 1.

An analysis of the autopilot function and the flight profile shows that the autopilot was most probably following a centred "frozen" GP signal.

A reconstruction of the flight conducted by ALITALIA showed that with the same fault, the profile was identical to that of the accident flight.

1.16.1.9 Examination of Passengers' Portable Telephones (NATEL = Portable Equipment)

As there were 15 passengers with Swiss residence on board, investigation was made into the possible use of NATEL-C units by one of the victims during the approach.

The use of NATEL units in aircraft has been prohibited by the PTT; this point is made in every subscriber's "conditions of use" document.

The reason for this prohibition lies in the problems associated with the single channel operating system (range), and also to eliminate the risk of interference with electronic equipment on board the aircraft.

Due to technical reasons, the mobile telephone system used in Switzerland can only be used in Scandinavian countries and not in those bordering Switzerland. Thus the investigation concentrated on the Swiss owners of mobile telephones.

This investigation was undertaken by the Zürich Kantonspolizei. It showed that ten passengers were in possession of NATEL-C units. Seven of these units were still in service after the accident. Two further units were found in victims' cars. The last of the ten NATEL-C units was used again on 21st December 1990.

A check of the wreckage recovered from the accident site gave no indications that a NATEL-C unit could have been on board DC-9-32 I-ATJA.

As a result of these investigations therefore, it was clear that no NATEL-C units had been taken on board the accident DC-9-32 by those victims who had been resident in Switzerland.

1.16.1.10 There were no clues which could be traced back to the presence of other portable electronic devices except for an electronic calculator.

1.16.1.11 Summary

1.16.1.11.1 Evidence

The evidence supporting a technical fault in the GP deviation circuit in NAV 1 is:

- It is inferred from the cockpit conversation that the crew had set the RADIO switch to the RADIO 1 position (NAV 1). ALITALIA requires the APP position.

- The examination of the NAV switching unit (Point 8) shows clearly that this was in position RADIO 1.

- The impressions on the side of the GS scale in HSI 1 just above the centre mark originate from the GP needle and were caused by the acceleration forces during the collision process.

1.16.1.11.2 Clues

Clues which support that a technical malfunction in the GP deviation circuit of NAV 1 existed:

- The behaviour of the autopilot during the approach
- The behaviour of the GPWS
- The normal functioning of the ILS transmitter for runway 14 at ZRH
- The fact that even before this accident, similar problems had existed on other aircraft. (centred "frozen" deviation indications) (according to communications from the aircraft manufacturer)

1.16.2 Altimeter

The altimeters installed in the aircraft were of the "drum pointer" type. On these the height is presented in thousand foot steps on a drum. For the details of the height above or below the particular thousand foot point a needle points on a round scale. The 'hundred' steps are numbered 1 - 9, each 20 ft step is marked by a small line.

On the drum pointer altimeter, two steps are required to read the height as part of the information is on the drum, and part on the round scale.

Only small parts of one of these altimeters were found in the wreckage. The degree of destruction was so great that no readings and no further examination was possible.

1.16.3 Reconstruction of the Flight

On the accident flight, in the region of 16 - 14 NM (ILS/DME RWY 14) about 1 - 2 NM west of the ILS centreline, at an altitude between 4800 and 4500 fr AMSL, problems occurred with the Glide Path indication. On the 9th March 1991, in order to check the reception and indication of the Glide Path signal with the same environmental conditions, a line flight (LIN to ZRH AZ 404) using an ALITALIA DC-9-32 followed the same flight path as that of the accident flight down to an altitude of 4000 ft QNH. It was possible to confirm that during the whole flight, until interception of the Glide Path, the GP indicator needles on all four indicators were always in the upper limit (out of sight) position. After tuning the VHF-NAV receiver to the ILS frequency at a distance of 17 NM (ILS/DME), the GP or LOC "flags" never appeared.

To obtain data about the reception quality of the Glide Path signal and the ILS DME throughout the Approach profile, two helicopter flights were conducted on 20th March 1991. The first flight during daylight, the second at night. The helicopter whilst flying on the LOC (RWY 14), followed the vertical profile from 14 NM (ILS/DME) until the point of impact. In addition to the two aircraft receivers, a GP signal strength measuring unit was used. During both flights the following observations were made:

LOC centred	NO FLAG
GP (Left) Full Fly UP	NO FLAG
GP (Right) Full Fly UP	FLAG at 6.5 NM ILS/DME
DME	FLAG at 6.5 NM ILS/DME

Additional observations at night:

During the approach, the runway was visible until a distance of 7 NM ILS/DME. The Stadlerberg seemed to be a "Black Hole".

Using the BRITISH MIDLAND/FLYTSIM DC-9-32 simulator at High Wycombe GB, the technical and operational implications of a scenario caused by a false GP indication from NAV-1 were noted. The simulator was modified to create an "open circuit" in VHF NAV-1, and thus a centred GP indication without a GP FLAG. The ALITALIA DC-9-32 simulator in Rome, which is identical to the accident aircraft, was modified in the same way. The sequence and correlations together with the resultant observations are noted in the analysis (2.3.1).

1.17 **Miscellaneous**

1.17.1 Air Traffic Control

1.17.1.1 Personnel Organisation of the affected ATC Shift

Personnel on Duty at the time of the accident in TWR/APP

Aerodrome Control	ADC -	1 person
Ground Control GRO, Supervisor	DL -	1 person
Clearance Delivery	CLD -	2 persons
Communications	COM -	1 person
Coordinator Approach	CAP -	unmanned
Approach Control (West Sector)	APW -	1 person
Approach Control (East Sector)	APE -	unmanned
Departure Control	DEP -	1 person

Allocation of Workstations

The workstations were allocated according to a shift plan. As a result of the reducing level of traffic, at about 1909 Hrs the CAP and DEP stations were closed as usual. The controller (ATCO) who had been relieved from the APP station was in the TWR available for further duty.

The AZ 404 was handled by APP west. The duty controller had the following duty and rest times:

- Shift began at 1500 lt 14th November 1990
- Between 13th November and 14th November 1990 the rest period was adhered to. On the 14th November there was no alcohol intake or use of medication.

Just before the accident the ATCO was handling 6 aircraft simultaneously. According to statements from colleagues, handling 6 to 8 aircraft an ATCO is not overloaded and this represents a normally high workload. Another ATCO stated that 6 aircraft was a normal high workload but the limit is reached with 10 to 12 aircraft.

1.17.1.2 Applicable Instructions for the Air Traffic Controller

The applicable instructions are mainly in the Manual of Air Traffic Control (Zürich) which is based on the relevant ICAO procedures.

1.17.2 ALITALIA Flight Procedures

These are to be found in the ALITALIA DC-9-32 Operating Manual and the ALITALIA Flight Operations Rules and the ALITALIA Company Manual.

1.17.3 Approach Charts

The ILS approach to runway 14 at Zürich is published in the AIP Switzerland. The approach chart published by the FOCA and current at the time of the accident is at annex 10 of this report. The approach chart from the ALITALIA Route Manual used by the crew can be found at annex 11, such a chart was used by the pilots. By comparing the two charts, it can be seen that, on the ALITALIA charts there is no relief shown beneath the final approach contrary to the AIP chart.

1.17.4 Recommendations of the Interim Report and the Reactions of the Responsible Authorities

In accordance with article 24 paragraph 2 of the Federal Council's Ordinance for Air Accident Investigation of 20th August 1980, on the 19th December 1990 the Investigator in Charge established some recommendations and immediate measures by means of an interim report, which was sent to the FOCA in Berne, and to the Italian Ministry of Transport (Ufficio Sicurezza Volo) in Rome.

1.17.4.1 The Recommendations to the Italian Authorities were:

1. The ALITALIA Company Operating Manual should be expanded in the following sense:

1.1 Should it not be possible to fly an ILS approach in the normal APP mode, and it has to be flown in NAV 1 or NAV 2, this is only allowed after checking position and altitude. In such a case, cross checks must be carried out by the crew at regular intervals as on a LOC approach.

1.2 The flight director pitch bar must not be centred manually.

1.3 After a call "GO AROUND" the respective measures should follow immediately, irrespective of who (the PIC or the Copilot) called for it. A GO AROUND, once started will be completed and not interrupted. (= 04.20.8 Operating Manual).

1.4 A simulated CAT II approach should be defined in the sense that a genuine CAT II approach should be executed.

2. It should be evaluated whether by issuing a personal route manual to each pilot, this would lead to a better flight preparation (home study).

3. The pilots should always have the approach chart in their direct field of view (perhaps a smaller format).

4. The approach charts in the ALITALIA Route Manual should have appropriate terrain section profiles under the glide paths (compare approach chart ILS 14 Zürich AIP Switzerland).

The Italian Ufficio Sicurezza Volo issued the following safety recommendations to the Italian Airlines on 15th January 1991 (Translation from Italian):

SAFETY ADVICES

1. The airline operations documentation shall contain the following information clearly:

1.1 When an ILS procedure is being conducted on any aircraft type using a single VHF NAV receiver, it is mandatory to maintain a continuous check of the correct vertical and horizontal position. This check is mandatory for aircraft which have a Flight Director system with the possibility to switch to RADIO 1 or RADIO 2 enabling the ILS presentation to be fed from a single receiver.

1.2 Whilst conducting a flight, if a situation arises which should be stopped and in the sense of "crew integration and communication" communication between the two pilots is lacking, the required corrective action should be executed by the pilots immediately. The one who recognised the situation must be supported until the completion of the manoeuvre. Above all if such a situation occurs during a final approach, the Go Around must be executed instantly and the PNF must give the maximum support so that the manoeuvre can be completed correctly.

2. The airline shall mention the following in documentation and during training:

2.1 The Briefing for an approach must be short and concise; it should however contain, bearing in mind the aircraft configuration and the approach proce dures, minimum altitudes at defined positions with their correct identification, the DH (Decision Height) or the MDH (Minimum Decision Height) connected with the approach procedure. The discussion of items which are not directly connected with the above should be avoided, for the sake of control of the flight, and the correct execution during the approach and landing phases only the initial points of the possible Go around should be mentioned.

2.2 All possible available information must be used to gain a complete picture of the accuracy of the actual position.

1.17.4.2 Recommendations to the Swiss Authorities

1. The Manual of ATC (Switzerland) should be expanded in the sense that the Approach Controller should monitor the altitude (as long as an appropriate SSR signal is visible on the radar screen) until the crew has called established. If needed be the crew must be requested to make this call.

2. All ILS runways in Switzerland should be equipped with a PAPI system. ICAO recommends VASI or PAPI for all ILS RWYs. Various states including Switzerland have exempted ILS RWYs and have notified ICAO accordingly.

3. The erection of an obstacle lighting system on the Stadlerberg should be evaluated immediately. According to current ICAO standards, the natural obstacles beneath an ILS need only be lighted to a distance of 3 km from the RWY threshold. The distance of the Stadlerberg from the threshold RWY 14 is 9.3 km.

The reaction of the Federal Office for Civil Aviation (FOCA):

to 1. On the 20 December 1990 the FOCA gave the instruction to SWISSCONTROL that the recommendations being an immediate and interim measure should be followed immediately. Swisscontrol actioned this instruction with an amendment to the Manual of ATC valid from 22nd December 1990. The relevant Swisscontrol operating instructions were adjusted on the 5th February 1991 and are still in force at the completion of the investigation.

to 2. Installation of PAPI on all Swiss ILS runways will be evaluated.

to 3. Steps have been taken to obtain obstacle lighting for the Stadlerberg.

1.17.5 Recommendations from the US NTSB to the FAA

In January 1992 the officials responsible for accident investigation in the USA, the National Transportation Safety Board (NTSB), issued the following Safety Recommendations to the Federal Aviation Administration (FAA) for publication. The recommendations are:

'Issue an Air Carrier Operations Bulletin to Principle Operations Inspectors requiring that operators of airplanes equipped with the following navigation receivers include in their operating manuals procedures for detecting malfunctions that result in the display of disparate information: Collins model 51RV-1; Collins model 51RV-4; Wilcox model 806; King model KNR 6030; and some versions of Bendix model RNA 26C. Also notify formally foreign airworthiness authorities about the potential failure mode in such equipment'. (For full text see Annex 12)

The NTSB recommended to the FAA that pilot handbooks of those airlines which use NAV receivers of the models specified should included an appropriate warning, and that the foreign (non American) aviation authorities should be informed. ALITALIA have already amended their books accordingly and thus have already complied with this American recommendation (see Annex 15).

1.17.6 Go Around Procedure

According to calculations from the investigating team and from the manufacturers, the go around started by the Copilot 19 seconds before the accident would have been successful had it not been interrupted (Annex 14).

2. ANALYSIS

2.1 The Ground Equipment

2.1.1 The Instrument Landing System of Runway 14

This was used by other aircraft prior to and after the accident without any irregularities being noted. The calibration flight conducted by the FOCA calibration aircraft a few hours after the accident, confirmed that the ILS equipment was functioning normally. It can therefore be assumed that at the time of the accident, the ILS 14 (CAT III) was functioning normally.

2.1.2 Obstruction Lighting on the Stadlerberg

The Stadlerberg is too far from the runway threshold for it to require obstruction lighting, as specified by the ICAO standards. As the 637 m high Stadlerberg can not be seen at night due to its unlit surroundings, it could thus become a danger to aircraft unintentionally flying below the glide. The subject of obstacle lighting has

been in discussion between Swissair, the airport authorities and the FOCA since 1976. Supported by the recommendations in the intermediate report to the authorities of the 19th December 1990, this lighting will now be erected.

It is not to say that the crew of the accident aircraft would have noticed such lighting. It gives no indication on the CVR recording that one of the pilots looked outside before the accident. It is more likely that in accordance with normal procedures and from the CVR conversations that their attention was concentrated fully on the instruments. Additionally, the Stadlerberg was capped with a cloud layer of unknown thickness.

2.1.3 Angle of Approach Lighting

Contrary to the ICAO standards, Switzerland and other countries do not equip ILS runways with Angle of Approach Lighting (VASI or the more accurate and modern PAPI). Switzerland has made ICAO aware of the difference.

As an angle of approach lighting system could have been of assistance in the event of an error in navigation and with visual conditions, the installation of a PAPI system is now being evaluated for Swiss ILS-runways.

2.2 The Aircraft

2.2.1 An explosion on board the aircraft during the approach could be excluded soon after the accident. There were no such clues. The radar recordings clearly showed that the aircraft had already descended below the correct altitude.

2.2.2 The examination of the engines after the accident and the recordings from the flight data recorder excluded any engine damage. These were working correctly throughout the flight.

2.2.3 The recordings from the CVR show that the instruments (ADI/HSI) had apparently captured the glide slope and at a moment when the aircraft was flying about 1300 ft below the glide path. Special emphasis was placed on the examination of the NAV instruments and the NAV receivers. In respect of the indications, only a part of the Captain's HSI unit was found. With the help of microscopic examination, it could be determined that during the impact, the glide path indicator had been positioned just above the centre "On Glide" position.

Securing of evidence, examination, and evaluation of the CVR confirmed that all 4 NAV indicating instruments followed the glide path during the final approach, although the aircraft was flying under the nominal glide path of RWY 14.

NAV receiver 1, onto which all 4 NAV instruments were switched during the final approach, could be recovered and examined. No pre-crash defects were found either on the unit, or on the plug in question. Admittedly after the accident, it was found in a heavily damaged and deformed state.

The detailed examination of the NAV equipment and the letter dated 24th August 1984, which related to the NAV Switching Failure Mode, passed to the Investigator in Charge by the aircraft manufacturer McDonnell-Douglas, shows that the use of the NAV mode can lead to a completely false LOC or GS indication ('ON' indication) without any warning appearing in the instrument (red flag). This happens when the NAV receiver does not deliver an output signal. The letter from the Douglas Aircraft Company went to all operators of DC-8, DC-9, C-9 and MD-80 aircraft and showed the doubtful NAV receiver types in which the failure could occur. ALITALIA received the letter and the accident aircraft was equipped with the receivers in question.

Although the Douglas Aircraft Company held a seminar for the affected companies during 1985 in Long Beach, USA, at which ALITALIA was represented by three Captains, the message from both the letter and the seminar was not transmitted to the ALITALIA operating crews. They, including the affected crew, were unaware of the possible false indications in question. After the accident, ALITALIA informed all the pilots about the problem and such failures have been included in the training and refresher programmes in the simulator. The US NTSB, who were only made aware of these false indications by this accident, have reacted in the meantime and made the necessary recommendations to the FAA.

2.2.4 Both altimeters were of the so-called, "Drum Pointer" type. These older models have the disadvantage that the altitude can only be read in two steps, because the main information is shown on the drum, and the refinements by a pointer on the round scale. A further complication is the fact that in certain pointer positions, the drum is not possible to read adequately as the numbers on the drum are partially obscured by the pointer. Despite the white band which appears on the left side of the "thousands" figures, this can lead to an incorrect interpretation of the "thousands" value.

The critical part of the flight is the landing phase. Although this is only about 4% of the whole flight time, 48.3% of accidents occur during the approach. In past years, there were several accidents which could be traced back to misreading the altimeters.

Amongst other studies, NASA has published the following which are concerned with the problem of Altimeter Misreading:

- NASA TM-81967 "How a Pilot looks at Altitude".
- NASA CR-3306 "Instrument Scanning and Controlling: Using Eye Movement Data to Understand Pilot Behaviour and Strategies".
- NASA TP-2525 "Analytical Techniques of Pilot Scanning Behaviour and their Application".
- NASA TM-86424 "Effects of Digital Altimetry on Pilot Workload".
- NASA TP-1250 "Airline Pilot Scan Patterns during Simulated ILS Approaches".

Summarising these studies, we can say the following:

1. Mis-reading of "Drum Pointer" altimeters occurs often.

2. Several glances at the altimeter scale are necessary to assimilate all the information that is available.

3. The pilot can recognise the relative needle position (left/right) with a short glance (0.1 sec).

4. Reading the drum (thousand indication) requires 0.6 sec. and is more difficult than reading a needle. As a result, the drum is consulted less frequently.

5. During an approach, the altimeter is consulted during about 3-6% of the time. The NASA studies showed that the pilots surveyed thought that they had monitored the altimeter during 20-25% of the approach.

From a survey of 169 US National Airlines B-727 pilots (NASA TM-81967):

- 137 pilots said that they had already mis-read an altimeter.
- 134 pilots had observed another pilot mis-reading an altimeter.
- 85% of both groups explained that they had made these observations more than once.
- A surprisingly high amount of mis-reading (50) occurred during the approach phase.

The survey led to the following additional comments from the pilots:

- "This altimeter takes more concentration than should be necessary to read accurately".

- 'The small drum window is a complication on the instrument and (is) quite small, often requiring a 'double look' and diverting attention from the needle. Other instruments require only a single point of visual attention to comprehend and do not divert, slow or complicate a smoothly flowing scan".

- "Misreads always seemed to occur at the lower altitude when attention is split between more activities."

- "The more stressful situations produced more misreads".

- "A quick look after (being distracted) can usually induce a reading of 1000 ft off if the barrel drum is half way between thousands".

Much earlier it was noted that the Drum Pointer Altimeter design was problematic. The following statements support this:

1959 USAF Report Training Research & Development Section "Evaluation of the Drum Pointer Type MD-1 Altimeter"

"The Drum Pointer Altimeter is not an acceptable instrument. When using the drum presentation, pilots can be expected to overshoot altitudes due to non-interception of the 1000 foot increment".

1959 USAF Flight Test Report, "Re-evaluation of Drum Pointer Altimeter Display"

"The drum pointer altimeter, in the configuration and the presentation tested, was found to be inferior to the three pointer altimeter and unacceptable for general Air Force use. It admittedly does away with the 10,000 ft reading error, especially at low altitudes. The disadvantages of the instrument outweigh the advantages by a wide margin".

1963 Bell Helicopter Co., Report "Altimeter Display and Hardware Development, 1902-1960, May 1963"

"The basic instrument design, coupling the indicator types of drum and pointer circular scale has been shown empirically to elicit relatively high percentages of 100 ft and 1000 ft quantitive reading errors".

1969 Flight Safety Foundation, Pilots Safety Exchange Bulletin, 69-103/105, "Misreading of Altimeters", Captain G C McGiloray, Vice President Operations, Middle East Airlines Air-Liban.

"The possibility of over-reading the particular type of altimeter (drum pointer) by 1000 ft, has been clearly established and it is possible to easily imagine circumstances in which such misreading could lead to an accident".

1972 Mitre Corp. "Altimeter Display Study"

"An advisory circular should be issued, suggesting that all aircraft replace 3P (3 pointer) and DP (drum pointer) altimeters where feasible to enhance flight safety".

1978 National Airlines, Internal Memo, WP Ledford, May 15, 1978 (7 days after the Pensacola accident).

"Remove all altimeters (drum pointer) from B-727 fleet and change to digital read-out type. The digital read-out altimeter is very difficult to misread below 1000 ft".

1980 Flight Crew Magazine, Summer 1980, Dr A O Dick, Behavioural Research Applications Group Inc., "Seeing Without Looking and Looking Without Seeing"

"If you think such altimeter misreads are uncommon, be forewarned. Some available evidence suggests misreads are uncomfortably common with this drum pointer. The current trend indicates another drum pointer related accident will occur in 1980 or 1981".

It should not be excluded that one or more altimeter reading errors contributed to the AZ 404 accident. It is plausible that the PIC had read a height below 1000 ft as a height above 1000 ft. As he was convinced that the Outer Marker height of 1250 ft had only been undershot by a small amount, he intervened during the Copilot's "Go Around" order. He prevented the missed approach in the belief, that with a reduced rate of descent or even a short level flight segment, the nominal glidepath could be attained within a short time. For technical reasons a GPWS warning was not possible at this point.

It is not known why:

- The aircraft manufacturer did not release any recommendations
- The national authorities did not produce any directives (Manufacture and Registry states)
- The company made no efforts to have the altimeters in question replaced.

2.2.5 During the approach, the crew had their indicating instruments (HSI and ADI) switched to NAV receiver 1 (RADIO 1). As a result an important safety system was bypassed and its optical warning was not available. It is doubtful whether the available switching capacity of the NSU is adequate for flight safety.

2.3 Flight Sequence

At 1836 hrs flight AZ 404 took off from runway 36R at LIN bound for ZRH. The climb towards CANNE was normal. Noteworthy is that during the cruise, although the pilots knew that the actual wind was relatively weak (actual 240/8 kt, TAF maximum 10 kt), unusually long discussions ensued about circling to runway 28 in ZRH. The most recent ATIS information (Germany) gave Runway 14 as the actual landing runway. Questioning the COPI about the radio failure procedures during the descent was unsual. Errors developed during the confirmation of the CAT II minimum and the Go Around procedures, and the COPI had the wrong landing chart in front of him. The instructional tone used by the PIC to the COPI on many occasions was noteworthy. Although a CAT II approach was to be conducted, nothing is heard about the procedure.

Based on the CVR recording, the last 10 minutes of the flight can be shown as follows:

19.01.30: The aircraft was abeam (South West) Kloten (KLO VOR) at FL 90. The PIC drew the COPI's attention to the position with the comment they were rather high. The PIC recommended emphatically that the COPI should reduce the speed further with the reasoning that from now on they would only move further away from the airport and that the aim was to make an economic approach. A little later (19.02.07 hrs) the flight was instructed by ZRH APP to reduce the speed further to 210 kt which was accompanied by the PIC's remark "You see!"

19.04.32: The PIC defined the outer marker height as being 1200 ft, (correct would have been 1248 ft QFE) and gave the distance as 3.8 NM KLO-DME (correct would have been 3.8 NM ILS-DME).

19.06.20: The crew received the following clearance: "AZ 404 descend to 4000, turn right HDG 110, cleared ILS approach runway 14, QNH 1019." This clearance was read back by the PIC only uncompletely and the HDG was read back as 120 instead of 110. In addition, the flight number and the confirmation of the approach clearance were missing from the readback. The Air Traffic Controller did not correct the wrong readback of the HDG. The flying pilot turned according to the clearance onto HDG 110.

Visualisation of Cockpit Indications (Annex 13)

19.06.45: Figure 1: Starting point RADIO 1
Figure 2: Starting point RADIO 2
Both versions are possible.

Having received the approach clearance and approval to descend to 4000 ft QNH the altimeters were correctly set as follows (see 1.18.5 ALITALIA Company Manual, Altimeter setting): PIC's side QFE 970 hPa, COPI's side QNH 1019 hPa; Altitude Preselect 1019 mb/4000 ft.

Fig. 1: In the Radio Selector position 1 the relative position to the localiser (LOC) and glidepath (GP) is shown on all four instruments (ADI 1 and 2, HSI 1 and 2), supplied by VHF- NAV 1 (108.30 MHz/ILS 14).

Assuming that the fault in the GP receiver already existed, the GP indicator on all four instruments was centred. As the crew were of the opinion that they were above or at least on the glidepath, the indication was plausible for them.

Fig. 2: The Radio Selector was on RADIO 2. All four instruments showed the position relative to the misleading course 138 on KLO-VOR (VHF-NAV 2).

19.07.25: Fig. 3: The crew selected RADIO APP on the Radio Selector. By switching to RADIO APP, VHF-NAV 2 internally automatically tuned the ILS frequency 108.30 MHz of VHF-NAV 1. The selected frequency of 116.40 MHz on VHF-NAV 2 remained visible and available for DME 2 receiver. Accordingly, DME 2 showed the distance to KLO-DME. DME 1 showed the value from ILS-DME 14. The signal from VHF-NAV 1 receiver was displayed on HSI 1. Due to the fault in the GP receiver 1 a Null (zero) Signal was sent which led to an apparently correct centred GP indication on HSI 1. ADI 2 takes the LOC and GP information of HSI 1. HSI 2 received information from VHF-NAV 2 receiver which was functioning correctly. ADI 1 received the LOC and GP information of HSI 2. The actual position was way below the nominal glidepath. Accordingly the pointers in HSI 2 and ADI 1 were in the upper limit position and as designed not in view. The OFF FLAG was not in view because the GP signal was being received.

19.07.40: Fig. 4: In the meantime, the Flight Director Mode Selector was switched to the position NORM, confirmed by "N-L ARM" in the Mode Annunciator Panel. Due to the disparity of the GP indications, the GP Comparator warning light came on. The Copilot (FP) asked: "Do you have the Glide?". The Captain replied "On 1...". Five seconds later the Copilot said: "I don't have it". The Captain's comment "On 1" referred to the indication on HSI 1 which was centred. The Copilot, with the words "I don't have it" was referring to the indication on HSI 2.

19.08.00: Fig. 5: At 19.07.59 hrs the PIC decided: "Good, let's do it on 1", whereby the COPI ordered "RADIO 1".

On switching to RADIO 1, all four instruments switched to VHF-NAV 1. The crew had a centred GP indication on all four instruments. This presentation corresponded with the pilots' idea of their position and altitude. At this point the altitude was still about 4600 ft QNH. On approaching the LOC the autopilot NAV Selector was turned to ILS. As designed, the autopilot captured the GP ("GP-CAP" in view on the AP Mode Annunciator). This event is documented by the change in Rate of Descent from about 1150 ft/min. to about 700 ft/min.

19.08.47: Fig. 6: The aircraft was slightly East of the LOC at about 4000 ft QNH where, although both Flight Directors and the Autopilot were following the LOC and GP. In the case of the GP it was the Null Signal from VHF-NAV 1 receiver. Here the aircraft was already 1200 ft below the nominal glidepath and still 12 NM from touch-down. This finding is supported because at 19.08.47 hrs the PIC confirmed "... capture LOC capture Glide path capture, so we are on the beam a little off track but ...".

19.08.53: Fig. 7: Descent through 4000 ft is confirmed by the COPI "970 for me too", as he also set his altimeter to 970 hPa QFE.

19.08.57: Fig. 8: The aircraft passed 3700 ft as the Altitude Exit Warning sounded. This was armed to the selected altitude of 4000 ft QNH on the Altitude Preselect System.

19.09.43: Fig. 9: Convinced that he was established on the ILS, the PIC said at 19.09.09 hrs: " I cancel and set 5000", referring to Altitude Preselect System. At this point the Landing Gear was probably extended, as during setting of the Flaps to 25 (19.09.41 hrs) no Gear Warning Horn was heard. At 19.09.18 hrs the PIC urged the COPI to reduce the speed further as he feared they were closing too near to the preceding aircraft. At 19.09.47 hrs the PIC stated "The outer marker check is at 1250 ft (QFE)". The altitude was now 1600 ft QFE and the distance from touchdown about 9 NM. As before, the aircraft was about 1200 ft below the the nominal GP.

19.10.12: Fig. 10: At 8 NM IKL, the altitude on the GP should have been 4000 ft/QNH or 2598 ft/QFE. As the PIC remarked "3.8 almost 4 miles", the actual height was 1100 ft/QFE (outer marker height 1248 ft/QFE). These distance figures referred to the ILS-DME distance to the Outer Marker. At 19.10.27 hrs the COPI asked whether they had already passed the Outer Marker. At 19.10.39 hrs he repeated this question once again. The PIC responded "No, no, it hasn't changed yet ...." It is not clear what this answer meant.

19.10.43: Fig 11: The PIC remarked that the ILS-DME showed 7 NM and possibly began an analysis of the position. His thoughts were interrupted by the order from ZRH APP to change to ZRH TWR on frequency 118,10 MHz. The instruction to change frequency with an indication of the relative position to the preflying airplane and the clearance that there were no more speed restrictions did not give the crew any reason to analyse their position. At 19.10.56 hrs the Captain's uncertainty was heard "That doesn't make sense to me ...", the COPI responded "... nor to me ...".

19.10.59: Fig. 12: At 19.10.57 hrs the PIC called out "Pull, pull, pull, pull" upon which disconnection of the Autopilot is heard. The PIC, due to misreading the altimeter, was obviously of the opinion that they were still at 1300 ft/QFE. Possibly the PIC wanted the COPI to fly the aircraft level until they reached the Outer Marker. The COPI probably interpreted the altimeter correctly and read a height of 300 ft/QFE. This caused him to commence a missed approach with the order "Go Around" (position about 6 NM from touchdown).

19.11.17: Fig 13: At 19.10.59 hrs, the beginning of the Go Around manoeuvre is clearly recognisable. Immediately (19.11.00 hrs) after the COPI's "Go Around" order the PIC intervened as follows: "No, no, no, no ... catch glide". Italian expression "fattiti" (phonetic).

2.3.1 Crew

2.3.1.1 Human Relationship in the Cockpit

The human relationship situation in the cockpit can only be judged on the basis of the CVR. Unfortunately due to the open speakers and possibly to a worn out tape, the quality of this tape recording is very bad.

The psychological interpretation of the sound levels in respect of the feelings and atmosphere is particularly difficult. It can certainly be stated that during the entire flight the conversation restricted itself to operational matters. The PIC thus showed his experience based superiority.

2.3.1.2 Use of the ALITALIA Procedures and Deviations from Trained Procedures

From the evidence, there is no strict adherence to the ALITALIA procedures. Had the crew stuck to the procedures, the void between the PIC and the COPI, i.e. the coordination and cooperation, would probably have been covered at least in the critical phases. Extracts from the ALITALIA Company Manual (04.20.4/4):

- Approach briefing
- Initial Approach Altitude
- MSA (briefing)
- Standard Operative Call-Outs "LOC alive", "Glide alive" (04.20. 7/2)
- Conditions requiring a missed approach (04.20. 8/2).

2.3.1.3 Airmanship (Professional Competence)

a) Crew

In general, it appears that during the flight the PIC's behaviour was professional during routine operations. The impression does not apply when abnormal conditions appeared. In switching the Radio selector to RADIO 1, the crew did not proceed to an analysis of the cause of the (supposed) false indication, or even to make a subsequent crosscheck. It appears to have acted on a predetermined opinion (expected indication regarding the GP). The COPI continued the descent below the outer marker altitude although this had not been passed.

b) Crew as team

The team work in the critical phases was incomplete.

2.3.1.4 Navigation Monitoring during Radar Vectoring

Flight AZ 404 received clearance from APP to descend to 4000 ft/QNH with a subsequent ILS approach. AZ 404 was only given a distance to the preflying airplane, but it was never given a distance to the touchdown of RWY 14. Similarly, the CVR contains no conversations between the pilots concerning verification of position, until the point (ca. 40 seconds before impact) when the pilots compared the indicated DME distance (7 NM) with the Outer Marker distance of 3.8 NM which led to uncertainty. It appears that from the beginning of the approach, the crew had exclusively followed the instructions of the APP controller. The ILS localiser intercept, reaching 4000 ft/QNH and the false GP indication (NAV 1) occurring simultaneously could have led the crew to believe that this was a result of an optimum radar vectoring. In addition, the "assumed" establishing on the ILS required no further navigational analysis. Had the crew verified the DME distance on leaving the Initial Approach Altitude of 4000 ft, then they would have noticed the discrepancy between the actual position at 14 NMs and the correct distance for this (Approach Fix) of 8 NM. Neither before nor during the approach did the crew carry out a timely systematic check of the indications of both NAV equipments. Additionally had these indications been compared with other available aids it would also have occurred to them that the GP indication on NAV 1 could be wrong. Factors from the predominantly dynamic environment could have led to inadequate monitoring of the navigation. The CVR shows that as several aircraft were on approach, there was intensive ATC radio traffic (APP) with the correspondingly high concentration and attention required of the pilots. In addition, the PIC's concern that the aircraft was closing on the preceding one too rapidly, thus risking a Go Around, further limited capacity.

2.3.1.5 Go-Around

The Flight Operation Rules of ALITALIA (04.20.8/2) contain amongst others, the instruction that during an IMC instrument approach a Go-Around shall be flown if there is any doubt about the functioning of available navigation aids.

About 40 seconds before the impact, the COPI asked whether the outer marker had been overflown, the PIC said that it had not. Immediately afterwards, the PIC noted that the distance was 7 NM ILS-DME. The resultant uncertainty is audible on the CVR. Even if one had misread the altimeter by 1000 ft too high this would still have suggested a Go-Around. The COPI as flying pilot executed one which was not accepted by the PIC. Even the Radio Altimeter warning which sounded ten seconds later caused no reaction.

Two independent studies have shown that had a Go-Around been continued, the Stadlerberg would have been cleared albeit very close (Annex 14).

General experience shows that a considerable resistance to Go-Arounds exists amongst pilots. The main reasons for this are the subsequent need for filling in reports, the time loss as well as the unpleasant duty to inform the passengers and cabin crew. A Go-Around is seen as a failure, as lack of professional competence and even loss of prestige. Before the critical situation, the PIC had already mentioned a possible Go-Around due to the proximity of the preceding aircraft and wanted to avoid this. His pointed self-confident manner towards the COPI, in addition to an internal resistance, did not make it easier for him to accept a Go-Around. He was apparently not aware of the danger of the situation.

According to ALITALIA their crews do not have to justify such situations.

2.3.1.6 Headsets and Microphones

The quality of the CVR recording is bad. It required a great deal of work to understand the cockpit conversations recorded from the area microphone. The reasons for this bad comprehension is due on the one hand to the inferior technical quality of the recording equipment but in particular it is due to the fact that the pilots, even during the approach, did not make use of the headsets (with attached microphone) for communications with the approach controller as is usual. The conversations between the pilots are therefore partly obscured by external radio traffic.

2.3.1.7 Medical Aspects

There are no indications of any medical causes for the accident based on previous medical history, as far as it is available, personal contacts, the flight progress, the CVR and the findings of the Post Mortem.

Various levels of Ethyl Alcohol concentration between 0.02 0/00 and 0.38 0/00 were found in the Copilot's tissue. Such differences do not occur with samples taken soon after death, and are attributable to changes in the alcohol content after death. The samples were heavily infested with 12 types of bacteria. 11 of these types produce ethylalcohol and 1 reduces it in very small amounts. The effects of intense heat can also vaporise alcohol.

Even on the basis of toxicological analysis, it can not definitely be excluded that the pilot consumed alcohol before death. The effects of an alcohol level of 0.3 0/00 on the capabilities is given different values by various authors: it is certainly not very great. Based on the observations of personal contacts and from the Cockpit Voice Recorder there is no evidence to support that the Copilot was in an inebriated state. Generally it is probable that this is related to alcohol produced after death.

2.4 Air Traffic Control

2.4.1 The radio-electronic approach aids - ILS 14 - were, according to the automatic monitoring systems, functioning normally. This fact was confirmed by subsequent calibration test flights. Test flights checked the LOC, GP, DME and the marker transmitters. The approach and runway lighting was switched on and operating normally. The communications and radar equipment was also working correctly.

2.4.2 The necessary Air Traffic Control work-stations were occupied according to the duty roster. The Air Traffic Control management have determined that the level of approach traffic prevailing at the time of the accident was normally so high.

2.4.3 On the beginning of the approach AZ 404 was on radar vectoring on FL 60. In this phase the ATC-Controller is responsible for terrain clearance according the prescriptions.

At 19.05.20 hrs the Approach Controller instructed flight AZ 404 to descend to 4000 ft, turn right onto heading 110 and he gave clearance for an approach on the ILS for runway14 using a QNH of 1019 hPa. This clearance guaranteed terrain clearance until the final approach point (FAP).

As the heading changed to about 150, the ATCO assumed that the AZ 404 had taken up his own navigation and was establishing on the LOC. According to the procedures, the radar vectoring is completed after the "Established" call. This call should be requested by the ATCO and in this case was omitted. The crew did not call on their own initiative.

Under the circumstances, the call established would probably have been made because the crew were under the illusion that they were fully established.

According to the published approach procedure, the aircraft should have left the cleared 4000 ft only when on the ILS, and at a distance of 8 NM ILS-DME. In fact the aircraft descended below the cleared altitude on intercepting the LOC at a distance of about 11.5 NM, flying parallel beneath the GP with a roughly constant rate of descent until the accident site.

Although the altitude transmitted by the aircraft transponder was clearly visible on the Approach Controller's radar screen, he did not pay attention to it, and did not notice that the aircraft had already left its cleared altitude before the Final Approach Point (8 NM). According to the standing instructions until this point the ATCO must check the adherence to cleared altitudes and in the event of an undershoot he must intervene. He omitted this check as he was of the opinion that his monitoring function was finished, because the aircraft was on the LOC at the instructed speed and he assumed that aircraft was also established. This assumption can be explained because during the whole duty time of an ATCO many aircraft are observed on the LOC beam on the radar screen compared with very rare cases of aircraft being below the cleared altitudes and the glidepath. The failure to call established by the pilots happens from time to time and was generally tolerated by ATC. The constant flow of traffic which in Zürich is occasionally quite dense did not seem to allow a time consuming questioning. In this situation it is expected that an aircraft observed on the LOC will also follow the prescribed approach profile.

Finally it must be noted that the Approach Controller never gave flight AZ 404 position or distance information relative to runway 14. He merely gave a distance to the preceding aircraft.

2.4.4 During the investigation it was noted that the instructions contained in the Manual of ATC volume 1, although conforming with the international standards of ICAO, were presented in a way that does not allow a good overview, and it is sometimes not precisely formulated and thus can lead to varying interpretations. In particular the transition from radar vectoring to pilot interpreted approaches is not precisely formulated. The terrain collision avoidance is not part of the ATC responsibility except during radar vectoring.

It may also be noted here that the SWISSCONTROL instructions exceed those of ICAO in the area of radar monitoring.

2.4.5 In summary it can be stated that the clearances and instructions of ATC contained no incorrect statements. However as a result of omissions by not following the standing instructions the disastrous sequence was not interrupted by ATC.

A timely warning from the Approach Controller and the appropriate action by the crew might possibly have prevented the accident. Particularly with the uncertainty prevailing in the cockpit at the time just before the accident, a warning would have been taken seriously and would have led the crew to a check and make a comparison of the various instruments - above all the altimeters.

A "Minimum Safe Altitude Warning System" on the APP radar, as has been used for the last ten years in the USA, would have automatically made the task of noticing a altitude undershoot possible independent of the traffic density.

From the numerous safety nets in air transport, also the one of the ATC did not prevent the accident.

3. CONCLUSIONS

3.1 Findings

- The aircraft fuselage and engines were in order and working normally during the flight. The weight and centre of gravity were within limits.
- The NAV receiver No 1 which was in use during the approach (Type King KNR 6030) was apparently not delivering an output signal. All 4 NAV indications gave an "On Glide" indication without a warning flag appearing.
- The possibility of such a failure on the NAV equipment in use has been known since 1984.
- ALITALIA was informed by the aircraft manufacturer about the possibility of these failure possibilities in the years 1984 and 1985. They were unknown to the crew of AZ 404.
- The altimeters used in the aircraft were of the so called "Drum Pointer" type. On these, the danger of misreading is particularly great.
- The crew of AZ 404 were in possession of the necessary licences.
- The pilots were in good health. The minimal level of alcohol found in the Copilot's body can most probably be attributed to post mortal micro-biological processes at the accident site.
- The COPI was the flying pilot.
- Before intercepting the ILS 14, the crew switched to RADIO 1 - (NAV No 1).
- The Final Approach Point ILS 14 is situated 8 NM from the runway (ILS-DME) at 4000 ft/QNH.

- On intercepting the LOC at 11.5 NM the aircraft descended below the cleared altitude of 4000 ft/QNH.

- The aircraft followed the LOC 14 precisely but descended constantly about 1300 ft below the GP until the accident site.

- The crew allowed the aircraft to descend below the outer marker height of 1248 ft before passing the outer marker

- During the entire approach, there was no GPWS warning in the cockpit.

- The Approach Controller was in possession of the necessary licences.

- The approach control work station is equipped with secondary radar including height and ground speed readout.

- The Approach Controller did not give the crew of AZ 404 any position or distance information relative to runway 14.

- The Approach Controller never noticed the altitude undershoot of the aircraft.

- Weather in the accident area: Wind SW/5 - 10, Visibility ~8 km, light rain, Cloud covered - base at different heights, locally at 1800 - 2000 ft AMGL.

- Weather on Zürich airport (ATIS 1850): Landing RWY 14, Take off RWY 28, Met report Zürich 1850, 240 degrees 4 kt, Final RWY 14 and 16 250 degrees 7 kt, Lift Off RWY 16 240 degrees 4 kt, visibility 10 km, Mist, 2/8 1500 ft, 5/8 3000 ft, 7/8 4000 ft, temperature 9, dew point 8, QNH 1019, NOSIG, Transition Level 50, Zürich Information ECHO.

- According to other pilots, the approach and runway lighting could be seen during the approach on the ILS.

- On the accident profile, the runway can be seen until 7 NM ILS-DME then it is obscured by the Stadlerberg - at night, a "black hole" effect.

- The Stadlerberg is not equipped with obstacle lighting.

- Runway 14 is not equipped with precision approach lighting (PAPI).

- The APP did not ask for a report, that the airplane was established. The crew of AZ 404 did not report "established" on ILS.

- The Go-Around commenced shortly before the accident by the COPI was immediately stopped by the PIC.

- The pilots cockpit work did not comply throughout with ALITALIA's operational procedures.

- The SWISSCONTROL instructions relating to the transition phase between radar vectoring and pilot interpreted approaches are not precise and leave room for interpretation. They correspond mainly to the ICAO instructions.

3.2 Causes

The accident was caused by:

- False indication of VHF NAV unit No 1 in the aircraft.

- Probable altimeter misreading by the PIC.

- No GPWS warning in the cockpit.

- Pilots not aware of the possibility of incorrect indications in the NAV equipment in use (without flag-alarm).

- Inadequate failure analysis by the pilots.

- Non-compliance by the pilots with basic procedural instructions during the approach.

- Unsuitable cooperation between the pilots during the approach.

- COPI's initiated go-around procedure aborted by the PIC.

- The Approach Controller not observing the leaving of the cleared altitude of 4000 ft QNH before the FAP.

4. RECOMMENDATIONS

1. NAV equipment which does not have monitoring of the output signal should no more be used.

2. The Drum Pointer altimeter as fitted to the accident aircraft should not be used with immediate effect.

3. The GPWS should operate also in case of a NAV-failure.

4. It should be evaluated whether it should be allowed that all navigation instruments can be switched onto one receiver as a normal procedure.

5. The flight procedures of an air transport company should ensure that a Go-Around once started can not be stopped.

6. The air transport company flight procedures have to define the so called simulated CAT II and CAT III procedures and to ensure that the same procedures are used as are used for approaches when the weather conditions are CAT II or CAT III.

7. It should be evaluated whether by issuing a personal set of Route Manuals to each pilot, a better preparation could be made.

8. The approach charts in the Route Manual should show the horizontal terrain profile below the glide path.

9. The duties of the Approach Traffic Control should be expanded to include the task of warning in the event of an altitude undershoot of the Minimum Safe Altitudes. In this respect, a warning system similar to that used in the USA (minimum safe warning system) which gives an automatic optical and acoustic warning when an aircraft undershoots an altitude should be added to the ATC equipment.

10. The instructions in ICAO document 4444 should be reformulated so that in the area of transition between radar vectoring and pilot interpreted approaches there is no possibility for misinterpretation.

11. The instructions in the SWISSCONTROL manual of ATC volume 1 should be reformulated so that in the area of transition between radar vectoring and pilot interpreted approaches there is no possibility for misinterpretation.

12. The national and international operating instructions for ATC should be adapted to modern technology much faster.

13. The installation of an area microphone recording system for the Air Traffic Controller stations (similar to the aircraft CVR area mike) should be evaluated.

14. Obstacle lighting should be installed on the Stadlerberg.

15. ILS RWYs should be fitted with optical approach aids (PAPI).

Berne, 27th January 1993

Aircraft Accidents Inquiry Board

H. Angst
President

Beilage / Annesso / Annex 1

Übersichtsplan der Absturzstelle
Piano di situazione dell'incidente
View of the accident-site

Kantonspolizei
Zürich

ÜBERSICHTSPLAN ABSTURZSTELLE

Massstab 1 : 100'000

675 680 685

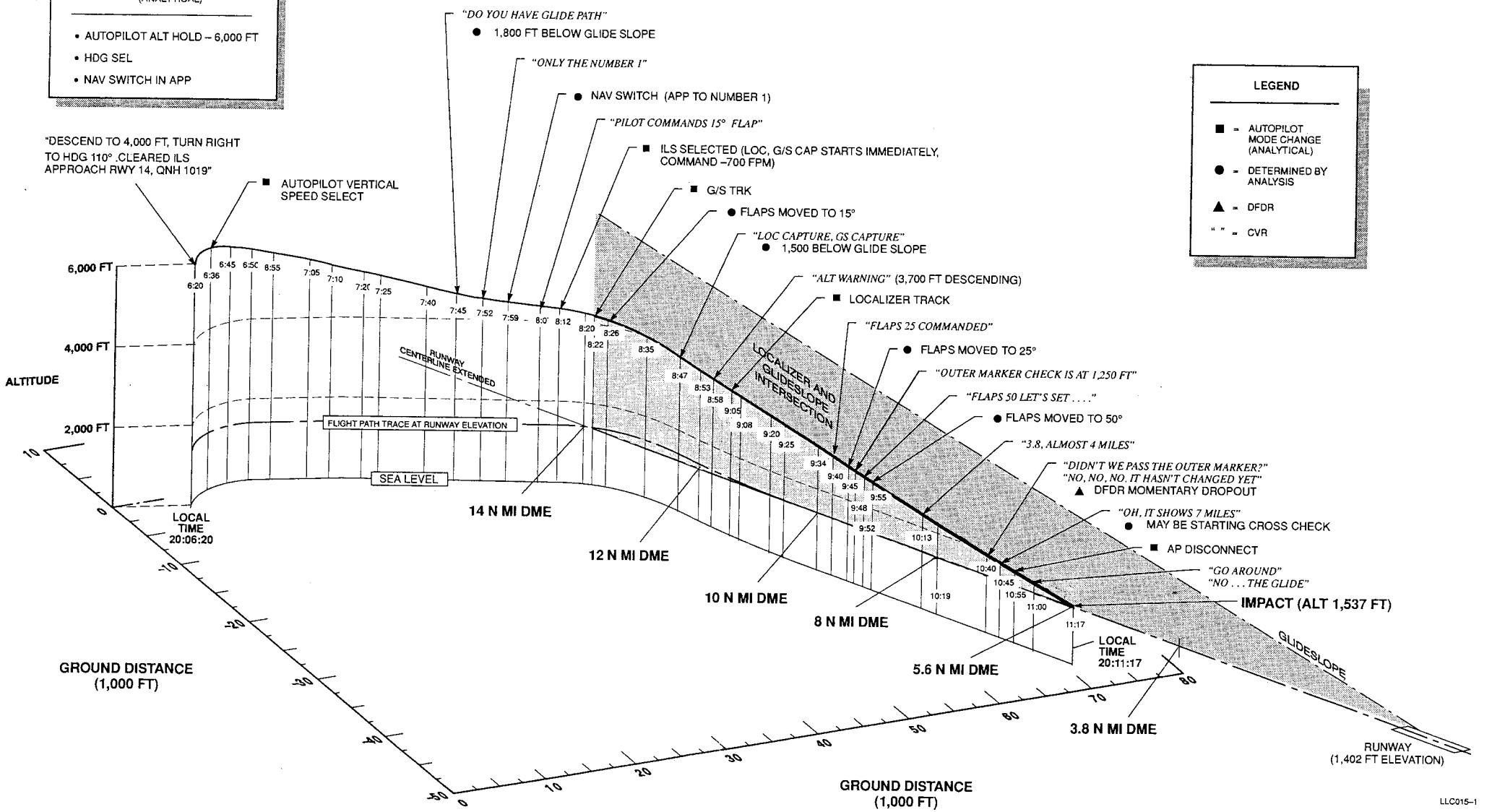
Beilage / Annesso / Annex 2

Anflugprofil der Alitalia DC-9-32 AZ 404 am 14. November 1990 in Zürich
Profilo d'avvicinamento del DC-9-32 dell'Alitalia AZ 404 il 14 novembre 1990 a Zurigo
Approach profile of Alitalia DC-9-32 AZ 404 on November 14th 1990 in Zurich

ALITALIA
DC-9-32 APPROACH ACCIDENT
14 NOVEMBER 1990
Zurich, Switzerland

MCDONNELL DOUGLAS

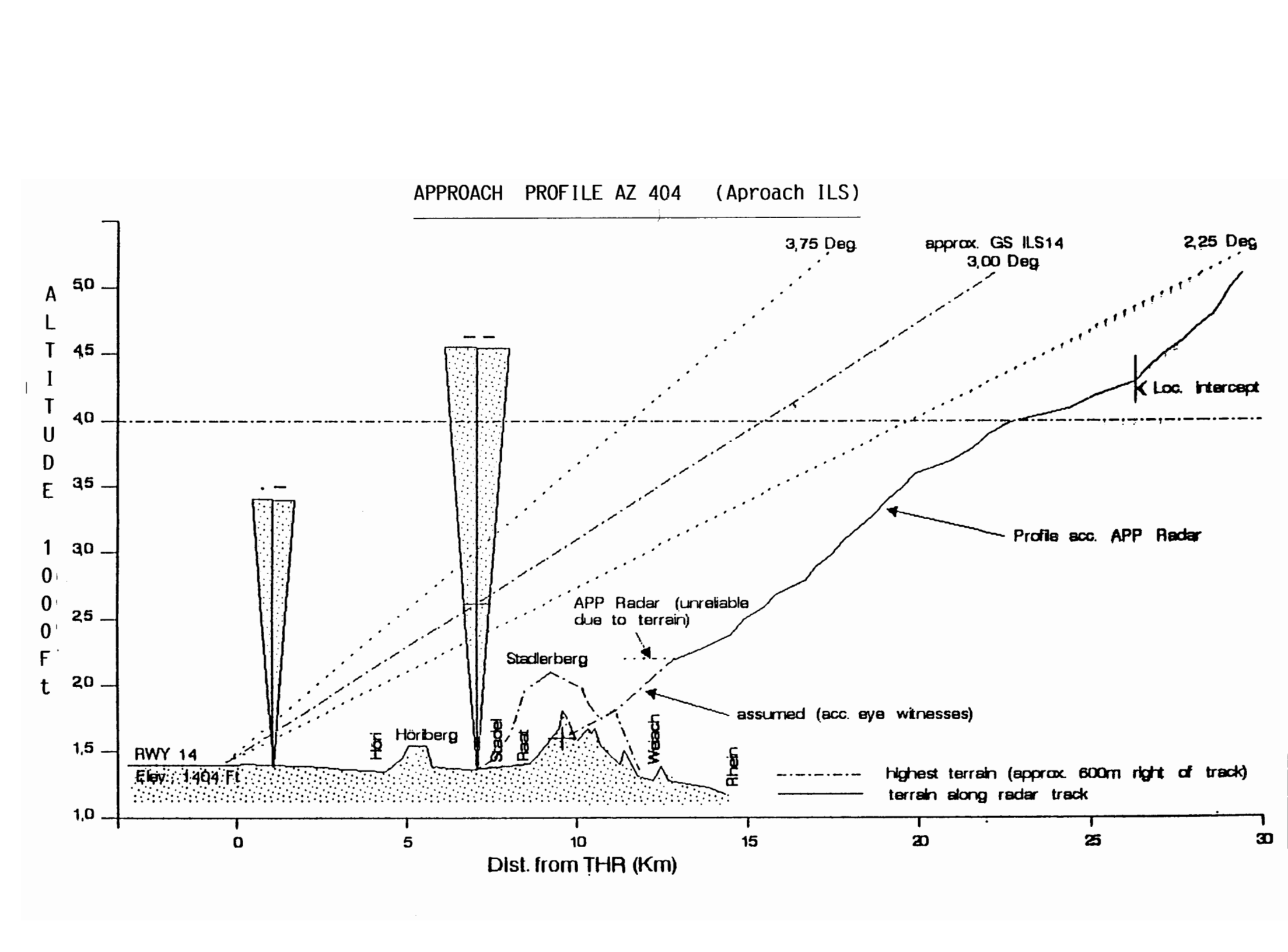
9 APRIL 1991



LLC015–1

Beilage / Annesso / Annex 3

Anflugprofil der AZ 404 (ILS-Anflug)
Profilo d’avvicinamento dell’AZ 404 (Avvicinamento ILS)
Approach profile AZ 404 (ILS Approach)


APPROACH PROFILE AZ 404 (Aproach ILS)
3,75 Deg
approx. GS ILS14
3,00 Deg
2,25 Deg
Loc. Intercept
Profile acc. APP Radar
APP Radar (unreliable
due to terrain)
assumed (acc. eye witnesses)
Stadlerberg
Höri
Höriberg
Stadel
Raat
Waiach
Rhein
RWY 14
Elev. 1404 Ft
highest terrain (approx. 600m right of track)
terrain along radar track
ALTITUDE 1000 Ft
5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0
5
10
15
20
25
30
Dist. from THR (Km)

Beilage / Annesso / Annex 4

AZ 404: Radaraufzeichnung des Flugweges
AZ404: Registrazione radar del percorso di volo
AZ404: Radar plotting of flight path

RADMAS APP/TWR MV-4000 Format

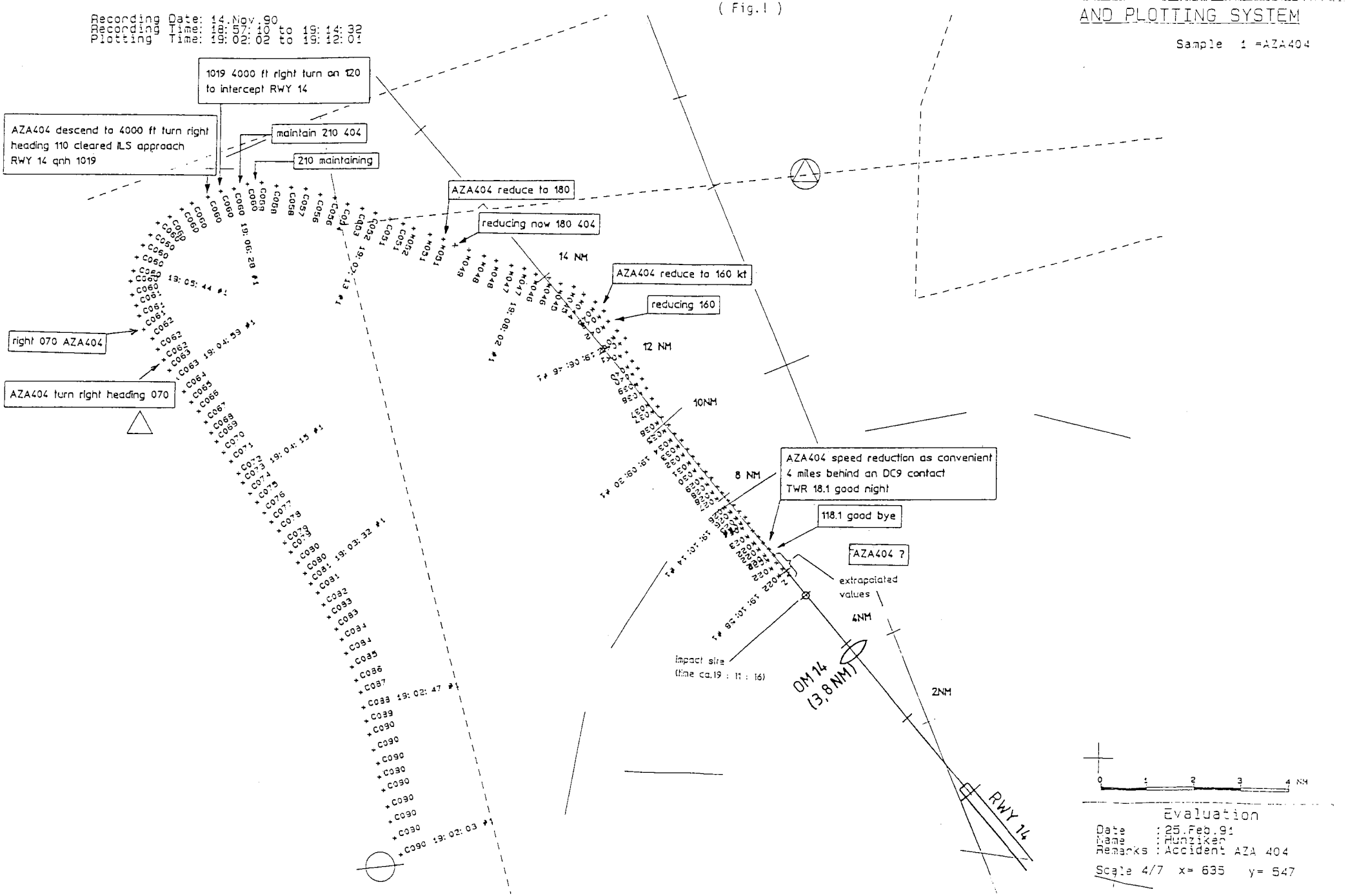
AZA 404 Radaraufzeichnung Flugweg

(Fig.1)

RADAR-DATA MONITORING ANALYSIS AND PLOTTING SYSTEM

Sample 1 =AZA404

Recording Date: 14.Nov.90
Recording Time: 18:57:10 to 19:14:32
Plotting Time: 19:02:02 to 19:12:01



Evaluation

Date : 25.Feb.91
Name : Hunziker
Remarks : Accident AZA 404

Scale 4/7 x= 635 y= 547

Beilage / Annesso / Annex 5

Protokoll der ATC Bandaufnahmen vom 14. November 1990
Protocollo delle registrazioni su nastro dell'ATC del 14 novembre 1990
Transcript of ATC tape recording, November 14th 1990

Büro für Flugunfalluntersuchungen
Fachgruppe Flugsicherung
CH-8058 Zürich-Flughafen

Zürich-Flughafen, 23. November 1990

Transcript of Tape-Recordings of November 14th 1990 **(No. of pages 9)**

(This transcript is a compiled version of recorder A, channels 3 and 30, recorder B channel 5 and recorder C channel 9.)

Subject : **ACCIDENT AZA404 of November 14th 1990**

Abbreviations and Callsigns :

ACC	=	ZÜRICH RADAR
ARR	=	ZÜRICH ARRIVAL
ARR-IC	=	ZÜRICH ARRIVAL INTER-COM
TWR-IC	=	ZÜRICH TOWER INTER-COM
C/E-IC	=	ZÜRICH ACC EAST SECTOR INTER-COM
C/N-IC	=	ZÜRICH ACC NORTH/SOUTH SECTOR INTER-COM
C/W-IC	=	ZÜRICH ACC WEST SECTOR INTER-COM

404	=	AZA404 DC9 IFR LIML-LSZH
5510	=	DLH5510 AT42 IFR EDDN-LSZH ARR LSZH 1901
1858	=	DLH1858 B737 IFR EDDH-LSZH ARR LSZH 1906
588	=	IBE588 DC9 IFR LEBL-LSZH ARR LSZH 1908
HQL	=	HBLQL PASE IFR LSZB-LSZH ARR LSZH 1910
863	=	FIN863 MD87 IFR EFHK-LSZH ARR LSZH 1912
932	=	RBB932 HS25 IFR ESOW-LSZH ARR LSZH 1943
1834	=	DLH1834 B737 IFR EDDL-LSZH ARR LSZH 1944
812	=	HOR812 PASE IFR LSZG-LSZH ARR LSZH 1952
153	=	BBB153 DC9 IFR GCLP-LSZH ARR LSZH 2034
468	=	SWR468 MD80 IFR LSZH-LHBP DEP LSZH

Frequencies : 128.050 MHz = ZÜRICH ACC NORTH/SOUTH SECTOR RADAR (ACC)

118.000 MHz = ZÜRICH APPROACH WEST SECTOR RADAR (ARR)

Times : UTC in hours, minutes and seconds

Remark: All figures which are not spoken according to standard RTF phraseology are written in words.

Büro für Flugunfalluntersuchungen
Fachgruppe Flugsicherung

The following members of the Accident Investigation Team certify the completeness and correctness of the present transcript:

Markus Forster Thomas Weder

To	From	UTC	Communications	Observations
ACC	404	18.50.30	buona sera ZÜRICH is AZA404 maintaining 200	
404	ACC	.40	AZA404 ZÜRICH good evening squawk 6234	
ACC	404		6234 coming	
404	ACC	.51.20	AZA404 radar contact maintain FL 200	
ACC	404		maintaining 200 404	
404	ACC	.53.40	AZA404 your heading?	
ACC	404		404 fly on heading 350	
404	ACC		roger fly heading 340	
ACC	404	.50	left 340 AZA404	
404	ACC		and 404 descend to FL 140	
ACC	404		down 140 AZA404 leaving	
404	ACC	.55.40	AZA404 descend to FL 100	
ACC	404	.50	continue down 100 404	
C/E-IC	ARR-IC	.56.40	ja	
ARR-IC	C/E-IC		1858 nünzg FIN nünzg RBB nünzg immer drissg Meile	
C/E-IC	ARR-IC		merci merci ja isch scho guet chasch alles nünzg mache ja ja	
ARR-IC	C/E-IC		ja-a bye	
C/N-IC	ARR-IC	.57.00	hallo	
ARR-IC	C/N-IC		AZA404 heading 340 descending 100 released	
C/W-IC	ARR-IC		merci	
404	ACC	.57.10	AZA404 contact ARRIVAL 118.0 good-bye	
ACC	404		118.0 good-bye	
ARR	404	18.57.20	ARRIVAL good evening AZA404	
		.30	descending 100 ECHO received	
404	ARR		AZA404 ZÜRICH ARRIVAL good evening fly heading 325 radar vectors to the	
		.40	ILS 14	
ARR	404		will be radar vectoring RWY 14 on heading 325 404	
404	ARR		AZA404 descend to FL 90	
ARR	404	.50	and continue down 90	
588	ARR		IBE588 turn right heading 030	

Version 2 - 23.11.90

To	From	UTC	Communications	Observations
ARR	588	.58.00	right 030 IBE588	
???	???		say again Sir → → → → → →	unknown station
5510	ARR		DLH5510 contact TWR 118.1	
ARR	5510	.10	118.1 bye	
1858	ARR		DLH1858 descend to 4'000 FT	
ARR	1858	.20	down to 4'000 DLH1858	
ARR	588	.30	IBE588 is maintaining 70	
588	ARR		IBE588 roger maintain	
1858	ARR	18.58.50	DLH1858 confirm your heading?	
ARR	1858		it's 260 DLH1858	
1858	ARR	.59.00	roger	
HQL	ARR	.10	HQL turn right heading 030 radar vectors to the ILS 14	
ARR	HQL		060 vectoring for 14 HQL	
HQL	ARR	.20	QL right heading 030	
ARR	HQL		030 QL	
ARR	863	.30	ZÜRICH ARRIVAL good evening FIN863 passing 135 down to 90	
863	ARR	.40	FIN863 ZÜRICH ARRIVAL good evening continue to SHA vectoring to the ILS 14 descend to FL 60	
ARR	863	.50	down to FL 60 äh, say again the rest of the message	
863	ARR		I call you back for radar vectors but for the time being continue to SHA	
ARR	863	19.00.00	continue as filed roger after SHA äh... TRA then down to 60 FIN863	
1858	ARR	.10	DLH1858 turn left heading 240	
ARR	1858		left 240 DLH1858 how many track miles about please?	
1858	ARR		DLH1858 15 miles to go	
ARR	1858		thank you	
863	ARR	.20	FIN863 turn right heading 270 radar vectors to the ILS 14	
ARR	863		right heading 270 FIN863	
HQL	ARR		HQL descend to 5'000 FT QNH 1019	
ARR	HQL	.30	HQL 5'000 1019	
404	ARR	.50	AZA404 turn right heading 340	
ARR	404	.01.00	right 340 AZA404	
588	ARR		IBE588 turn right heading 070	
ARR	588		right 070 IBE588	
1858	ARR	.20	DLH1858 turn left heading 160 cleared ILS approach 14	
ARR	1858		left 160 cleared ILS 14 DLH1858	
588	ARR	.30	IBE588 reduce to 180 KT descend to 4'000 FT QNH 1019	
ARR	588		reducing 180 4'000 FT 1019 IBE588	
HQL	ARR	.50	HQL descend to 4'000 FT	
ARR	HQL		4'000 QL	

To	From	UTC	Communications	Observations
HQL	ARR	19.01.50	your speed QL?	
ARR	HQL		160 QL	
HQL	ARR	.02.00	roger maintain	
ARR	HQL		will maintain	
HQL	ARR		thank you	
404	ARR		AZA404 reduce to 210 KT	
ARR	404	.10	210 KT reducing 404 → → • •	cockpit sound
HQL	ARR		HQL right heading 120 cleared ILS approach 14	high pitched beep, possibly
ARR	HQL		right 120 cleared for approach 14 QL	gear warning
588	ARR	.20	IBE588 turn right heading 120 cleared ILS approach 14	horn?
ARR	588		120 cleared on ILS 14 IBE588	
404	ARR		AZA404 descend to FL 60	
ARR	404	.30	down 60 AZA404	
ARR	1858		DLH1858 established 14	
1858	ARR	.40	DLH1858 contact TWR 118.1 bye-bye	
ARR	1858		118.1 DLH1858 bye	
404	ARR	.50	AZA404 turn left heading 325 again	
ARR	404		left 325 404	
863	ARR		FIN863 report speed?	
ARR	863		speed now 220 FIN863	
863	ARR		roger reduce to 180 KT	
ARR	863	.03.00	speed 180 FIN863	
588	ARR	.10	IBE588 maintain speed as, äh , sorry IBE588 maintain your present speed I call you back for reduction shortly	
ARR	588	.20	we maintain speed IBE588	
863	ARR		FIN863 descend to 5'000 FT QNH 1019	
???	???		5'000 → → → → → → → →	unknown station
863	ARR	.30	FIN863 descend to 5'000 QNH 1019	
ARR	863		5'000 1019 FIN863	
ARR	932		ARRIVAL guete abig RBB932 level 110 descending 90 information ECHO	
932	ARR	.40	RBB932 ZÜRICH ARRIVAL guete abig turn right heading 270 radar vectors to the ILS 14 descend to FL 60	
ARR	932	.50	right heading 270 vectors ILS 14 descending to level 60 RBB932	
ARR	HQL	.04.10	QL established LLZ 14	
HQL	ARR		QL roger	
588	ARR	.30	IBE588 speed as convenient contact TWR 118.1 good night	
ARR	588	19.04.30	118.1 IBE588 good by	
932	ARR	.40	RBB932 turn further right heading 310	
ARR	932		roger turning right heading 310 RBB932	

To	From	UTC	Communications	Observations
ARR	1834	.05.00	ZÜRICH guete abig DLH1834 out of 105	
		.10	for level 90 on-course SHA	
1834	ARR		DLH1834 ZÜRICH ARRIVAL good evening standby break break	
404	ARR		AZA404 turn right heading 070	
ARR	404	.20	right 070 AZA404	
863	ARR		FIN863 descend to 4'000 FT turn left heading 160 cleared ILS approach 14	
ARR	863		down to 4'000 left heading 160 cleared	
		.30	ILS 14 FIN863 roger	
ARR	HQL		HQL fully established and may we reduce speed?	
HQL	ARR		QL reduce to 130 KT	
ARR	HQL	.40	130 QL	
HQL	ARR	.50.	QL start reducing speed now further below one-thirty and contact TWR eighteen-one bye-bye	
ARR	HQL		roger speed äh one thirty and over to TWR	
		.06.00	guet nacht	
C/W-IC	ARR-IC	.06.00	ja	
ARR-IC	C/W-IC		z'Willisau cleared d'r HOR uf achzg	
C/W-IC	ARR-IC		ja merci	
1834	ARR		DLH1834 turn right heading 310 radar	
		.10	vectors to the ILS 14 descend to FL 70	
ARR	1834		roger present position right-turn 310 out of level 90 for 70 DLH1834	
404	ARR	.20	AZA404 descend to 4'000 FT turn right heading 110 cleared ILS approach RWY 14 QNH 1019	
ARR	404		1019 4'000 FT right-turn on 120 to	
		.30	intercept RWY 14	
404	ARR		maintain two-ten four-o-four	
ARR	404		two-ten maintaining	
932	ARR		RBB932 desired, required speed two-twenty	
ARR	932	.40	roger RBB932 speed two-twenty	
1834	ARR		DLH1834 reduce to two-twenty	
ARR	1834		speed two-twenty 1834	
932	ARR	.50	RBB932 turn left heading 245	
ARR	932		left heading 245 RBB932	
863	ARR	.07.30	FIN863 reduce to, speed to one-sixty	
ARR	863		reduce one-sixty FIN863	
404	ARR		AZA404 reduce to one-eighty	
ARR	404	19.07.40	reducing now one-eight 404	
1834	ARR		DLH1834 turn left heading 250	
ARR	1834		left 250 DLH1834	
1834	ARR	.50	and 1834 descend to 5'000 QNH 1019	
ARR	1834		roger 5'000 on 1019 we have ECHO 1834	
1834	ARR		roger	

To	From	UTC	Communications	Observations
ARR	812	.08.00	ZÜRICH ARRIVAL guete abe HOR812 FL 80	
812	ARR		HOR812 ZÜRICH ARRIVAL good evening	
		.10	proceed to EKRON expect vectors to the ILS 14	
ARR	812		HOR812 proceeding to EKRON	
932	ARR		RBB932 descend to 4'000 QNH 1019	
ARR	932	.20	descending to 4'000 QNH 1019 RBB932	
404	ARR	.30	AZA404 reduce to 160 KT	
ARR	404		reducing 160	
863	ARR		FIN863 reduce to final approach speed	
ARR	863	.40	final approach speed FIN863	
932	ARR		RBB932 reduce to one-eighty	
ARR	932		reducing 180 KT RBB932	
812	ARR	.50	HOR812 descend to FL 60	
ARR	812		leaving 80 down to 60 HOR812	
863	ARR	.09.00	FIN863?	
932	ARR	.10	RBB932 turn left heading 160 cleared ILS approach 14 report established	
ARR	932	.20	left 160 call you established ILS 14 RBB932	
ARR	863	.50	FIN863 OM inbound	
863	ARR		yeah change to TWR eighteen one please	
ARR	863	.10.00	eighteen one FIN863 good-bye	
TWR	468		ZÜRICH TWR → → → → → → → illegible	
1834	ARR		DLH1834 descend to 4'000 FT reduce	
		.10	to 180 KT	
TWR	468		..... → → → → → → → illegible	
1834	ARR		sorry DLH1834 you have been blocked out I say again descend to 4'000 FT	
		.20	reduce to 180 KT	
ARR	1834		Sir we are out of 5 for 4'000 one-eighty KT DLH1834	
812	ARR		HOR812 turn right heading 040 radar	
		.30	vectors to the ILS 14	
ARR	812		right heading 040 for ILS radar vectoring 14 HOR812	
404	ARR	.40	AZA404 speed reduction as convenient 4 miles behind an DC9 contact TWR eighteen one good night	
ARR	404		118.1 good bye	
932	ARR	.50	RBB932 speed back one-sixty	
ARR	932	19.10.50	roger reducing RBB932	
ARR-IC	TWR-IC	.11.20	ja go	
TWR-IC	ARR-IC	.30	het d'r AZA404 grüeft?	
ARR-IC	TWR-IC		AZA404?	
TWR-IC	ARR-IC		ja ... dä isch verschwunde vom Radar	
ARR-IC	TWR-IC		ja sägs rächt	
TWR-IC	ARR-IC		ja sött bi öppe 4 Meile si rüef em mal uf	

To	From	UTC	Communications	Observations
ARR-IC	TWR-IC		ja rüef em hä	
TWR-IC	ARR-IC	.40	ja	
1834	ARR	.11.20	DLH1834 turn left heading 160 cleared ILS approach 14	
ARR	1834	.11.30	roger left 160 cleared ILS 14 DLH 1834	Added on Nov.22.1991 from recorder A, channel 6
404	ARR	.40	AZA404?	
1834	ARR	.50	DLH1834 reduce to 160 KT	
ARR	1834	.12.00	to one-sixty DLH1834	
TWR-IC	ARR-IC		het er grüeft?	
ARR-IC	TWR-IC		nei	
TWR-IC	ARR-IC		du dä isch verschwunde vom Radar	
ARR-IC	TWR-IC		git mir kei Antwort	
TWR-IC	ARR-IC		glaub ich ja nöd	
ARR-IC	TWR-IC		wo isch är gsi wo?	
TWR-IC	ARR		ja bi 4 , 5 Meile	
ARR-IC	TWR-IC	.10	ja wart emal	
ARR	932		RBB932 established ILS 14	
932	ARR	.20	RBB932 roger	
932	ARR		RBB932 do you have an aircraft in sight about 2 miles ahead of you?	
ARR	932	.30	standby	
ARR	932		there is a fire on ground but we have no traffic in sight	
932	ARR	.40	yeah OK roger	
ARR-IC	TWR-IC		ja	
TWR-IC	ARR-IC		du AZA404 schtien... schint ab-	
		.50	gschürzt gsi bi 5 Meile	
ARR-IC	TWR-IC		bi 5 Meile?	
TWR-IC	ARR-IC		ja, sofort Voll-Alarm mache	Added on Nov 22. 1991 from recorder A, channel 6
ARR-IC	TWR-IC		ja guet Voll ...	
932	ARR		RBB932 approach clearance is can-	
		.13.00	celled climb to 5'000 FT	ARR 932 roger climbing to 5000 FT, RBB 93
1834	ARR		DLH1834 approach clearance is can-	
		.10	celled climb to FL 60	
ARR	1834		say again for 1834	
1834	ARR		approach clearance is cancelled climb to FL 60 DLH1834	
ARR	1834	.20	roger we are starting a go around straight ahead level 60 confirm?	
1834	ARR		that is correct continue on present heading for the time being	
ARR	1834		so the heading is 150	
932	ARR	.30	RBB932 turn left proceed to SHA and hold	
ARR	932		roger turning left to SHA and hold RBB932	
812	ARR	19.13.30	HOR812 turn left proceed to EKRON	
		.40	track 320 and hold	
ARR	812		left to EKRON track 320	
ARR	932	.50	RBB932 maintaining 5'000	
932	ARR		RBB932 yeah	
1834	ARR	.14.00	DLH1834 do you have ground contact?	

To	From	UTC	Communications	Observations
ARR	1834		negative	
1834	ARR		roger	
ARR	1834		and we are in a climb up to 5, passing 5 for level 60	
1834	ARR		DLH1834 yeah	
ARR	1834	.20	1834 we have, we are in and out, we have ground contact äh ground contact occasionally, but we are in a heavy shower now	
1834	ARR	.30	OK DLH1834	
1834	ARR		do you see any fire on the ground?	
ARR	1834		äh negative	
1834	ARR		roger	
1834	ARR	.40	DLH1834 turn left to SHA and hold	
ARR	1834		roger we are turning inbound SHA and hold	
1834	ARR		DLH1834 climb to FL 70	
ARR	932	.50	.....im Aaflug, öppe sechs Meile Final	simultaneous transmission with ARR
932	ARR	.50	yeah RBB932 say again?	
ARR	932		es grosses Füür gsi dört am Bode ziemlich gnau uf em Localizer	
932	ARR	.15.00	ja öppe bi föif meile?	
ARR	932		dasch richtig ja	
932	ARR		merci	
932	ARR	.10	RBB932 climb to FL 60	
ARR	932	.20	roger, climbing to 60 RBB932	
ARR-IC	TWR-IC		ja	
TWR-IC	ARR-IC		d'r RABBIT 932 het es grosses Füür	
		.30	gseh bi 5 Meile genau uf em Localizer	
ARR-IC	TWR-IC		ja Weiachen, Weiach hemmer au ghört	
TWR-IC	ARR-IC		OK ja merci	
1834	ARR	.40	DLH1834 climb to FL 70	
ARR	1834		FL 70 DLH1834	
932	ARR	.16.20	R8B932 proceed to SHA and hold indefinite delay the airport is closed	
ARR	932	.30	ah, that's copied 932 we're checking for BALE we let you know we join SHA 60 and maintain	
932	ARR	19.16.30	roger	
1834	ARR		DLH1834 did you copy?	
ARR	1834		1834 negative say again	
1834	ARR	.40	as well for you proceed to SHA and hold indefinite delay due to the airport is closed	
ARR	1834		indefinite delay airport closed äh and we are standing by, I let you know how long we can hold	
1834	ARR	.50	roger	

To	From	UTC	Communications	Observations
???	ARR-IC		ja roger	
???	???		???	
???	ARR-IC		jawohl OK	
812	ARR	.17.10	HOR812 did you copy?	
ARR	812		HOR812 we copied	
812	ARR	.20	yeah we have an emergency and the airport is closed due to that	
812	ARR	.30	HOR812 for your information your position is 3 miles east of EKRON	
812	ARR		HOR812?	
ARR	812		HOR812	
812	ARR	.40	your position is about 3 and a half miles east of EKRON	
812	ARR	.50	did you copy HOR812?	
ARR	812		812 roger we are in a right-turn now maintaining 60 and we proceed now to the the EKRON holding ..21	
ARR	153	.18.00	ARRIVAL Guete Abig BBB153 level 130 descending 90 with ECHO	
153	ARR	.10	BBB153 ZÜRICH ARRIVAL good evening proceed to EKRON and hold maintain FL 90 when reaching indefinite delay the airport is closed	
ARR	153	.20	BBB153 EKRON and hold indefinite delay	
153	ARR		we have an emergency	
ARR	153	.30	OK BBB153	
ARR	1834	.40	DLH1834 entering SHA holding FL 70	
1834	ARR		roger DLH1834	new controller

- END -

Beilage / Annesso / Annex 6

Originalprotokoll des CVR der AZ 404 vom 14.11.1990 (Italienisch-Englisch)
Protocollo originale del CVR del volo AZ 404 del 14.11.1990 (Italiano-Inglese)
Original CVR transcript of AZ 404, 14.11.1990 (Italian-English)

CVR - Transcript of Flight Alitalia 404 14 Novembre 1990

Final Draft, 7. May 1991

18:39:30	ATC	AZA 404 Milano.
	AP	Go ahead.
	ATC	Climb to level 140 call Milano radar 127.45.
	AP	127.45 up 140 ciao.
	AP	349 te l'ho messo.
	FP	Si grazie.
18:40:00	AP	Buona sera Milano AZA 404 up 140.
	ATC	Buona sera 404 on the radar climb to FL 200.
	AP	Up 200.
	AP	Eccezionale - allora possiamo anche...
18:40:30	ATC	AZA 404 proceed direct to Saronno - eh correction to Canne.
	AP	Thank you straight ahead Canne 404.
	FP	Allora...
	AP	313 te lo scrivo qui.
	FP	...327. Perché 313?
	AP	Eh 313 per andarlo a chiappà diretto a Canne no? La 313 va a Canne. Hai visto? Va a Canne
	FP	Diretti da qua, eh?
	AP	Eh?
	FP	Qua è scritto 327...
	AP	Ma 327...
	FP	E noi dove siamo adesso?
	FP	E ma io devo dare retta a questo qua...
	AP	E che ci vai là?
	FP	Adesso là ci mettiamo...
	AP	13.7...va be?
	AP	13.7...349 mi sembra quant'è va be 350.
	FP	Le minime quanto diventano 120 a - ?
	AP	Adesso le minime te le devi fa tu. Canne 1B deve essere 120 e poi va subito a 150 nelle 32 miglia. Non c'abbiamo più problemi no?
	FP	Accelero a 250.
	AP	Guarda solo se c'è ghiaccio perché io non trovo più la mia torcia.
	FP	Ho già guardato. Rimetti...
	AP	Siamo fuori?
	FP	No.
	AP	C'è una sbavata dai.
	AP	Non la trovo - eppure ce l'avevo. ...l'ho pagata 11000 lire.
	FP	(laughing)
	AP	L'ho pagata 11000 lire oh!
	FP	150 l'abbiam' fatta - accelero a 290.

	AP	...Zurigo pista 16, company, ground, delivery, departure, ramp, atis 128.52.
	FP	C'è l'ATIS di Zurigo no?
	AP	Ebbene si. ...tutte le minime da considerare...uno. 32 miglia fuori.
	FP	Abbiamo letto l'after takeoff?
	AP	L'abbiamo letto no?
	FP	Si - questo qua sta sempre a zero.
	FP	Qua c'è eh?
	AP	C'è eh lo vedo. Bene allora gli diamo una riscaldata pure all'altro sistema, visto che è abbondante qui.
	CLICK	Solo pe daje...
	CLICK	la coda vedi. Allora viene 200 88 89.
	AP	Però i motori tielli...
	FP	...
	AP	Ma che CXXXX vedo tutto sotto io.
	FP	Sotto si ma sopra no.
	AP	...
	FP	...
	FP	Approaching 200.
	ALTITUDE ALERT SOUND	
	AP	Molto bene.
18:45:10	AP	AZ 404 maintaining 200.
	ATC	404 Milano roger.
	AP	Gniene frega niente.
	ZURICH VOLMET	
	CLICK CLICK	
	AP	Togliamo il ghiaccio.
	ZURICH VOLMET	
	AP	Benissimo eventualmente andiamo a Bale che è abbastanza buono. Ha finito quasi de piove. Zurigo dà 240 8 adesso dà eh!
	FP	Eh quindi - ...
	AP	Sarà un circling!
	MARKER "BRUNNEN"	
		Allora fammi vedere per la pista 28 -
	FP	Abbiamo...
	CLICK CLICK	
	AP	Per la pista 28 che è quella che ci interessa a noi da 240 6...
	ZURICH ATIS	
	AP	Eh?
	FP	Me lo passi anche a me?
	AP	Bollettino Delta information la pista per adesso è ancora la 14 e la 28 da 240 8 nodi sulla 16 6 nodi però danno la 14, 9 kilometri 3 a 1400, 5 a 3000, 7 a 4000, 9 con 8 10:9.

		Tolgo tutto io allora - come dici tu, come dici tu ...
	CVR Track	Change
	FP	La coda gliela abbiamo data?
	AP	Si è solo per la coda che l'avevo dato.
	FP	Va bo'! Allora adesso sull'uno ci possiamo mettere Trasadingen.
	AP	Allora io ti metto Trasa...13.7 qui - poi radio uno di qua ci metto 116.4 - Trasadingen ci resta...sul...ci serve per l'arrivo no?
	FP	Bo!
	AP	Kloten lo mettiamo di qua e poi dopo - CXXXX - o forse ti interessa più Kloten di là vero? Ma si cosi' Kloten ce l'hai fino alla fine.
18:50:20	ATC	AZA 404 Milano.
	AP	Vai avanti. - Go ahead.
	ATC	AZA 404 Radar 128.05. Buona sera.
	AP	128.05 ciao a fra poco.
	AP	...OK 116.4 te l'ho messo sul numero due.
18:50:40	AP	Buona sera Zurich AZA 404 maintaining 200.
	ATC	AZA 404 Zurich good evening squawk 6234.
	AP	6234 coming.
	AP	50 - Trasa sullo stesso valore di 349...-. Eventualmente, la 28 dove c'hai left right hand quindi vai do te pare.
	FP	Arriviamo, rompiamo a sinistra, manteniamo la pista visto che sono io il PF sulla destra, cosi' la vedo, ti va bene?
18:51:20	ATC	AZ404 radar contact maintain FL200.
	AP	Maintaining 200 404.
	AP	Guarda bene la pista, ce l'hai qua no?
	FP	Si.
	AP	Per mantenerla sulla destra tu fai così...
	FP	Si.
	AP	Se tu invece seguiti ad andare diritto fino al centro pista...
	FP	Eh.
	AP	Tu la pista...la vedi e ti fa così... sottovento almeno sei sicuro che ce passi sulla pista, non te la perdi più. Io una volta rompendo qui andando sottovento me so perduto e qui ce so' le montagne eh.
	XX	Overhead the aerodrome, turn left turn downwind left turn.
	XX	...stiamo tranquilli, poi tu...
	AP	Perfetto...- oh hai capito io te guardo sempre la pista e - tu fai sempre uno

		strumentale fino al traverso e tu fai sempre uno strumentale e poi dopo dritto...fino all' ultimo quant'è questo...ci allontaniamo in modo tale a 1200...sono 25 - 30 - 35 secondi.
	FP	...a 1390 - 1019 no?
	AP	1019 affermativo.
	FP	970.
	AP	Va bene.
	AP	Io te lo do in discesa eh!
	XX	...la pista è 14...
	AP	...ci sei quasi vicino...VOR...controlli...
	FP	...
	AP	In avvicinamento c'abbiamo 15000 fino a Brunnen che sono - 10 - 18 - 28.
18:53:40	ATC	AZA 404 your heading?
	AP	404 flying on heading 350.
	ATC	Fly heading 340
18:53:50	AP	Left 340 AZA 404.
	AP	Va be' perché...
	ATC	AZA 404 descend to FL 140.
	ATC	Down 140 AZA 404 leaving.
	CLACK CLACK	
	AP	Abbassata - minima - controllata.
	FP	Checked.
	AP	Poi ci abbiamo 100 da lasciare per Albix che sono 10 miglia e il traverso lo possiamo fare intorno ai 7 8 mila.
	FP	Da mantenere 8 mila poi ci manda su Ekron...
	AP	Si.
	FP	5 mila, il glide è di 3 gradi, l'outer marker a 1040 sull'echo, che lo appoggiamo anche...dietro...
	AP	Se mi riduci un pò la velocità...
	ZURICH ATIS	
	AP	...è cambiato eh.
	ZURICH ATIS	
	AP	Va benissimo, eventualmente se vedi che in finale siamo un pò veloci e non ti va bene puoi chiamare anche flap a 50 ma non ci son problemi perché la pista è lunga...massimo 7 8 nodi.
	FP	...allora 260 è la nostra minima...
	CA	Comandante - chiedo scusa faccio l'annuncio della discesa?
	AP	Si stiamo scendendo. Tra 15 minuti saremo touch down e...

18:55:40	ATC	AZA 404 descend to FL 100.
18:55:50	AP	Continuing down 100 404.
	AP	Il tempo è...con 9 gradi coperto.
	THROTTLE	IDLE SOUND
	CA	...grazie.
	FP	Questo è Kloten - qua abbiamo messo 332 Rhine tutt'e due d'accordo?...- ...in caso di turbolenza tengo 300 nodi.
	AP	Adesso te faccio una domanda che sicuramente tu ce l'hai sotto controllo. Ma se per caso adesso non lo sentiamo più dove CXXXX andiamo, dai su...
	FP	Se non sentiamo più chi? Il controllo. Avaria radio?
	AP	Il controllo, eh l'avaria radio.
	FP	Riportiamo - allora andiamo verso Kloten facciamo la procedura standard andiamo verso Ekron che...l'initial approach fix...
	AP	Andiamo su Kloten...
	FP	Da Kloten?
	AP	Da Kloten puntiamo su Ekron manteniamo sempre quei 7 mila ... famose...arriviamo su Ekron ... andiamo a Ekron aspettiamo se siamo in orario ...andiamo via subito facciamo la procedura standard...
18:57:10	ATC	AZA 404 contact arrival 118.00 good bye.
	AP	118.00 good bye.
18:57:30	AP	Arrival good evening. AZA 404 descending 100 echo received.
18:57:40	ATC	AZA 404 Zurich Arrival good evening. Fly heading 325 radar vectors to the ILS 14.
	AP	Radar vectors to runway 14 on heading 325 404.
	ATC	AZA 404 descend to FL 90.
18:57:50	AP	Continue down 90.
	XX	...
	AP	Sulla pista 14 come vedi dobbiamo uscire quasi verso la fine..
	XX	...la riattaccata...
	AP	Allora la riattaccata te ne vai a Wallisellen NDB che c'abbiamo sul numero due non serve a niente perché è un NDB lo capisci. Dobbiamo girare a sinistra e da lì...andiamo fino in fondo pista e giriamo a sinistra per Schaffhausen.
	FP	Schaffhausen lo appoggeremo qui.
	AP	...362 te lo metto qua. Schaffhausen a

		5000 affermativo. Tu vai in fondo pista e giri a sinistra e te ne vai su Schaffhausen e sei sul numero 2.
	FP	...la visibilità quant'è?
	AP	La visibilità è 9 kilometri.
	FP	Rallento a 250.
	AP	Bravo.
	FP	Facciamo categoria due.
	AP	Si perché la dobbiamo provare.
	FP	...allora metto qua...
	AP	Questo l'accetta la categoria due? Si?
	FP	Mettiamo le minime di cat due?
	AP	Dobbiamo provare il...95.
	FP	93
	AP	95
	FP	Allora quant'è? 93?
	AP	No io leggo 95...95...95
	AP	Abbiamo guardato la stessa pista si?
	FP	No.
	AP	Ah ecco!
	FP	...com'è la riattaccata?
	AP	La riattaccata poi gira a sinistra per Schaffhausen.
	AP	Ah ecco perché non eri d'accordo su quello che dicevo ma che ci vai a fare sul beacon - ...stessa pista...
	FP	Servirà per un'altra volta.
	AP	Va bene l'importante...
	FP	...
	AP	...è che poi si capisca. Quando tu non sei d'accordo...io t'ho detto non ci andare su quel beacon....vai direttamente a sinistra, vedi t'avevo messo...
	FP	...io ti ho detto due volte perché. Tu mi hai detto perché tanto vedi la fine pista...
	AP	Si...no quest'altra è obbligatorio andarci eh Qui è obbligatorio andarci perchè quì ci sta una punta di 1627 piedi vedi è alta sai quella.
19:00:50	ATC	AZA 404 turn right heading 340.
19:01:00	AP	Right 340 AZA 404.
	AP	Quando...non sei d'accordo?
	AP	Scusa se forse non ho capito io - ma perché mi dici così io ero convinto che che tu m'avessi detto perché...mi dici di mettere Wallisellen...
	FP	Eh...
	AP	Però non è vitale non è importante perché mi dici quando c'hai quel valore

		di Wallisellen gira a sinistra...capisci invece quell'altro dice no, vai diritto proprio su Wallisellen...no per chiarire ...vorrei chiarire eh eh perché se no...
	AP	Siamo al traverso di Kloten a livello 90 per cui ci porta alti eh!
	FP	Siamo alti ecco questo...
	AP	Infatti io decelererei ancora di più perché superato il traverso è inutile correre, più corri più t'allontani capito? E se più t'allontani le minime ti salgono.
	FP	...Stavolta...
	AP	Tanto stai al traverso...più vai piano e meno tempo impieghi per l'atterraggio.
	ATC	AZA 404 reduce to 210 knots.
19:02:10	AP	210 knots reducing 404.
	THROTTLES	IDLE SOUND
	AP	Hai visto?
	ATC	AZA 404 descend to FL 60.
19:02:30	AP	Down 60 AZA 404.
	THROTTLES	IDLE SOUND
19:02:50	ATC	AZA 404 turn left heading 325 again.
	AP	Left 325 404.
	TRIM	
	AP	Consiglio riduci a 200 nodi pure tu che tanto è inutile correre siamo già 15 miglia out.
	CLICK CLICK	
	FP	...andando verso Ekron... facciamo...
	FP	...metto l'inbound 068 per andare...
	TRIM	
	FP	49...59...69.
	AP	Ci sono nove gradi. Quindi non ci occorre l'antighiaccio qui, siamo al limite...adesso ci sono 6 gradi.
	ALTITUDE ALERT SOUND	
	AP	L'outer marker è a 1200 determinabili anche da 3.8 da Kloten, Rheine 5.6...
19:05:15	ATC	Lufthansa 1834 Zurich Arrival good evening stand by. Break break. AZA 404 turn right heading 070.
19:05:20	AP	Right 070 AZA 404.
	CLACK	
	TRIM	
	MORSE CODE	
	AP	India Kilo Lima.
19:06:20	ARR	AZA 404 descend to 4000 feet, turn right heading 110, cleared ILS approach runway 14, QNH 1019.
19:06:30	AP	1019 4000 feet, turn right heading 120 to

		intercept runway 14.
	ATC	Maintain 210 404.
	AP	Two ten maintaining.
	CLICK CLICK	
19:06:45	AP	...altimeters 1 - 9 6...7.
19:06:50	FP	1019.
	AP	Quant'è allora?
19:06:55	FP	970 l'ho guardato io.
19:07:05	AP	...bene 970 va bene. Landing data 37 125 sulla salmone va bene. La riattaccata a memoria.
19:07:10	FP	37 40 doppie 183 Schaffhausen.
	AP	Perfetto.
	FP	...5000 sul due.
19:07:20	FP	Cosa ha detto? 110?
	AP	(contemporaneamente) 10 tolgo tutto.
	CLICK CLICK	
	FP	Autorizzati a seguire?
19:07:25	AP	Autorizzati fino a 4000 piedi dopo di che a intercettare e seguire.
	FP	...allora facciamo Radio Approach.
	AP	Vai.
	ATC	AZA 404 reduce to 180.
19:07:40	AP	Reducing now 180 404.
19:07:45	AP	...ce l'hai tu qui il glide?
19:07:52	FP	...sul uno non...ce l'ho.
19:07:59	AP	Benissimo, allora lo facciamo sull'uno.
	FP	Radio uno.
19:08:07	FP	Flaps...
19:08:20	AP	Riduci un tantino la velocità...
	TAP TAP TAP	
	ATC	AZA 404 reduce to 160 kts.
19:08:35	AP	Reducing 160.
19:08:47	AP	...capture Loc capture Glide Path capture, quindi siamo nel fascio catturato un pò spostati ma...
19:08:53	FP	Nove sette zero anch'io.
19:08:58	ALTITUDE WARNIG SOUND	
19:09:01	AP	160.
19:09:09	AP	Cancello e scrivo 5000.
	(GEAR DOWN?)	
	TRIM	
19:09:18	AP	Ce ne abbiamo uno abbastaza vicino. Metti anche 150 se no va a finì che schiaffano na riattaccata.
19:09:33	FP	C'è ghiaccio?
19:09:35	AP	No no, praticamente no, c'abbiamo 10 gradi e 10 in terra.
19:09:41	FP	Flaps 25.

	AP	Flaps 25.
19:09:47	AP	Check dell'Outer Marker è a 1250 piedi.
	FP	Flaps fifty mettiamo...123.
19:09:52	AP	Bravo.
	CLICK	
19:10:12	AP	...3.8 quasi 4 miglia.
19:10:27	FP	...Non è passato...?
19:10:39	FP	Non è passato l'outer marker?
	AP	No, no, non ha cambiato...- oh, qui mi da 7.
19:10:50	ATC	AZA 404 speed now as convenient 4 miles behind a DC9 contact Tower eighteen-one. Good night.
	AP	118.1 good bye.
	FREQUENCY	CHANGE
19:10:55	AP	...che non me torna...
	FP	No neanche a me.
19:10:57	AP	Tira su, tira su, tira su, tira su!
	CLACK	
19:10:59	FP	Go around.
19:11:00	AP	No, no, no, no [fattidi]* il glide.
19:11:11	AP	Ce la fai a reggerlo?
19:11:13	FP	Si.
19:11:14	PIP PIP PIP PIP PIP PIP PIP PIP	
19:11:16	AP	Aspetta proviamo a rim...
19:11:18	CRASH	

* phonetisch, nicht genau definiert

Beilage / Annesso / Annex 6a

Deutsche Fassung des CVR-Protokolls der AZ 404 vom 14.11.1990
Versione in italiano del CVR del volo AZ 404 del 14.11.1990
English translation of CVR transcript of AZ 404, 14.11.1990

CVR TRANSCRIPT OF FLIGHT ALITALIA 404 14. NOVEMBER 1990
(CVR - ABSCHRIFT VON ALITALIA FLUG 404 14. NOVEMBER 1990)
(Mit italienischen Original-Gesprächen)

LETZTE FASSUNG 7. MAI 1991

ATC - Flugverkehrsleitung
ARR - Anflugverkehrsleitung
AP - Flying Pilot, Fliegender Pilot (Copi)
FP - Assisting Pilot (PIC)
CA Cabin Attendant (Hostess)

18:39:30	ATC	*AZA 404 Milano*
	AP	*Go ahead*
	ATC	*Climb to level 140 call Milano radar 127.45*
	AP	*127.45 up 140 ciao*
	AP	*349 te l'ho messo.*
		(349 habe ich Dir eingestellt)
	FP	*Si grazie.*
		(Ja danke)
18:40:00	AP	*Buona sera Milano AZA 404 up 140.*
	ATC	*Buona sera 404 on the radar climb to Fl. 200*
	AP	*Up 200.*
	AP	*Eccezionale - allora possiamo anche...*
		(Ausserordentlich - also können wir auch..
18:40:30	ATC	*AZA 404 proceed direct to Saronno - oh correction to Canne.*
	AP	*Thank you straight ahead Canne 404*
	FP	*Allora...*
		(Also...)
	AP	*313 te lo scrivo qui.*
		(313 schreibe ich Dir da)
	FP	*...327. Perché 313?*
		(...327, Warum 313?)
	AP	*Eh 313 per andarlo a chiappà diretto a Canne no? La 313 va a Canne. Hai visto? Va a Canne.*
		(Eh 313 um ihn direkt nach CANNE zu er wischen, oder? Die 313 geht nach CANNE. Hast du gesehen? Geht nach CANNE.)
	FP	*Diretti da qua, eh?*
		(Direkt von hier, eh?)
	AP	*Eh?*
	FP	*Qua è scritto 327...*
		(Da ist 327 geschrieben..)
	FP	*Ma 327...*
		(Aber 327...)
	FP	*E noi dove siamo adesso?*
		(Und wir, wo sind wir jetzt?)
	FP	*E ma io devo dare retta a questo qua*
		(Aber ich muss diesem folgen)

AP *E che ci voi fà?*
Und was willst Du machen?)

FP *Adesso là ci mettiamo...*
(Jetzt dort setzen wir...)

AP *13.7...va be?*
(13.7...ist es gut?)

AP *13.7...349 mi sembra quant'è va be 350.*
(13.7..349 es scheint mir, wieviel ist es, es ist gut, 350)

FP *Le minime quanto diventano 120 a ?*
(Wie werden die Mindestflughöhen...120 in...?)

AP *Adesso le minime le devi fa tu. Canne 1 B deve essere 120 e poi va subito a 150 nelle 32 miglia. Non c'abbiamo più problemi no?*
(Jetzt musst Du die Mindestflughöhen er rechnen. CANNE 1 B muss 120 sein und dann geht es sofort auf 150, innerhalb 32 Meilen. Wir haben keine Probleme mehr, oder?)

FP *Accelero a 250.*
(Ich beschleunige auf 250)

AP *Guarda solo se c'è ghiaccio perché io non trovo più la mia torcia.*
(Schau nur mal ob es Vereisung hat, weil ich meine Lampe nicht mehr finde.)

FP *Ho già guardato. Rimetti...*
(Habe schon nachgeschaut. Setze wieder)

AP *Siamo fuori?*
(Sind wir draussen?)

FP *No.*
(Nein)

AP *C'è una sbavata dai.*
(Es hat einen Schleier, gib)

AP *Non la trovo - eppure ce l'avevo, ...l'ho pagata 11000 lire.*
(Ich finde sie nicht, aber ich hatte sie... habe für sie 11000 Liren bezahlt

FP *(laughing)*

AP *L'ho pagata 11000 lire oh!*
(Habe für sie 11000 Liren bezahlt, oh!)

FP *150 l'abbiam' fatta - accelero a 290*
(150 haben wir's geschafft ich beschleunige auf 290)

AP *... Zurigo pista 16, company, ground, delivery, departure, ramp, atis 128.52*

FP *C'è ATIS di Zurigo no?*
(Ist das ATIS ZH da, oder?)

AP *Ebbene si.*
(Also, ja.)
...tutte le minime da considerare...uno. 32 miglia fuori.
(Alle Minimas zu betrachten...eins. 32 Meilen entfernt.)

FP *Abbiamo letto l'after takeoff?*
(Haben wir den after takeoff gelesen?)

AP *L'abbiamo letto no?*
(Haben wir ihn gelesen, oder?
FP *Si - questo qua sta sempre a zero.*
(Ja - dieser bleibt immer auf null)
FP *Qua c'è eh?*
(Da ist er, eh?)
AP *C'è eh lo vedo. Bene allora gli diamo una riscaldata pure all'altro sistema, visto che è abbondante qui.*
(Es ist da, eh, ich sehe es. Gut, dann heizen wir auch das andere System, da es hier ja reichlich ist.)
Click *Solo pe dajo....*
(um ihm nur zu geben)
Click *la coda vedi. Allora viene 200 88 89*
(Sehe das Heck. Dann kommt 200 88 89)
AP *Però i motori tielli...*
(Aber die Motoren halte sie)
FP ....
AP *Ma che CXXX vedo tutto sotto io...*
(Aber was... ich sehe Alles nach unten)
FP *Sotto si ma sopra no*
(Nach unten ja aber nach oben nicht)
AP ...
FP ...
FP *Approaching 200.*

ALTITUDE ALERT SOUND

AP *Molto bene.*
(Sehr gut)

18:45:10 AP *AZ 404 maintaining 200*
ATC *404 Milano roger*
AP *Gniene frega niente.*
(Es ist ihm egal)

ZURICH VOLMET
CLICK CLICK

AP *Benissimo eventualmente andiamo a Bale che é abbastanza buono. Ha finito quasi de piove. Zurigo dà 240 8 adesso dà eh!*
(Sehr gut, unter Umständen gehen wir nach Bale, das ziemlich gut ist. Es hat fast zu regnen aufgehöhrt. Zürich gibt 240 8 jetzt gibt er es eh!)
FP *Eh quindi - ...*
(Und dann - ...)
AP *Sarà un circling!*
(Es wird ein "circling" sein)

MARKER "BRUNNEN"

FP *Abbiamo...*
(Wir haben...)

CLICK CLICK

AP *Per la pista 28 che è quella che ci interessa a noi da 240 6 ...*
(Für die Piste 28, das ist die, die uns interessiert, gibt er von 240 6)

ZURICH ATIS

AP *Eh?*
FP *Me lo passi anche a me?*
(Gibst Du es mir auch?
AP *Bollettino Delta information la pista per adesso è ancora la 14 e la 28 da 240 8 nodi sulla 16 6 nodi però danno la 14, 9 kilometri, 3 a 1400, 5 a 3000, 7 a 4000, 9 con 8 1019.*
Tolgo tutto io allora come dici tu, come dici tu...
(Meldung DELTA Information, die Piste für jetzt ist noch die 14 und die 28 gibt 240 8 Knoten, auf der 16 6 Knoten aber sie geben die 14, 9 Kilometer, 3 auf 1400, 5 auf 3000, 7 auf 4000, 9 mit 8, 1019.)
Ich nehme also alles weg wie Du sagst, wie Du sagst)

CVR Track Change

FP *La coda gliela abbiamo data?*
(Dem Heck haben wir es gegeben?)
AP *Si è solo per la coda che l'avevo dato.*
(Ja ich habe es nur am Heck gegeben)
FP *Va bo'! Allora adesso sull'uno ci possiamo mettere Trasadingen.*
(Gut so! Also auf dem eins können wir jetzt Trasadingen setzen.)
AP *Allora io ti metto Trasa...13.7 qui - poi radio uno di qua ci metto 116.4 Trasadingen ci resta...sul... ci serve per l'arrivo no?*
(Also ich setze Dir Trasa...13.7 da dann Radio eins auf dieser Seite setzte ich 116.4 Trasadingen bleibt... auf...wir brauchen es für den Anflug.)
FP *Bo!*
AP *Kloten lo mettiamo di qua e poi dopo - CXXX - o forse ti interessa più Kloten di là vero? Ma si così' Kloten ce l'hai fino alla fine.*
(Kloten setzen wir auf dieser Seite und dann nachher... oder vielleicht interessiert Dich mehr Kloten auf der anderen Seite, oder? Aber doch, so hast Du Kloten bis am Ende.

18:50:20	ATC	*AZA 404 Milano*
	AP	*Vai avanti. - Go ahead.* (Vorwärts. - Go ahead.)
	ATC	*AZA 404 Radar 128.05 Buona sera.* (AZA 404 Radar 128.05 Guten abend.)
	AP	*128.05 ciao a fra poco* (Tschau bis bald)
	AP	*...OK 116.4 te l'ho messo sul numero due.* (...OK 116.4 habe ich Dir auf Nummer zwei gesetzt)
18:50:40	AP	*Buona sera Zurich AZA 404 maintaining 200.* (Guten abend Zürich AZA 404.....)
	ATC	*AZA 404 Zurich good evening squawk 6234*
	AP	*6234 coming*
	AP	*50 - Trasa sullo stesso valore di 349...-. Eventualemente, la 28 dove c'hai left right hand quindi vai do te pare.* (50 - Trasa auf den gleichen Werl von 349...- Unter Umständen die 28 wo Du left/right hast, also gehe wo es Dir passt.)
	FP	*Arriviamo, rompiamo a sinistra, manteniamo la pista visto che sono io il PF sulla destra, cosi' la vedo, ti va bene?* (Wir kommen an, brechen nach links aus, halte die Piste da ich ja der FP bin auf der rechten, so sehe ich sie, passt Dir das?)
18:51:20	ATC	*AZ 404 radar contact maintain FL200.*
	AP	*Maintaining 200 404.*
	AP	*Guarda bene la pista, ce l'hai qua no?* (Schau mal recht die Piste an, Du hast sie da, oder?
	FP	*Si.* (Ja.)
	AP	*Per mantenerla sulla destra tu fai così...* (Um sie rechts zu halten, machst du so...
	FP	*Si.* (Ja.)
	AP	*Se tu invece seguiti ad andare diritto fina al centro pista...* (Wenn Du aber immer gerade gehst bis zur Pistenmitte...)
	FP	*Eh.*
	AP	*Tu la pista...la vedi e ti fa così... sottovento almeno sei sicuro che ce passi sulla pista, non te la perdi più. Io una volta rompendo qui andando sottovento me so perduto e qui ce so' le montagne eh.* (Du die Piste...siehst Du und sie macht so... Gegenwind, so bist Du wenigstens sicher, dass Du über die Piste kommst und sie nicht mehr verlierst. Als ich hier einmal in die Gegen gerade ausgebrochen bin, habe ich mich verloren, und da hat es Berge eh.)

XX *Overhead the aerodrome, turn left turn downwind left turn.*

XX *...stiamo tranquilli, poi tu...*
(...Seien wir ruhig, dann Du...

AP *Perfetto... oh hai capito io ti guardo sempre la pista e - tu fai sempre uno strumentale fino al traverso e tu fai sempre uno strumentale e poi dopo dritto...fino all' ultiomo quant'è questo... ci allontaniamo im modo tale a 1200...sono 25 30 - 35 secondi.*
(Perfekt - oh hast Du verstanden, ich schaue immer zur Piste und Du machst immer einen Instrumentenanflug bis querab und Du machst immer einen Instrumentenanflug und dann nachher gerade...bis zum letzten, wieviel ist das...- wir entfernen uns in solcher Weise auf 1200 es sind 25 - 30 - 35 Sekunden.

FP *...a 1390 - 1019 no?*
(...auf 1390 - 1019 oder?

AP *1019 affermativo.*
(1019 bestätigt, bejahend)

FP *970*

AP *Va bene.*
(Gut so.)

AP *Io te lo do in discesa eh!*
(Ich gebe es Dir im Sinkflug!)

XX *...la pista è 14...*
(...die Piste ist 14...)

AP *...ci sei quasi vicino...VOR...controlli...*
(...Du bist fast nahe...VOR...Kontrollen)

AP *In avvicinamento c'abbiamo 15000 fino a Brunnen che sono - 10 - 18 - 28.*
(Im Anflug haben wir 15'000 bis Brunnen, das ist 10 18 28.)

18:53:40 ATC *AZA 404 your heading?*

AP *404 flying on heading 350*

ATC *Fly heading 340*

18:53:50 AP *Left 340 AZA 404.*

AP *Va bene' perchè...*
(Gut so, warum...)

ATC *AZA 404 descend to FL 140*

ATC *Down 140 AZA 404 leaving*

CLACK CLACK

AP *Abbassata minima controllata.*
(Ausgefahren - Minima - Kontrolliert)

FP *Checked*

AP *Poi ci abbiamo 100 da lasciare per Albix che sono 10 miglia e il traverso lo possiamo fare intorno ai 7 8 mila.*
(Dann haben wir 100 zu verlassen nach Albix, das 10 Meilen sind, und querab können wir um die 7 8 tausend machen.)

FP *Da mantenere 8 mila poi ci manda su Ekron...*
(8 tausend einzuhalten, dann schickt er uns nach EKRON.)

AP *Si.*
(Ja.)

FP *5 mila, il glide è di 3 gradi, l'outer marker a 1040 sull'echo, che lo appoggiamo anche... dietro...*
(5-tausend, der Glide ist 3 Grad, der outer Marker auf 1040 auf dem Echo den wir ?anlehnen? auch...- hinten)

AP *Se mi riduci un pò la velocità...*
(Wenn Du mir ein bisschen die Geschwindigkeit reduzierst)

ZURICH ATIS

AP *...è cambiato eh*
(Es hat gewechselt, ch.

ZURICH ATIS

AP *Va benissimo, eventualmente se vedi che in finale siamo un po veloci e non ti va bene puoi chiamare anche flap a 50 ma non ci son problemi perchè la pista è lunga...massimo 7 8 nodi.*
(Es ist sehr gut, eventuell, wenn Du siehst, dass wir im Endanflug ein wenig zu schnell sind und es Dir nicht passt, kannst Du auch Flaps 50 verlangen, aber es gibt keine Probleme, weil die Piste lang ist...7-8 Knoten.)

FP *...allora 260 è la nostra minima...*
(Also 260 ist unser Minimum)

CA *Comandante - chiedo scusa faccio l'annuncio della discesa?*
(Komandant - Entschuldigung soll ich die Sinkflug-Ansage machen?)

AP *Si stiamo scendendo. Tra 15 minuti saremo touch down e...*
(Ja wir sind im Sinkflug. In 15 Minuten sind wir touch down und...)

18:55:40 ATC *AZA 404 descend to FL 100*

18:55:50 AP *Continuing down 100 404*

AP *Il tempo è...con 9 gradi coperto*
(Das Wetter ist...mit 9 Grad bedeckt)

THROTTLE IDLE SOUND

CA *...grazie*
(...Danke)

	FP	*Questo è Kloten · qua abbiamo messo 332 Rhine tutt'e due d'accordo?...–* *...in caso di turbolenza tengo 300 nodi.* (Das ist Kloten da haben wir 332 Rhine gesetzt, beide, einverstanden? ...im Falle von Turbulenz halte ich 300 Knoten.)
	AP	*Adesso le faccio una domanda che sicuramente tu ce l'hai sotto controllo. Ma se per caso adesso non lo sentiamo più dove CXXXX andiamo, dai su...* (Jetzt frage ich Dich etwas das Du sicher beherrschst. Wenn wir ihn zufälligerweise nicht mehr hören, wo zum Teufel gehen wir? Antworte...)
	FP	*Se non sentiamo più chi? Il controllo. Avaria Radio?* (Wenn wir wen nicht mehr hören? Die Flugverkehrsleitung. Radioausfall.)
	AP	*Il controllo, eh l'avaria radio.* (Die Flugverkehrsleitung, eh, Radioausfall.)
	FP	*Riportiamo · allora andiamo verso Kloten facciamo la procedura standard andiamo verso Ekron che...l'initial approach fix...* (Wir melden – also dann gehen wir Richtung Kloten, machen das Standard Verfahren Richtung Ekron welcher...der initial approach fix.)
	AP	*Andiamo su Kloten...* (Gehen wir Richtung Kloten)
	FP	*Da Kloten?* (Von Kloten)
	AP	*Da Kloten puntiamo su Ekron manteniamo sempre quei 7 mila ... famose ... arriviamo su Ekron ...andiamo a Ekron aspettiamo se siamo in orario ...andiamo via subito facciamo la procedura standard...* (Von Kloten stechen wir Richtung Ekron, halten immer die 7-tausend...berühmte...kommen über Ekron an ...gehen nach Ekron, warten ob wir zur Zeit sind – gehen sofort weg, machen das Standard Verfahren)
18:57:10	ATC	*AZA 404 contact arrival <u>118.00</u> good bye.*
	AP	*118.00 good bye.*
18:57:30	AP	*Arrival good evening. AZA 404 <u>descending</u> 100 echo received.*
18:57:40	ATC	*AZA 404 Zurich Arrival good evening. Fly heading 325 radar vectors to the ILS 14.*
	AP	*Radar vectors to runway 14 on heading 325 404.*
	ATC	*AZA 404 descend to FL 90*

18:57:50	AP	*Continue down 90.*
	XX	...
	AP	*Sulla pista 14 come vedi dobbiamo uscire quasi verso la fine.* (Wie Du siehst müssen wir auf der Piste 14 fast am Ende die Piste verlassen.)
	XX	*...la riattaccata...* (...der Durchstart...
	AP	*Allora la riattaccata te ne vai a Wallisellen NDB che c'abbiamo sul numero due non serve a niente perché è un NDB lo capisci. Dobbiamo girare a sinistra e da lì...andiamo fino in fondo pista e giriamo a sinistra per Schaffhausen.* (Also der Durchstart gehst Du nach Wallisellen NDB, den wir auf Nummer zwei haben, er nützt nichts da es ein NDB ist, verstehst Du? Wir müssen nach links drehen und von dort... gehen wir bis zum Pistenende und drehen nach links Richtung Schaffhausen.)
	FP	*Schaffhausen lo appoggeremo qui.* (Schaffhausen den werden wir hier einstellen)
	AP	*...362 te lo metto qua. Schaffhausen a 5000 affermativo. Tu vai in fondo pista e giri a sinistra e te ne vai su Schaffhausen e sei sul numero 2.* (...362 stelle ich Dir hier ein Schaffhausen auf 5000 ja. Du gehst bis Ende Piste und drehst nach links und dann gehst Du nach Schaffhausen und bist auf Nummer 2.)
	FP	*...la visibilità quant'è?* (Wieviel beträgt die Sicht?)
	AP	*La visibilità è 9 kilometri.* (Die Sicht ist 9 Kilometer)
	FP	*Rallento a 250* (Ich verlangsame auf 250)
	AP	*Bravo.*
	FP	*Facciamo categoria due.* (Machen wir Kategorie zwei)
	AP	*Si perché la dobbimo provare.* (Ja, weil wir es ausprobieren müssen)
	FP	*...allora metto qua...* (...also setze ich hier...)
	AP	*Questo l'accetta la categoria due? Si?* (Akzeptiert dieser die Kategorie zwei? Ja?
	FP	*Mettiamo le minime di cat due?* (Setzen wir die Kategorie zwei Minima's?
	AP	*Dobbiamo provare i]...95.* (Wir müssen den...95 versuchen)
	FP	*93*
	AP	*95*
	FP	*Allora quant'è? 93?* (Also wieviel ist es? 93?)
	AP	*No io leggo 95...95...95* (Nein ich lese 95...95...95)

	AP	*Abbiamo quardato la stessa pista si?* (Haben wir die gleiche Piste angeschaut, ja?)
	FP	*No.* (Nein.)
	AP	*Ah ecco!* (Ah, da hast Du's!)
	FP	*...com'è la riattaccata?* (...wie ist der Durchstart?)
	AP	*La riattaccata poi gira a sinistra per Schaffhausen.* (Der Durchstart dreht dann links nach Schaff-hausen)
	AP	*Ah ecco perché non eri d'accordo su quello che dicevo ma che ci vai a fare sul beacon - ...stessa pista...* (Ach so, das ist es warum Du mit mir nicht einig warst, aber was machst Du auf den beacon -...gleiche Piste...)
	FP	*Servirà per un 'altra volta.* (es wird für ein anderes Mal dienen)
	AP	*Va bene l'importante...* (Gut, das Wichtige...)
	FP	*...*
	AP	*...è che poi si capisca. Quando tu non sei d'accordo...io t'ho detto non ci andare su quel beacon...vai direttamente a sinistra, vedi t'avevo messo...* (Ist es am Schluss, dass man versteht. Wenn Du nicht einverstanden bist...ich hatte Dir gesagt geh nicht auf den beacon...geh direkt links, siehst Du ich hatte Dir gesetzt...)
	FP	*...io ti ho detto due volte perché. Tu mi hai detto perché tanto vedi la fine pista...* (Ich habe es Dir zweimal gesagt warum. Du hast mir gesagt, Du siehst sowieso das Pis tenende.)
	AP	*Si...no quest'altra è obbligatorio andarci eh! Qui è obbligatorio andarci perchè quì ci sta una punta di 1627 piedi vedi è alta sai quella.* (Ja...nein bei dieser Anderen ist es obliga-torisch dorthin zu gehen eh! Hier ist es ob-ligatorisch dorthin zu gehen, weil hier eine Spitze von 1627 Fuss besteht, siehst Du die ist hoch.)
19:00:50	ATC	*AZA 404 turn right heading 340*
19:01:00	AP	*Right 340 <u>AZA 404</u>*
	AP	*Quando... non sei d'accordo?* (Wenn...Bist Du nicht einverstanden?)

AP *Scusa se forse non ho capito io ma perché mi dici così io ero convinto che, che tu m'avessi detto perché...mi dici di mettere Wallisellen...*
(Entschuldige wenn ich vielleicht nicht verstanden habe - aber da Du mir so sagst, war ich überzeugt, dass Du mir darum gesagt hattest...Du sagst mir Wallisellen zu setzen.)

FP *Eh...*

AP *Però non è vitale è importante perché mi dici quando c'hai quel valore di Wallisellen gira a sinistra...capisci invece quell'altro dice no, vai diritto proprio su Wallisellen... no per chiarire...vorrei chiarire eh eh perché se no...*
(Aber es ist nicht lebenswichtig, es ist nicht wichtig, weil Du mir sagst, wenn Du diesen Wert von Wallisellen hast, drehe links... verstehst Du, der Andere sagt aber, nein gehe gerade aus, genau auf Wallisellen.. nein um klarzustellen, ich möchte es klarstellen, eh eh weil sonst)

AP *Siamo al traverso di Kloten a livello 90 per cui ci porta alti eh!*
(Wir sind querab von Kloten auf Flugfläche 90 er bringt uns hoch!)

FP *Siamo alti ecco questo...*
(Wir sind hoch, so dieser...)

AP *Infatti io decelererei ancora di più perché superato il traverso è inutile correre, più corri più t'allontani capito? E se più t'allontani le minime ti salgono.*
(Also doch, ich würde noch langsamer fliegen, weil, sobald wir "querab" durchquert haben, ist es unnötig zu rennen, je schneller Du bist, umsomehr entfernst Du Dich und die Min desthöhen steigen.)

FP *...Stavolta...*
(...Jetzt...)

AP *Tanto stai al traverso...più vai piano e meno tempo impieghi per l'atterraggio.*
(Du bist sowieso querab...je langsamer Du gehst umso weniger lang hast Du zur Landung.)

ATC *AZA 404 reduce to 210 knots*

19:02:10 AP *<u>210</u> knots reducing 404*

THROTTLES IDLE SOUND

AP *Hai visto?*
(Hast Du gesehen?)

ATC *AZA 404 descend to FL 60*

19:02:30 AP *Down 60 AZA 404*

THROTTLES IDLE SOUND

19:02:50 ATC *AZA 404 turn left heading 325 again*
AP *Left 325 404*

TRIM

AP *Consiglio riduci a 200 nodi pure tu che tanto è inutile correre siamo già 15 miglia out.*
(Ich empfehle, reduziere auf 200 Knoten auch Du es hat sowieso keinen Sinn zu pressieren. Wir sind schon 15 Meilen out.)

CLICK CLICK

FP *...andando verso Ekron...facciamo...*
(...Richtung Ekron fliegend...machen wir...)
FP *...metto l'inbound 068 per andare...*
(...ich setze den inbound 068 um zu gehen...)

TRIM

FP *49...59...69...*
AP *Ci sono nove gradi. Quindi non ci occorre l'antigiaccio qui, siamo al limite...adesso ci sono 6 gradi.*
(Es ist neun Grad. So brauchen wir nicht die Enteisung hier, wir sind an der Grenze...)

ALTITUDE ALERT SOUND

AP *L'outer marker è a 1200 determinabili anche da 3.8 da Kloten. Rhine 5.6...*
(Der Outer Marker ist auf 1200 die auch durch 3.8 von Kloten werden können Rhein 5.6...)

19:05:15 ATC *Lufthansa 1834 Zurich Arrival good evening stand by. Break break. AZA 404 turn right heading 070.*

19:05:20 AP *Right 070 AZA 404*

CLACK
TRIM
MORSE CODE

AP *India Kilo Lima*

19:06:20 ARR *AZA 404 descend to 4000 feet, turn right heading 110, cleared ILS approach runway 14, QNH 1019.*

19:06:30	AP	*1019 4000 feet, turn right heading 120 to intercept runway 14*
	ATC	*Maintain 210 404*
	AP	*Two ten maintaining*
	CLICK CLICK	
19:06:45	AP	*...altimeters 1 - 9 6...7.*
19:06:50	FP	*1019*
	AP	*Quant'è allora?* (Wieviel ist es also?)
19:06:55	FP	*970 l'ho guardata io.* (970 ich habe nachgeschaut.)
19:07:05	AP	*...bene 970 va bene. Landing data 37 125 sulla salmone va bene. La riattaccata a memoria.* (...Gut 970 es ist gut. Landing data 37 125 auf dem Zeiger. Es ist gut. Den Durchstart auswendig.)
19:07:10	FP	*37 40 doppie 138 Schaffhausen* (37 40 doppelt 138 Schaffhausen)
	AP	*Perfetto.* (Perfekt)
	FP	*...5000 sul due* (... 5000 auf dem zwei)
19:07:20	FP	*Cosa ha detto? 110?* (Was hat er gesagt? 110?)
	AP	*(contemporaneamente) 10 tolgo tutto.* (10 Ich nehme alles weg)
	CLICK CLICK	
	FP	*Autorizzati a seguire?* (Freigegeben um zu folgen)
19:07:25	AP	*Autorizzati fino a 4000 piedi dopo di che a intercettare e seguire.* (Freigabe bis 4000 Fuss, nach den Auflinieren und folgen)
	FP	*...allora facciamo Radio Approach.* (...Dann machen wir Radio Approach)
	AP	*Vai.* (Gehe)
	ATC	*AZA 404 reduce to 180*
19:07:40	AP	*Reducing <u>now</u> 180 404*
19:07:45	AP	*...ce l'hai tu qui il glide?* (Hast Du ihn hier den Glide?

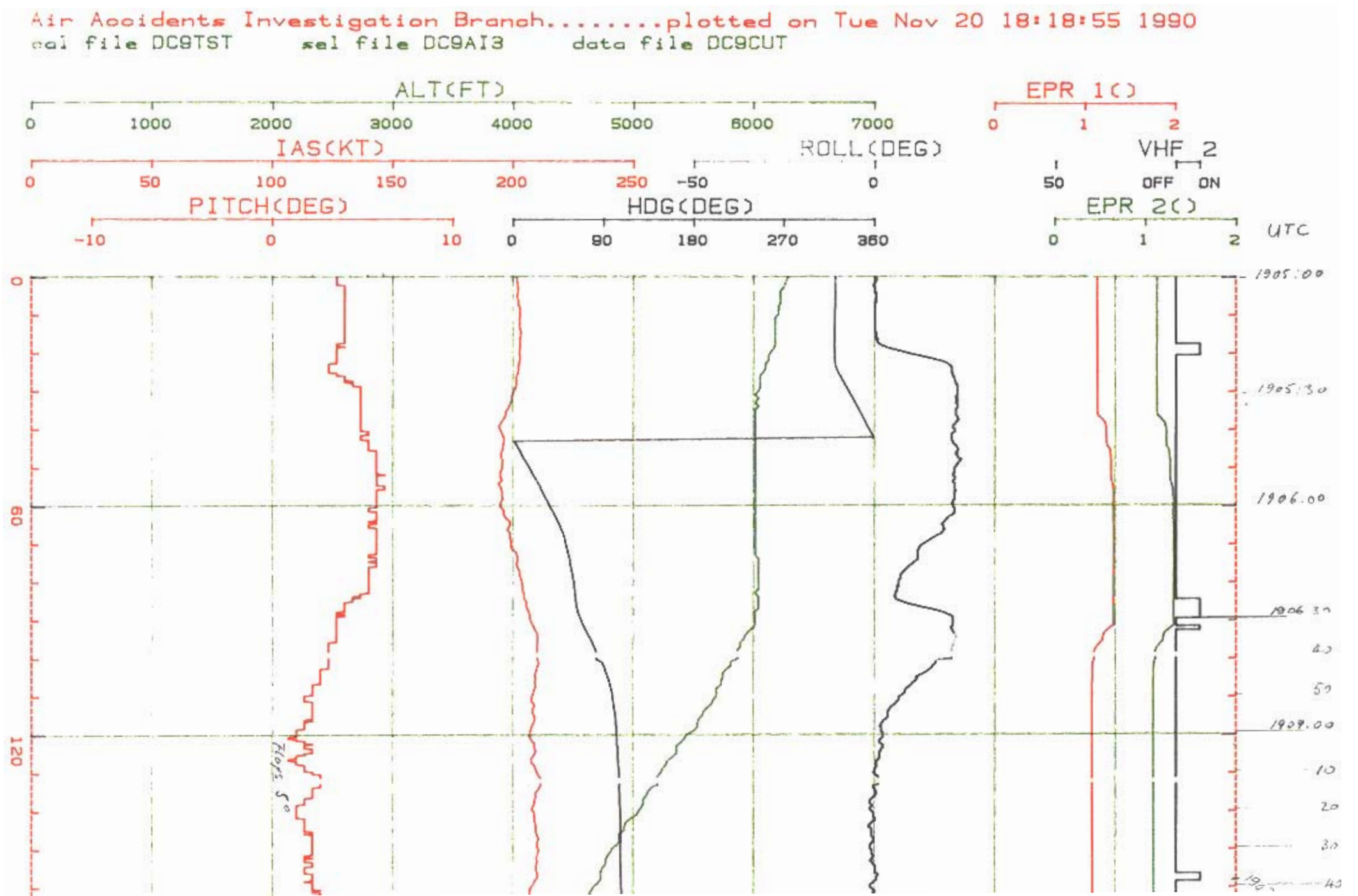
19:07:52	FP	*...sul uno non... ce l'ho* (...Auf dem eins, nein (nicht)...habe ich es)
19:07:59	AP	*Benissimo, allora lo facciamo sull'uno* (Sehr gut. dann machen wir es auf dem eins)
	FP	*Radio uno* (Radio eins)
19:08:07	FP	*Flaps*
19:08:20	AP	*Riduci un tantino la velocità...* (Reduziere ein bisschen die Geschwindigkeit)
	TAP TAP TAP	
	ATC	*AZA 404 reduce to 160 kts.*
19:08:35	AP	*Reducing 160*
19:08:47	AP	*... Capture Loc capture glide Path capture, quindi siamo nel fascio catturato un pò spostati ma.* (Wir sind also im eingefangenen Strahl etwas verschoben aber...)
19:08:53	FP	*Nove sette zero anche io,* (neun sieben null auch ich)
19:08.58	ALTITUDE WARNING SOUND	
19:09:01	AP	160.
19:09:09	AP	*Cancello e scrivo 5000* (Ich lösche und setze 5000)
	(GEAR DOWN?) TRIM	
19:09:18	AP	*Ce ne abbiamo uno un'alto davanti abbastanza vicino, Metti anche 250 se no va a finì che schiattano na riattaccata.* (Wir haben einen vorne, ziemlich nahe . Setze auch 150 sonst geht es noch so weit, dass sie uns einen Durchstart aufzwingen.)
19:09:33	FP	*C'è ghiaccio?* (Hat es Eis?)
19:09:35	AP	*No no, praticamente no, c'abbiamo 10 gradi e 10 in terra.* (Nein nein, praktisch nicht, wir haben 10 Grad und 10 am Boden)
19:09:41	FP AP	*Flaps 25.* *Flaps 25.*

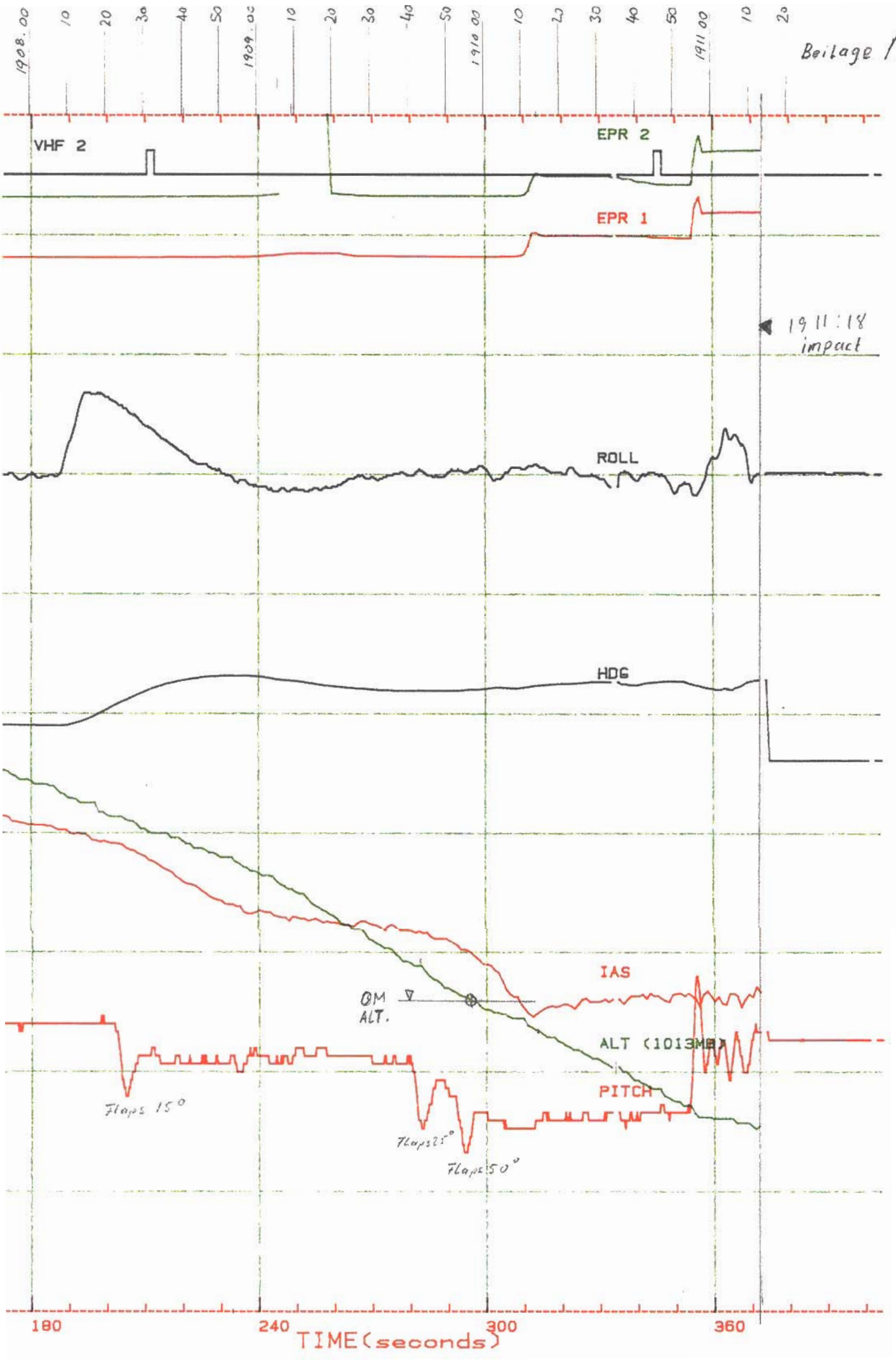
19:09:47	AP	*Check dell' Outer Marker è 1250 piedi* (Der Outer Marker Check ist auf 1250 Fuss)
	FP	*Flaps fifty mettiamo...123*
19:09:52	AP	*Bravo*
	CLICK	
19:10:12	AP	*...3.8. quasi 4 miglia* (...3.8. fast 4 Meilen)
19:10:27	FP	*...Non è passato...?* (...Ist er noch nicht vorbei...?
19:10:39	FP	*Non è passato l'outer marker?* (Ist der Outer Marker noch nicht vorbei?)
	AP	*No, no, non ha cambiato...oh, qui mi da 7...* (Nein, nein, hat nicht gewechselt...oh, hier gibt es mir 7)
19:10:50	ATC	*AZA 404 speed now as convenient 4 miles behind a DC9 contact Tower eighteen one Good night.*
	AP	*118.1 good bye.*
	FREQUENCY CHANGE	
19:10:55	AP	*...che non me torna...* (...das hat für mich keinen Sinn...)
	FP	*No neanche a me.* (Nein, mir auch nicht)
19:10:57	AP	*Tira su, tira su, tira su, tira su!* (Ziehe, ziehe, ziehe, ziehe)
	CLACK	
19:10:59	FP	*Go around*
19:11:00	AP	*No, no, no, no (fattidi)* il glide* (Nein, nein, nein, nein, ?packe? den Glide)
19:11:11	AP	*Ce la fai a reggerlo?* (Kannst Du ihn halten?)
19:11:13	FP	*Si.* (Ja.)
19:11:14	PIP PIP PIP PIP PIP PIP PIP PIP	
19:11:16	AP	*Aspetta proviamo a rim...* (Warte, versuchen wir zu ble...)
19:11:18	CRASH	

* phonetisch, nicht genau definiert.

Beilage / Annesso / Annex 7

Anzug aus dem DFDR der AZ 404 vom 14.11.1990 (1905:00-1911:18)
Estratto delle registrazioni del DFDR del volo AZ 404 del 14.11.1990 (1905:00-1911:18)
Extract of DFDR of AZ 404, 14.11.1990 (1905:00-1911:18)


Air Accidents Investigation Branch.....plotted on Tue Nov 20 18:18:55 1990
cal file DC9TST
sel file DC9AI3
data file DC9CUT
ALT(FT)
0
1000
2000
3000
4000
5000
6000
7000
IAS(KT)
0
50
100
150
200
250
PITCH(DEG)
-10
0
10
ROLL(DEG)
-50
0
HDG(DEG)
0
90
180
270
360
EPR 1()
0
1
2
VHF 2
50
OFF
ON
EPR 2()
0
1
2
UTC
1905:00
1905:30
1906.00
1906 30
1907.00
1908.00
0
60
120
Flaps 5°

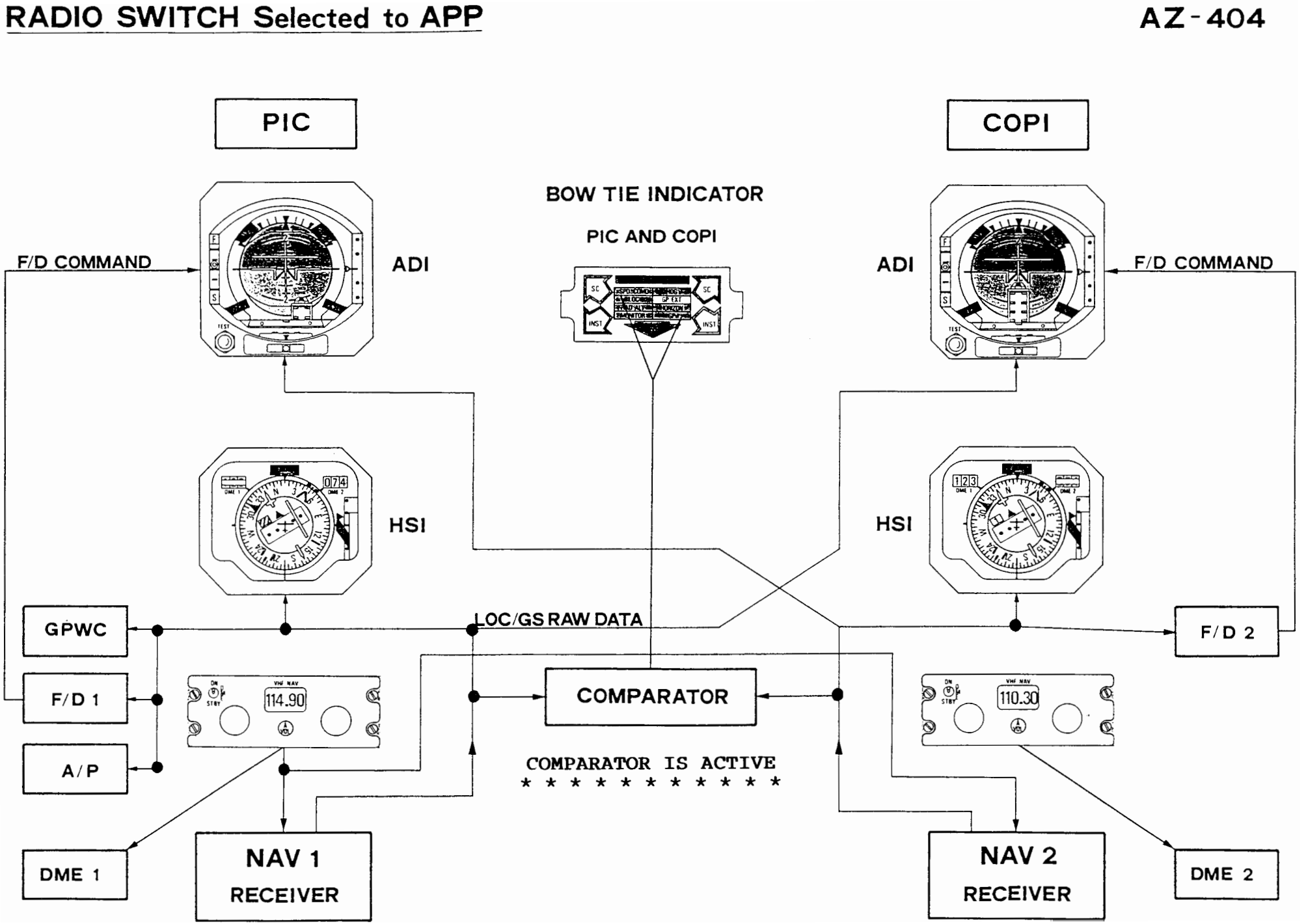

1908.00
10
20
30
40
50
1909.00
10
20
30
40
50
1910.00
10
20
30
40
50
1911.00
10
20
Beilage / Encl.
VHF 2
EPR 2
EPR 1
1911:18
impact
ROLL
HDG
IAS
OM
ALT.
ALT (1013MB)
PITCH
Flaps 15°
Flaps 25°
Flaps 50°
180
240
300
360
TIME (seconds)

Beilage / Annesso / Annex 8

Bildliche Darstellung der Arbeitsweise des „Comparator“ mit dem Radio switch in Stellung APPROACH (*Comparator in Betrieb*)
Rappresentazione grafica del funzionamento del “comparatore” con il selettore radio in posizione APP (*comparatore attivato*)
Pictoral presentation of “comparator” operation with Radio switch selected to APP (*comparator active)*

RADIO SWITCH Selected to APP

AZ-404

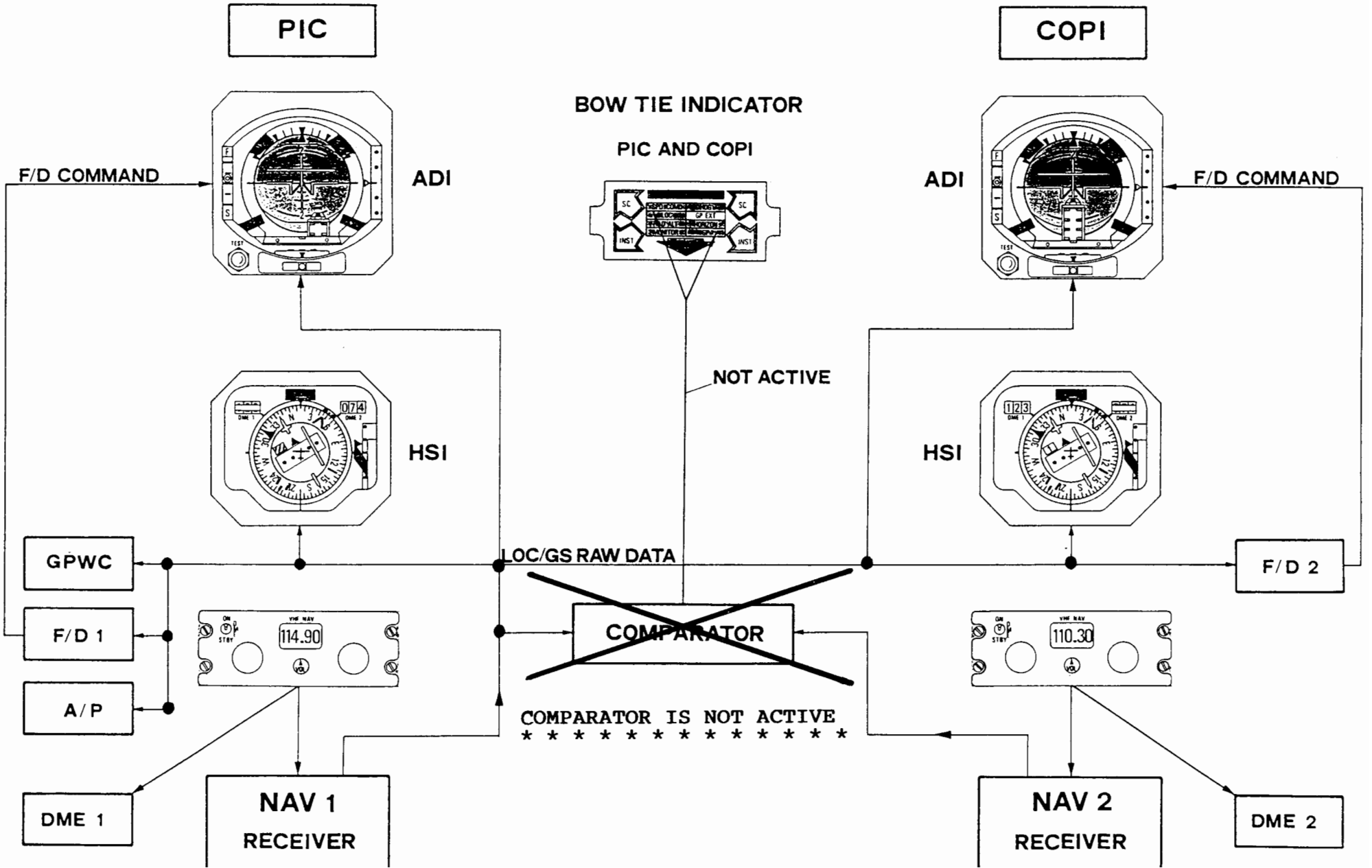


Beilage / Annesso / Annex 9

Bildliche Darstellung der Arbeitsweise des „Comparator“ mit dem Radio switch in Stellung I (*Comparator ausser Betrieb*)
Rappresentazione grafica del funzionamento del “comparatore” con il selettore radio in posizione 1 (*comparatore disattivato*)
Pictoral presentation of “comparator” operation with Radio switch selected to 1 (*comparator not active)*

RADIO SWITCH Selected to 1

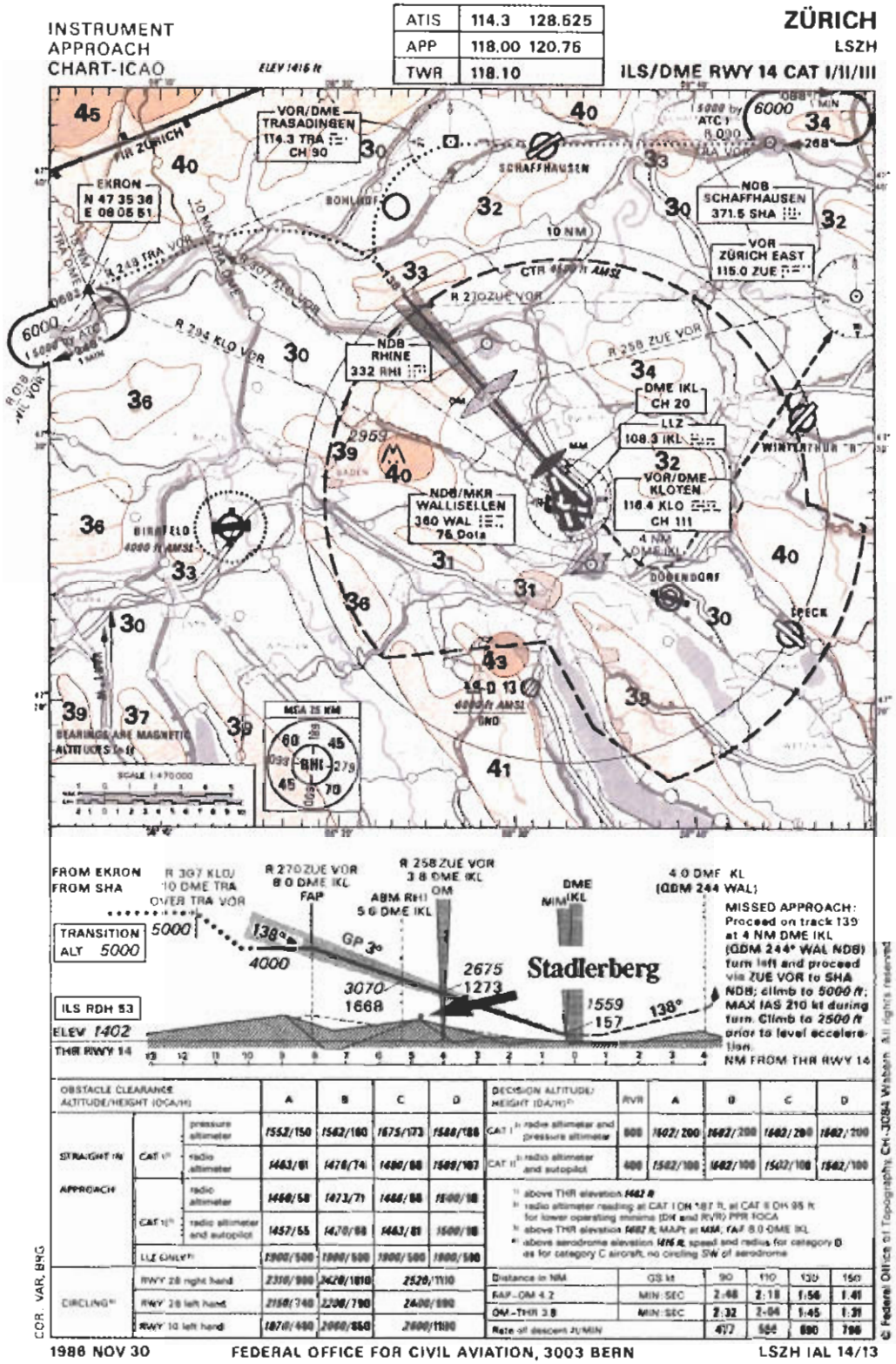
AZ-404



Beilage / Annesso / Annex 10

Instrumenten Anflug- und Landekarte aus AIP Schweiz
Carta d'avvicinamento e atterraggio strumentale dall'AIP Svizzera
Instrument approach and landing chart from AIP Switzerland

Instrumenten Anflugkarte aus AIP Schweiz



Beilage / Annesso / Annex 11

Instrumenten Anflug- und Landekarte aus Alitalia Route Manual
Carta d'avvicinamento e atterraggio strumentale dal manuale di rotta Alitalia
Instrument approach chart from Alitalia Route Manual

ZURICH, SWITZERLAND

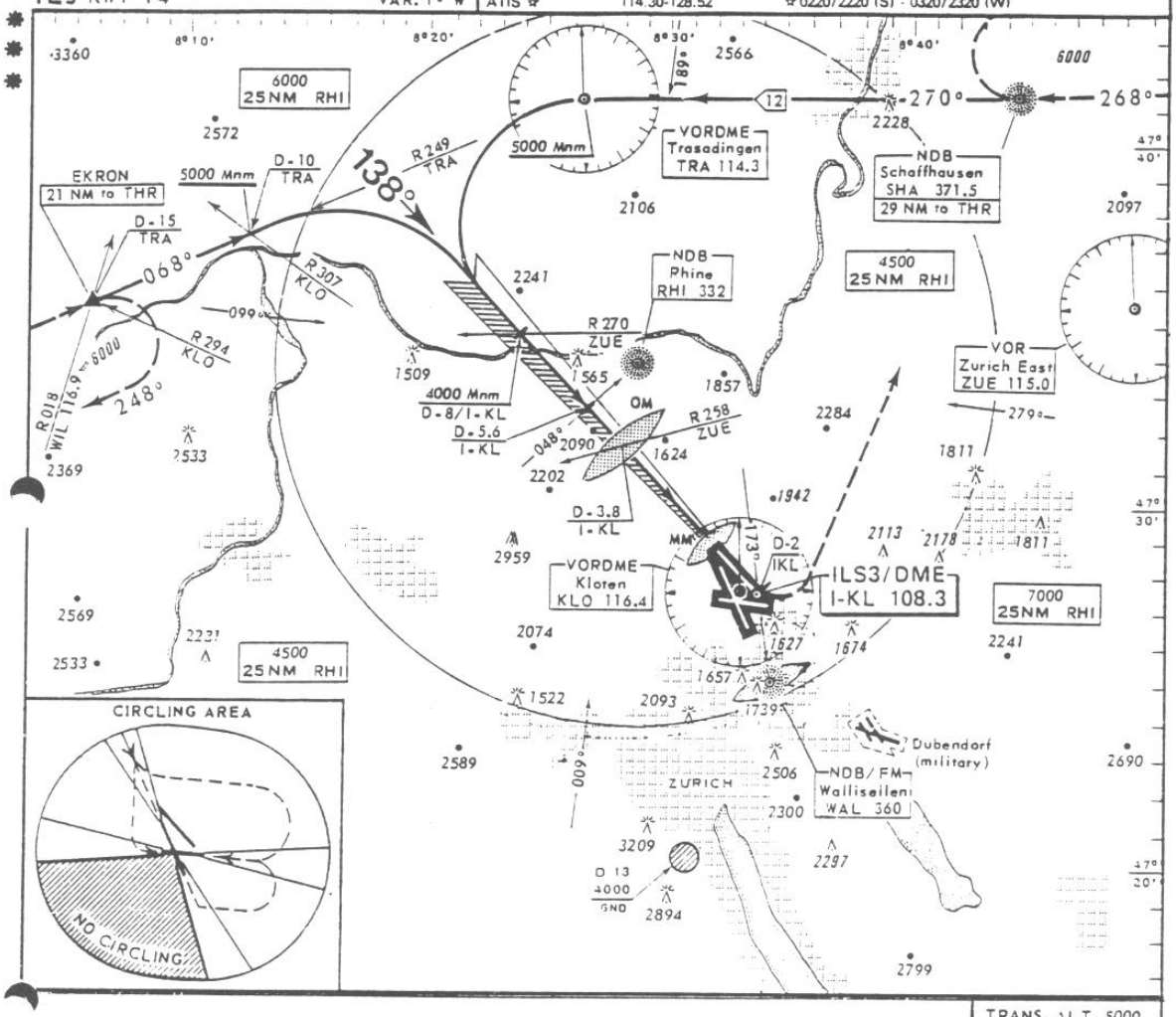
ZURICH AIRPORT

A/D ELEV. 1416

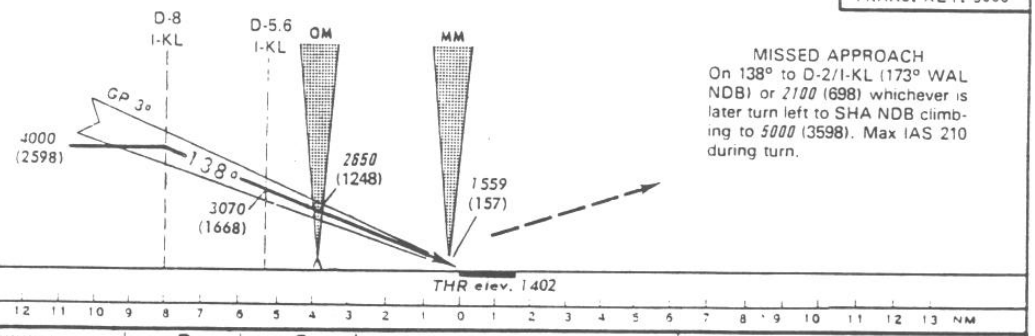
VAR. 1° W

ILS RWY 14

Zurich	APP/SRE	118.00-120.75-127.75	COMPANY ⁰		131.70 (SWR) when in flight
Zurich	TWR	118.10-127.75			129.70 (SWR) when on ground
Zurich	GROUND	121.90	Guard		119.70
Zurich	DELIVERY	121.80 *	VDF avbl on APP/TWR freq.		
Zurich	DEP	125.95	* ATC clearance	◆ Engine START-UP.	
Zurich	RAMP◆	121.75-◆ 121.65	• 04/23z	° 08/22z	
ATIS ☆		114.30-128.52	☆ 0220/2220 (S) - 0320/2320 (W)		



TRANS. ALT. 5000



MISSED APPROACH
On 138° to D-2/I-KL (173° WAL NDB) or *2100* (698) whichever is later turn left to SHA NDB climbing to *5000* (3598). Max IAS 210 during turn.

LNDG MINIMA		D	C
CAT 3A	DH - RA	20	20 ❶
	RVR	200	200
CAT 2	DH	100	100
	RA	95	95
	RVR	350	350
CAT I	DH/ RVR-VIS	200/600	200/600
ILS no GP	MDH/ RVR-VIS	500/1600❷	500/1600❷
CIRCLING❸	MDH/ VIS	1200/4500	1200/4000

❶ DC-9/80: 50 ❷ IF APL U/S: VIS - 400 ❸ See sketch

TRAFFIC CIRCUIT
Rwy 10 left hand
Rwy 28 left or right hand

NOTE
- MAPt ILS no GP: MM
- MHA over EKRON and SHA NDB lowered to 5000 by ATC discretion only.

TIME (MIN-SEC)
RATE OF DESCENT (FT/MIN)

From	to	Dist. Slope	Ground Speed (KTS) 120	140	160	180
OM	THR	3.8 NM 3° / 5.2%	1-54 630	1-38 730	1-26 840	1-16 940

Change: Engine START-UP freq.

Change: Minor

ARRIVAL INFO

ATIS – TRA 114.3 – 128.52 0220/2220z (S) 0320/2320z (W).

SPEED RESTRICTIONS

Max IAS 250 Kts below FL 100, if not otherwise instructed. Assigned speeds shall be maintained also during intermediate approach. If unable inform ATC.
A/C to ZURICH APT shall be flown at IAS 250 Kts or less when within DME 60 TRA arc.
If DME TRA U/S, DME 60 KLO arc. is to be used. Pilots unable to comply with this speed limit, they shall fly the minimum speed acceptable.

NOISE ABATEMENT

1. Normally all landings shall be made on RWYs 16 and 14, other runways may only be used if landing on RWYs 14 and 16 is unpracticable due to technical or meteorological reasons. Proceed circling visual right or left hand for landing on RWY 28 or left hand for RWY 10. RWY 32 and 34 not available for landing.
2. Fly visual circuits at 3000 or higher and avoid flying over the adjacent communities whenever possible.
3. Reverse thrust: do not use more than idle reverse if possible.
4. Auxiliary Power Units (APU)
   After arrival, APU shall not last more than 20 mins. In special cases, the Airport Authority may permit longer use.
   The use of these units for maintenance reasons shall be minimized.
5. **Night flight restrictions**

5.1 Landings not sistematically granted between 2000/0400 (S) – 2100/0500 (W).

5.1.1 Scheduled a/c (including supplementary flights and rerouted flights but excluding alternate landings).

- Landings until 2200 (S) – 2300 (W) will be authorized by F.O.C.A. (Federal Office for Civil Aviation).
  In case of delay till 2230 (S) – 2330 (W) without special permission.
  Supplementary landings till 2200 (S) – 2300 (W) can be authorized by F.O.C.A upon request.
- Landings between 2230 and 0300 (S) and 2330 and 0400 (W) can be authorized by F.O.C.A for important reasons.
- Pilots can only expect to receive a clearance for approach if he is over or abeam (when radar vectored) reporting points SHA NDB or ERKON at 2220 (S) – 2300 (W) at the latest.

5.1.2 Non-scheduled a/c

- Landings between 2000 and 2100 (S) – 2100 and 2200 (W) are subject to an authorization. In case of delay authorized night flights will be admitted only till 2130 (S) – 2230 (W).
- Landings between 2130 and 0400 (S) – 2230 and 0500 (W) can be authorized by F.O.C.A for important reasons.
- Pilots can only expect to receive a clearance for approach if he is over or abeam (when radar vectored) reporting points SHA NDB or EKRON at 2120 (S) 2220 (W) at the latest.

TAXI PROCEDURES – See GND Movement Chart

- A/c shall contact "ZURICH APRON" following instructions from "ZURICH TWR" or "GND CONTROL" and shall taxi indipendently to their parking position as instructed by "ZURICH APRON".
  If, while taxiing into a dock-parking position, the crew notices that the docking guidance system has not been put into operation or is otherwise unserviceable they shall stop the A/C immediately.
  The unserviceability has to be notified, on the Apron Control frequency.
  The A/C shall not taxi any further, until a "Follow-me" car as taken over the guidance.

ARRIVAL INFO

RUN-UP

Run-ups are authorized from 0500/2100z, duration and power setting for such run-ups shall be kept at a minimum. For safety reasons and noise monitoring, the running of engines, not used for taxiing out, is subject to prior permission, to be request from Zurich APRON 121.75.

PARKING PROCEDURES

Guidance of a/c on Apron: (See GND Movement Chart)

- Visual docking guidance system available.
  AGNIS/Stopping position indicator at Dock Terminal "B". (See Aerodrome Info)
  SAFEGATE for stands at Dock Terminal "A". (See Aerodrome Info).
- In exceptional operational conditions "Follow me" cars are available for a/c guidance.
- For parking at self manoeuvering parking stands
  For directional guidance into a specifing stand, follow exactly respective ACFT line, when your eyeline coincides with yellow STOP-line on your left side.
- Direction for taxi onto stands.
  DC9: follow (dashed) standline with 0 in front of stand number
  A300/DC10: Follow (solid) standline with 1 in front of stand number
  B747: Follow (solid) standline with 2 in front of stand number.

OTHER INFORMATION

1. Reduction of separation minima between landing a/c on Rwys 14 & 16.
   A clearance to land can be issued to arriving a/c provided that the preceeding landing a/c has crossed the THR and passed beyond a point at latest 2500 m from the THR and is in movement.
   Conditions for application:
   a) Full landing distance available.
   b) A/c concerned operating normally.
   c) By day only and visibility at 8 Km or above.
   d) No turbulence or windshear is known.
   e) Runway is in dry condition.

   Phraseology: "AZ 400 cleared to land, DC9 about to clear the runway".
2. RWY 16 grooved except last 400 m.
3. ASMI available outside "APRON CONTROL" area. Info and instr.s through TWR and/or "GND CTL".

CAT II/III APPROACHES

During CAT II/III weather conditions the approach will be radar-vectored alternatively from SHA NDB to Rwy 16 and from EKRON to Rwy 14.
Approach-lighting-system and runway lights Rwy 14 and 16 are fully operating simultaneously.

WARNING: Do not mistake Rwy 14 for Rwy 16 in rapidly changing weather conditions.

COMMUNICATION FAILURE

ICAO basic proc. and in addition:

Proceed via the appropriate inbound route to either EKRON RP or SHA NDB. At flight plan ETA commence descent in the holding pattern and carry out a standard instrument approach.

Beilage / Annesso / Annex 12

Sicherheitsempfehlungen des NTSB
Raccomandazione dell'NTSB
NTSB Safety recommendations

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 4, 1992

In reply refer to: A-92-8 and -9

Honorable Barry L. Harris
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 14, 1990, a McDonnell Douglas DC-9-32, registered in Italy as I-ATJA and operated as Alitalia flight 404, (AZA-404) crashed into the side of a mountain about 5 miles north of Zurich-Kloten Airport (LSZH). The flight had departed Milano-Linate Airport (LIML) at 1936.[1] The accident occurred at 2013, during an instrument landing system (ILS) approach to runway 14 at LSZH. The captain, first officer, 4 flight attendants, and 40 passengers perished. The accident is under investigation by the Swiss Federal Aircraft Accident Investigation Bureau, and the National Transportation Safety Board, the Federal Aviation Administration (FAA), and Douglas Aircraft Company are participants in accordance with the provisions of the International Convention on Civil Aviation.

Details of the accident sequence of events and conclusions will be forthcoming when the Swiss Government publishes the report in March, 1992. The investigation has disclosed a possible failure mode of the very high frequency omnidirectional range (VOR)/ILS system, which was installed on the airplane, that could have contributed to this controlled flight into terrain. This failure mode could have led the flightcrew into believing they were on course and on the glidepath when they were not.

According to Douglas Aircraft Company engineers, it is possible that a short circuit or an open circuit in certain models of VOR/ILS receivers could cause navigation instruments to indicate "zero deviation." Thus, raw data deviation information on the attitude direction indicator, displayed by the flight director bars, and the horizontal situation indicator could center and remain centered with no failure or warning flag in view. In addition, this short circuit or open circuit could prevent the autopilot and the ground

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[1] All times are Zurich local time (UTC+1 hour).

proximity warning system (GPWS) from receiving the proper course and glidepath deviation signals. The autopilot would continue to guide the airplane according to previously established crew inputs, and the GPWS would not sound an alarm due to glideslope deviation or descent below a safe altitude. This could also occur if the VOR localizer (LOC) or glideslope signals to the autopilot were interrupted by an open circuit.

As a crosscheck of the system, the captain and first officer would normally use two separate VOR/LOC receivers for navigation information that would be displayed on their respective instruments. However, without warning flags indicating system failure, the pilots might accept as accurate centered indications and then use the "NAV" switching function to select the malfunctioning VOR/LOC receiver on both panels.

According to Douglas, some VOR/ILS receivers have an expanded self-monitoring capability to detect this type of failure. Receivers that do not have this feature are:

Collins model 51RV-I
Collins model 51RV-4
Wilcox model 806
King model KNR6030
Bendix model RNA 26C (some versions)

Douglas issued two All Operators Letters (AOLs) (AOL No. C1-E60-HHK-L134, dated July 27, 1984, and AOL No. 9-1565, dated August 24, 1984,) that described the potentially hazardous failure modes. The company issued another All Operators Letter (Douglas AOL No. C1-JLO-TMR-91-L001) on March 1, 1991, following this accident that reiterated the information in the 1984 letters. According to Douglas records, Alitalia received the 1984 letters and other information relating to the anomaly in 1984. Alitalia pilots, however, were unaware of the potential problem until after the accident.

Douglas Aircraft Company revised DC-9 and MD-80 flightcrew operating manuals to reflect the possibility of short or open circuits within the VOR/ILS system. Douglas officials also believe that the failure scenario should be incorporated into all DC-9/MD-80 flightcrew training curricula. The Safety Board believes that this action is appropriate. Douglas officials are recommending that if a discrepancy exists between deviations displayed on the indicators of the same type of instrument, the pilots should carefully compare the VOR/LOC or glideslope deviation information with other navigational aids, such as distance measuring equipment, VOR bearing, radio and barometric altitude, marker beacon, automatic direction finder bearing, and vertical speed. Also, if "NAV" switching is used, it should be accomplished before localizer and glideslope capture on an instrument approach to allow positive verification of all deviation information that will be used for that approach. Douglas further recommends that if one VOR/ILS receiver is inoperative, the other receiver should be temporarily tuned to a nearby VOR station and the selected course varied to ensure that the course deviation indicator moves in accordance with the selected course.

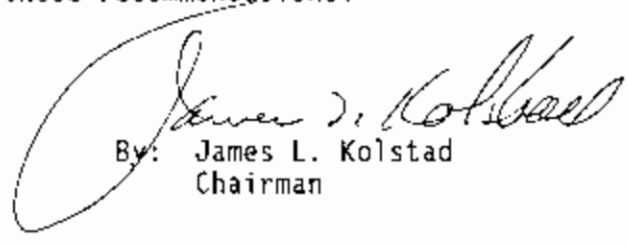
These VOR/ILS receivers may also be installed in an undetermined number of air carrier and other aircraft made by U.S. and other manufacturers. The Safety Board has no reasonable means to determine what other types of airplanes utilize these receivers or what companies operate these airplanes. However, because these VOR/ILS receivers may also be installed in some corporate or other general aviation aircraft, the Safety Board believes that information regarding this potential problem should be published in Advisory Circular (AC) 43-16, General Aviation Airworthiness Alerts, in addition to being disseminated to all air carriers.

In view of the findings, the Safety Board recommends that the Federal Aviation Administration:

Issue an Air Carrier Operations Bulletin to Principal Operations Inspectors requiring that operators of airplanes equipped with the following navigation receivers include in their Pilot Operating Manuals procedures for detecting malfunctions that result in the display of disparate information: Collins model 51RV-I; Collins model 51RV-4; Wilcox model 806; King model KNR6030; and some versions of Bendix model RNA 26C. Also, notify formally foreign airworthiness authorities about the potential failure modes in such equipment. (Class II, Priority Action) (A-92-8)

Publish the substance of this recommendation in Advisory Circular (AC) 43-16, General Aviation Airworthiness Alerts. (Class II, Priority Action) (A-92-9)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT, concurred in these recommendations.



By: James L. Kolstad
Chairman

Beilage / Annesso / Annex 13

Instrumenten-Anzeigen, Stellung des Radio-Schalters und Anzeigen des „Mode Annunciator“ und des „Bow Tie indicator“ im Cockpit der AZ 404

Indicazioni degli strumenti, Posizione dell’interrutore Radio e indicazioni del „Mode annunciator“ e del „Bow Tie indicator“ nel cockpit del volo AZ 404

Instrument indications, Radio switch position and indication of mode annunciator and Bow Tie in the AZ 404 cockpit

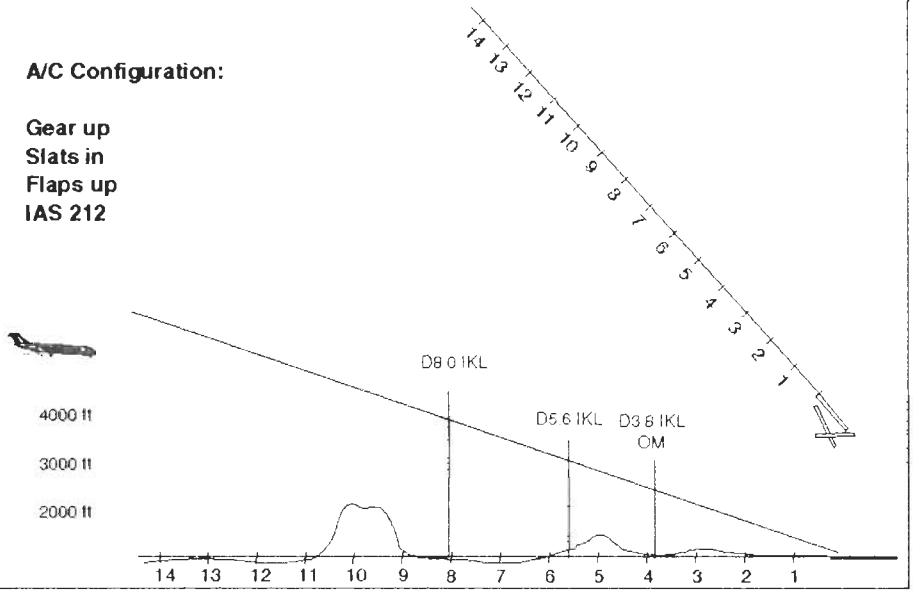
Cockpit Indications

Geographical Situation

Not to scale

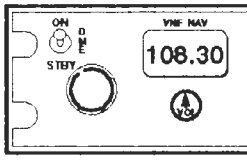
A/C Configuration:

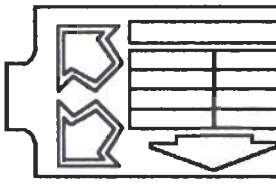
Gear up
Slats in
Flaps up
IAS 212

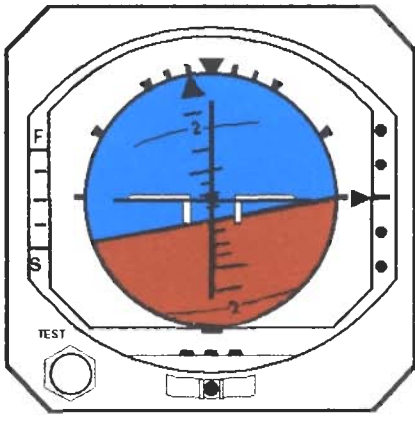


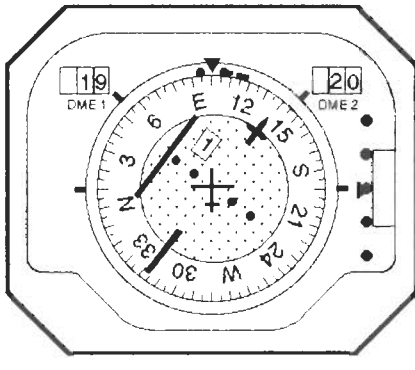
Cockpit Voice Recorder

1906.20	APP	AZA 404 descend to 4000', turn right HDG 110, cleared ILS approach runway 14, QNH 1019.
1906.30	404	1019, 4000', turn right 120 to intercept runway 14.
	APP	Maintain 210, 404.
	404	Two ten maintaining
	- Switching is heard -	
1906.45	A/P	...altimeters 1- 9...67
1906.50	F/P	1019
	A/P	What is it?
1906.55	F/P	970 I checked it
1907.05	A/P	Good 970 it's OK. Landing Data 37 125 on the red bug OK, the Goaround by heart.
1907.10	F/P	37 40 at the 'Double Bugs', 183 Schaffhausen
	A/P	Perfect
	F/P	...5000' on 2



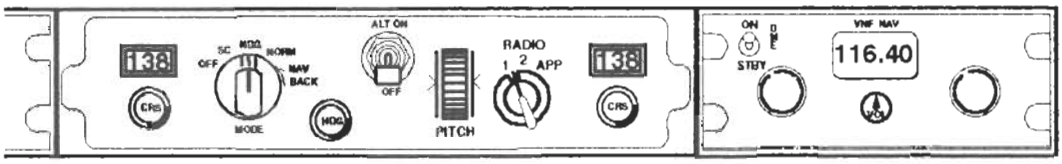


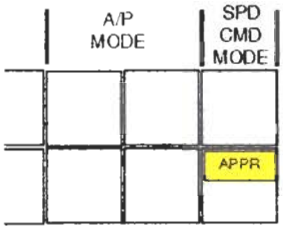


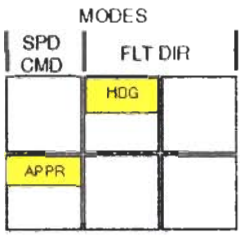


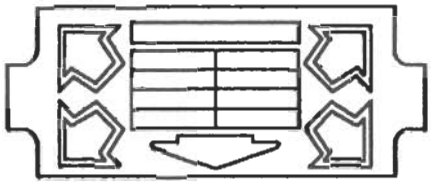
19:06:45 UTC A

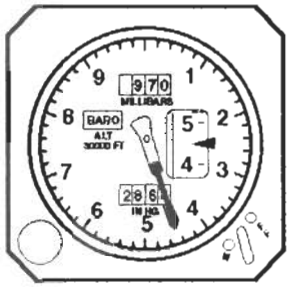
Figure 1

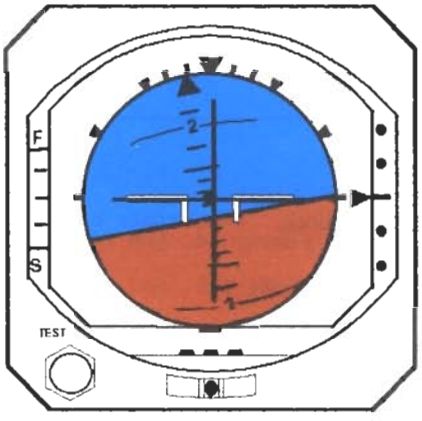


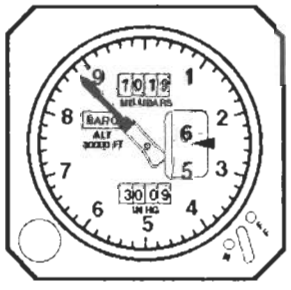


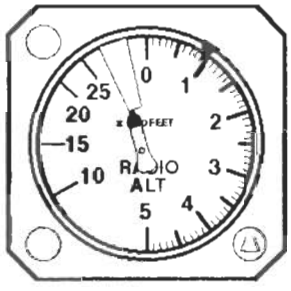


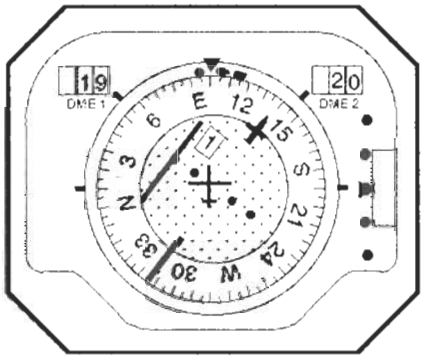


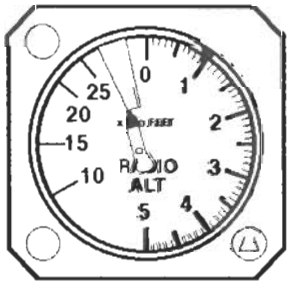


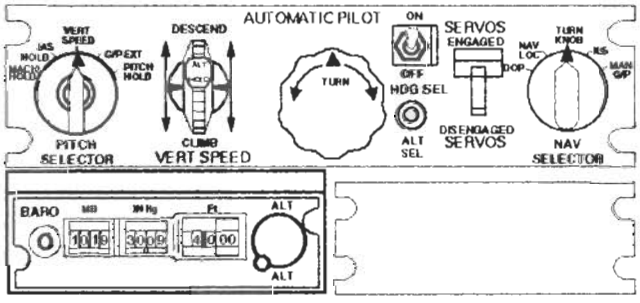












Unfall AZ404 / 14. November 1990

Büro für Flugunfalluntersuchungen
Operations Group 1.10.91

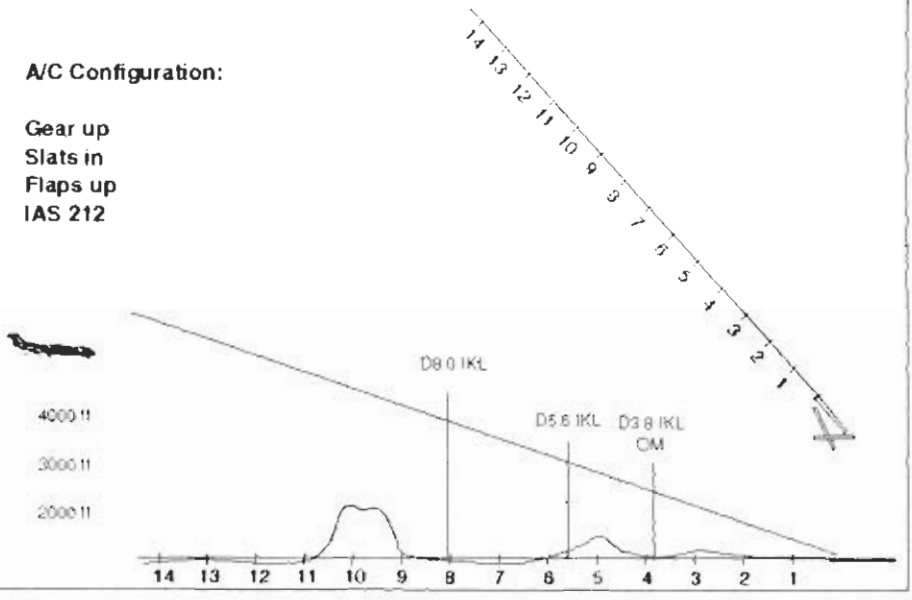
Cockpit Indications

Geographical Situation

Not to scale

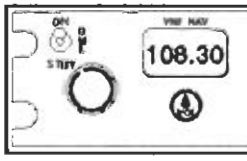
A/C Configuration:

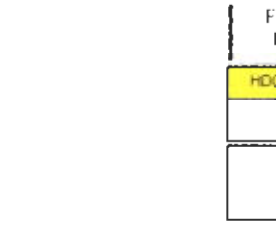
Gear up
Slats in
Flaps up
IAS 212

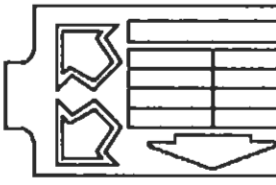


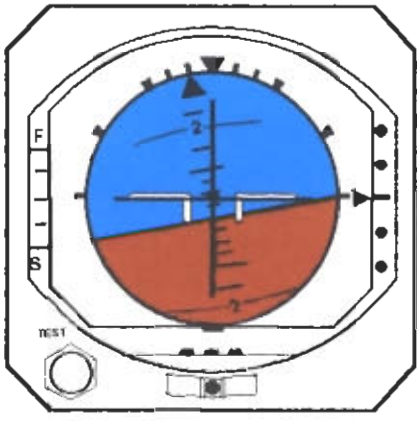
Cockpit Voice Recorder

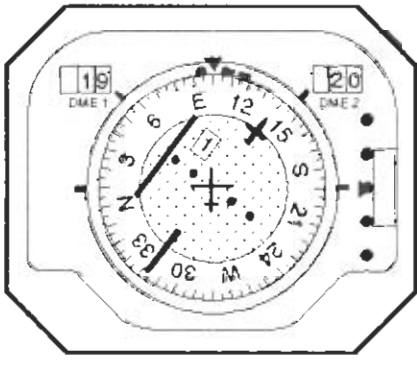
1906.20	APP	AZA 404 descend to 4000', turn right HDG 110, cleared ILS approach runway 14, QNH 1019.
1906.30	404	1019, 4000', turn right 120 to intercept runway 14.
	APP	Maintain 210, 404.
	404	Two ten maintaining
	- Switching is heard -	
1906.45	A/P	...altimeters 1- 9...67
1906.50	F/P	1019
	A/P	What is it?
1906.55	F/P	970 I checked it
1907.05	A/P	Good 970 it's OK. Landing Data 37 125 on the red bug OK, the Goaround by heart.
1907.10	F/P	37 40 at the 'Double Bugs', 183 Schaffhausen
	A/P	Perfect
	F/P	...5000' on 2





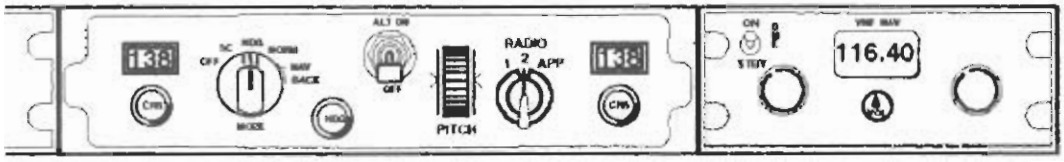


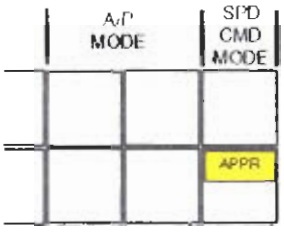


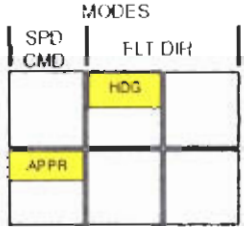


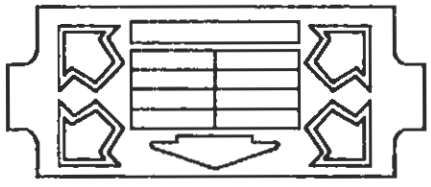
19:06:45 UTC B

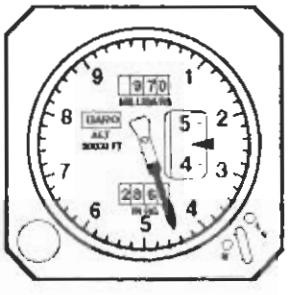
Figure 2

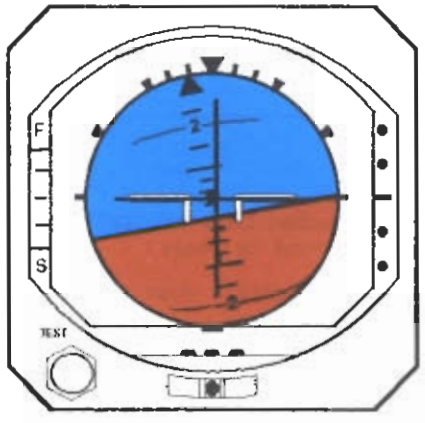


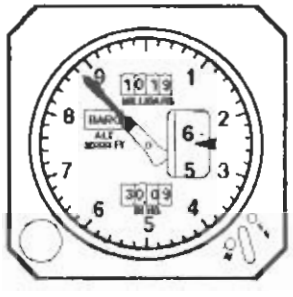


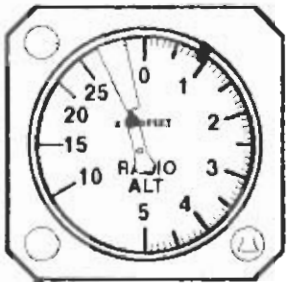


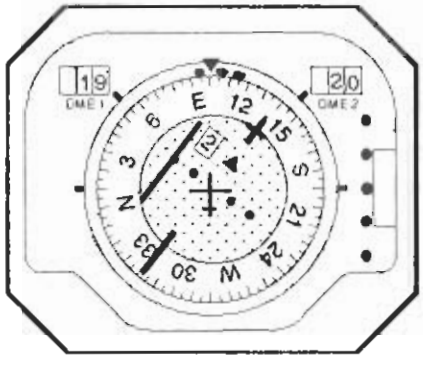


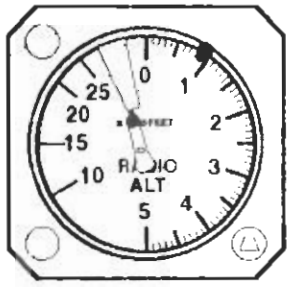


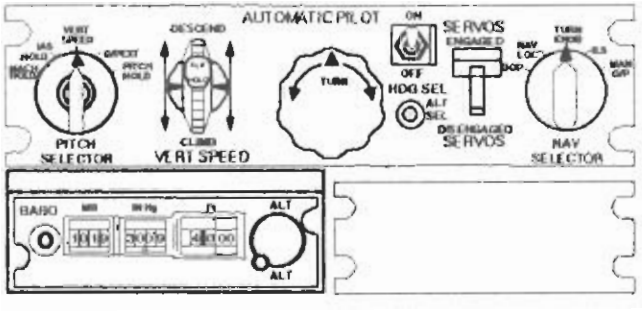












Unfall AZ404 / 14. November 1990

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Operations Group 1.10.91

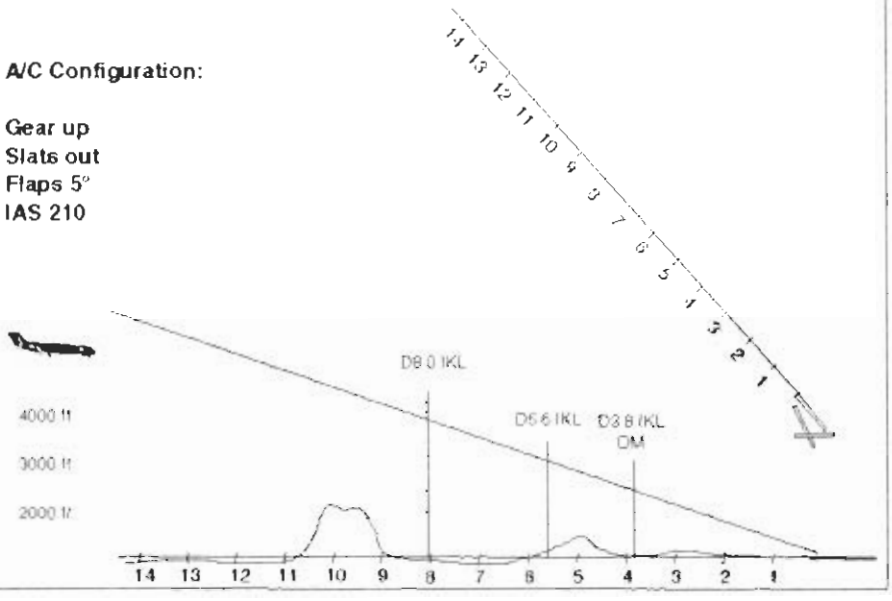
Cockpit Indications

Geographical Situation

Not to scale

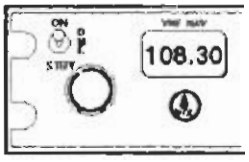
A/C Configuration:

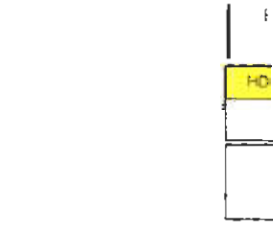
Gear up
Slats out
Flaps 5°
IAS 210

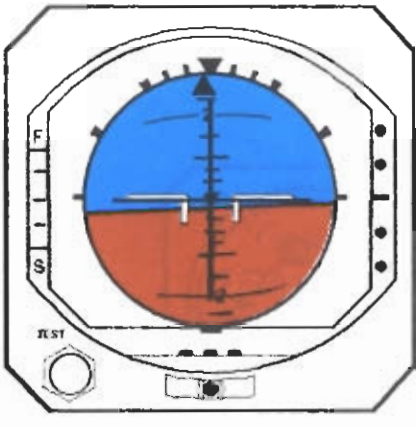


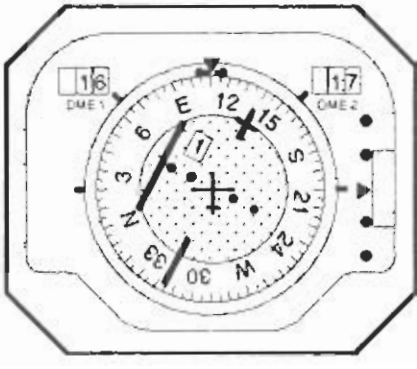
Cockpit Voice Recorder

1907.05	A/P	Good 970 it's OK. Landing Data 37 125 on the red bug OK. the Goaround by heart.
1907.10	F/P	37 40 at the 'Double Buga', 183 Schaffhausen
	A/P	Perfect
	F/P	...5000' on 2
1907.20	F/P	What did he say? 110?
	(simultaneously the A/P says)	
	A/P	10. everything OFF (Anti icing)
	F/P	Are we cleared for approach?
1907.25	A/P	Cleared down 4000', afterwards to intercept and follow.
	F/P	...So let's set Radio Approach
	ALTITUDE ALERT SOUNDS	
	A/P	Go
	APP	AZA 404 reduce to 180
1907.40	404	Reducing now 180. 404.



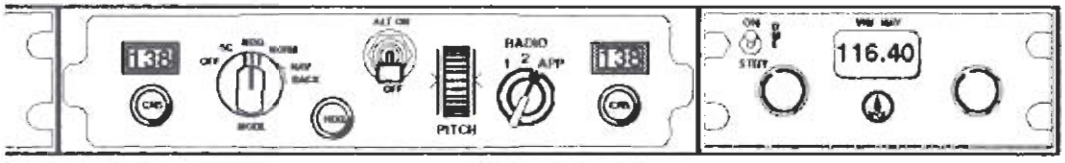


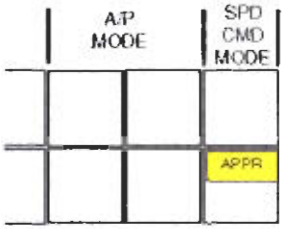


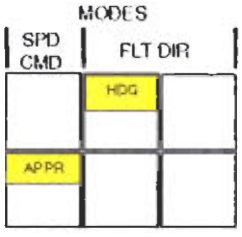


19:07:25 UTC

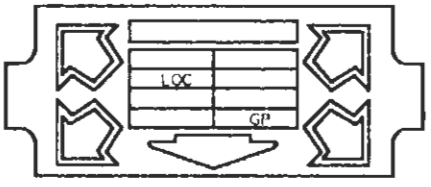
Figure 3

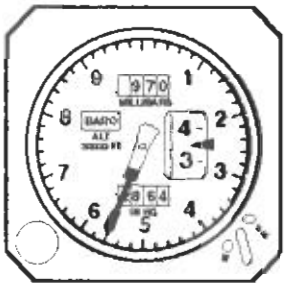


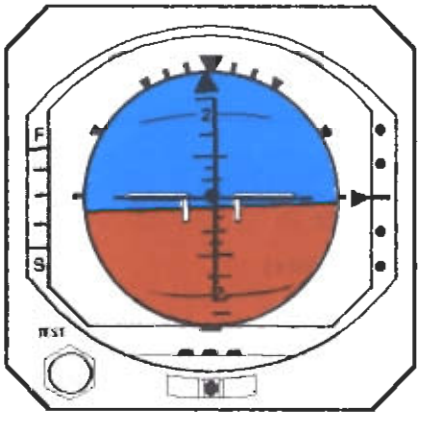


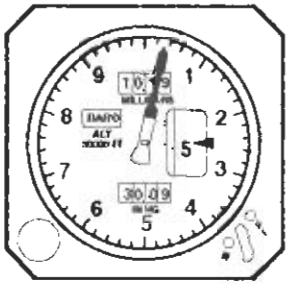


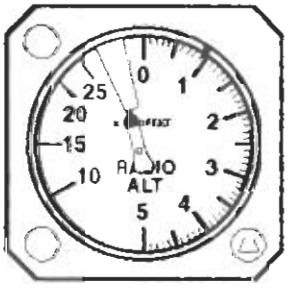
Comparator LOC on,
then off
Comparator GP on

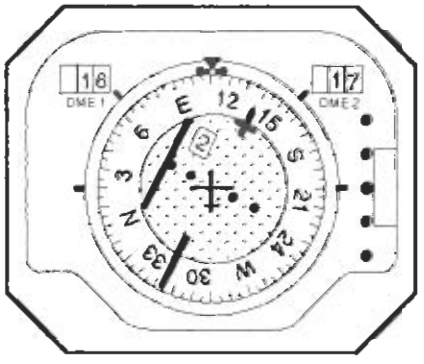


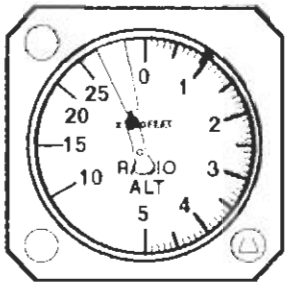


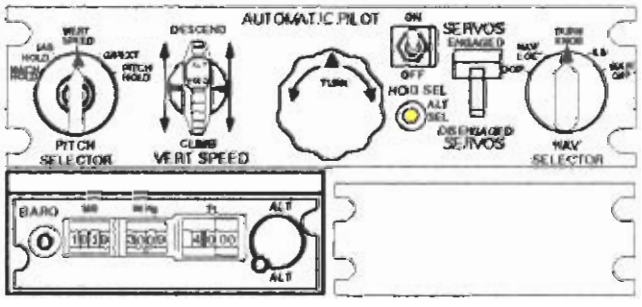












Unfall AZ404 / 14. November 1990

Büro für Flugunfalluntersuchungen
Operations Group 1.10.91

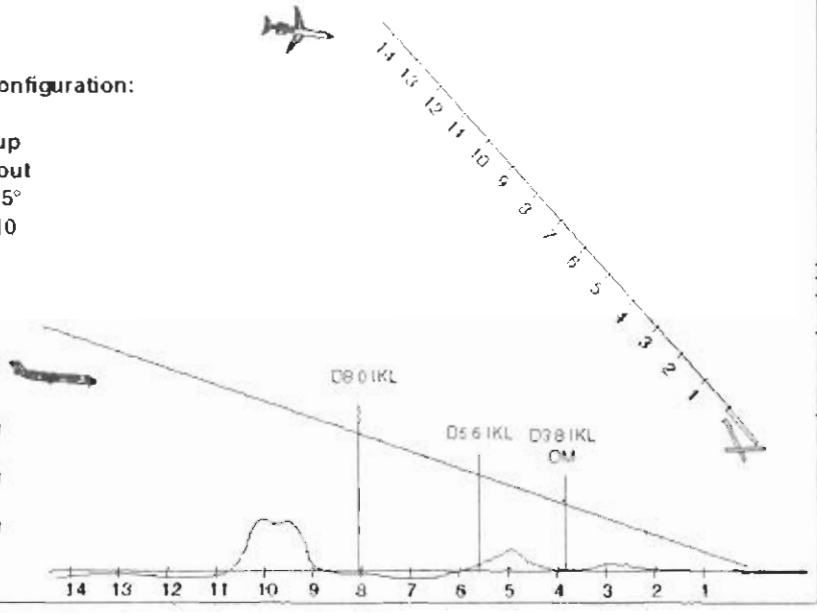
Cockpit Indications

Geographical Situation

Not to scale

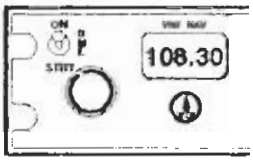
A/C Configuration:

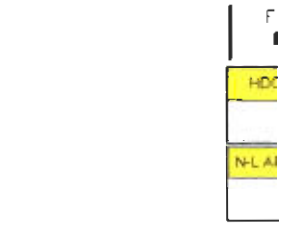
Gear up
Slats out
Flaps 5°
IAS 210

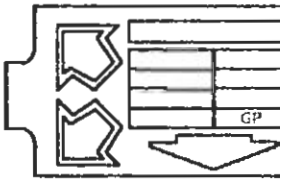


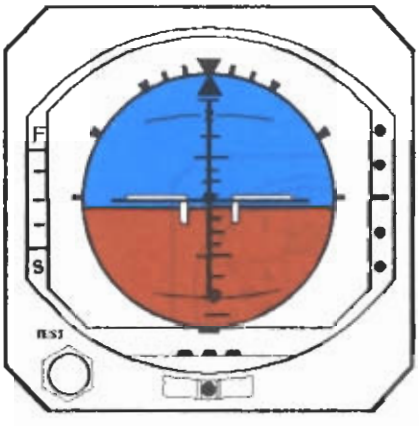
Cockpit Voice Recorder

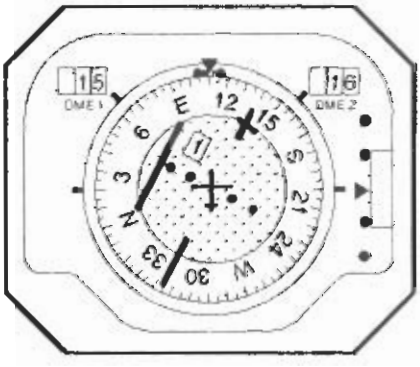
1907.40	404	Reducing now 180, 404.
		(Next portion barely understandable)
1907.45	F/P	...Do you have the glide?
1907.52	A/P	...on the 1
1907.57	F/P	I don't... have it.





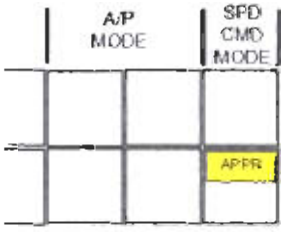


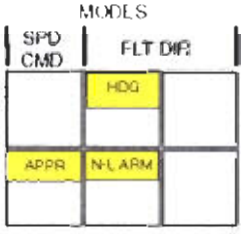


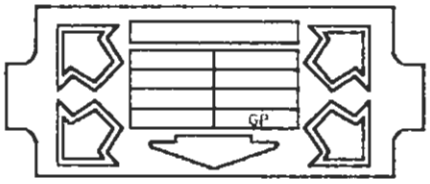


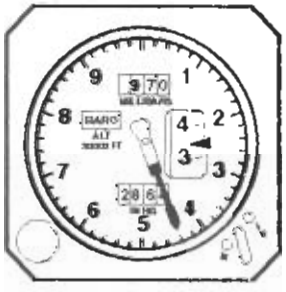
19:07:40 UTC

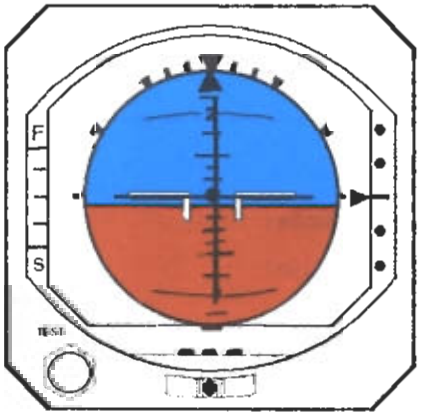
Figure 4

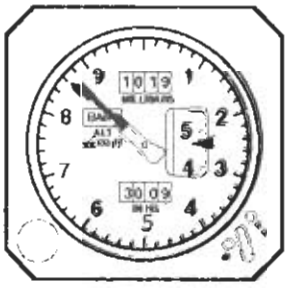


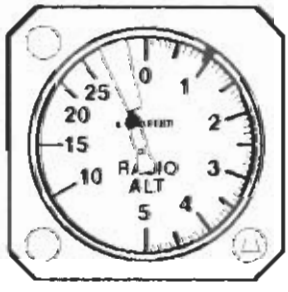


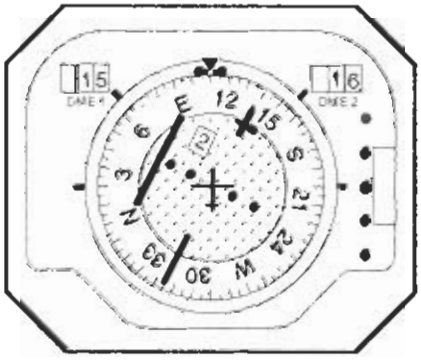


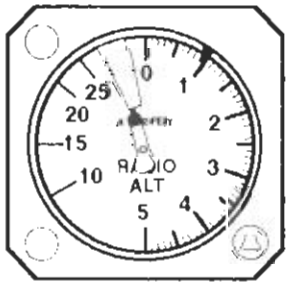


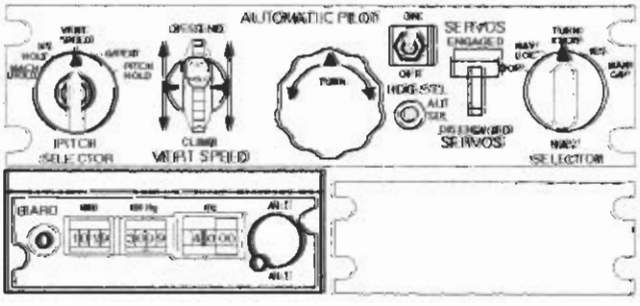












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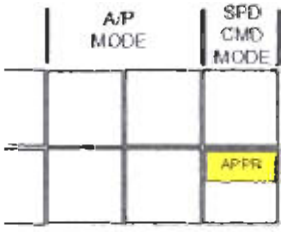
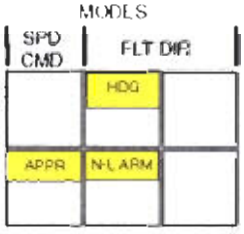
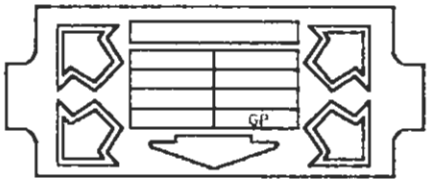
Operations Group 1.10.91

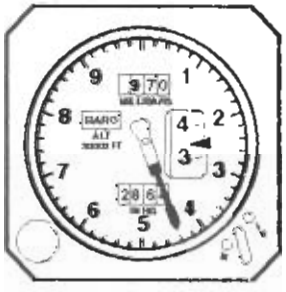
19:07:40 UTC

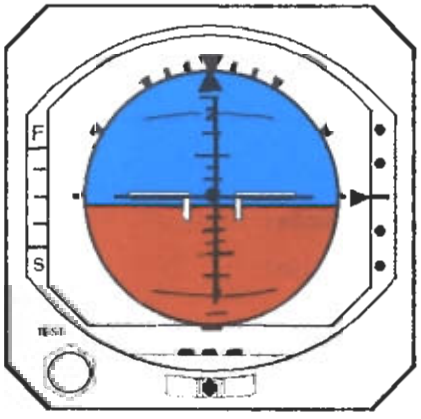
Figure 4

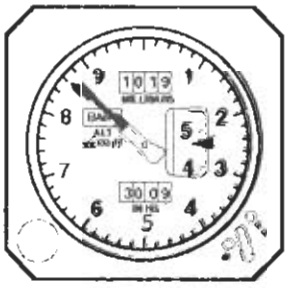


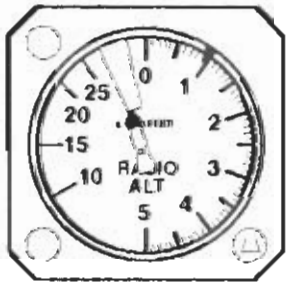


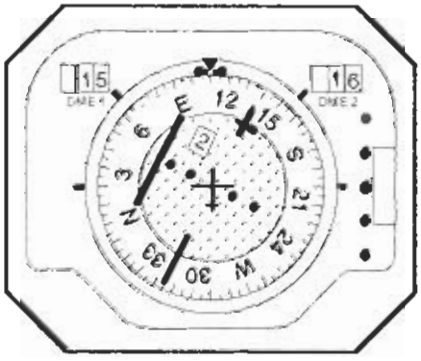


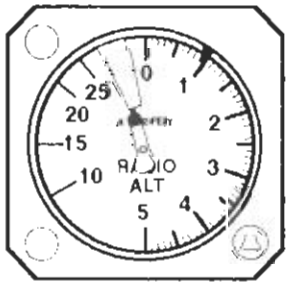


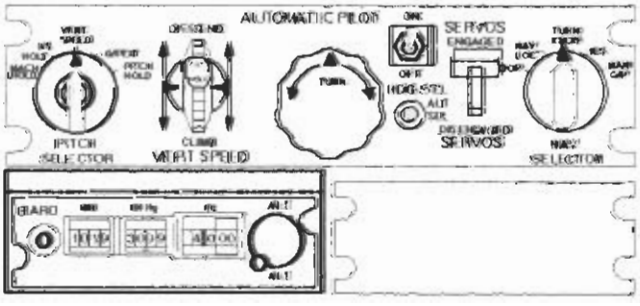












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Operations Group 1.10.91

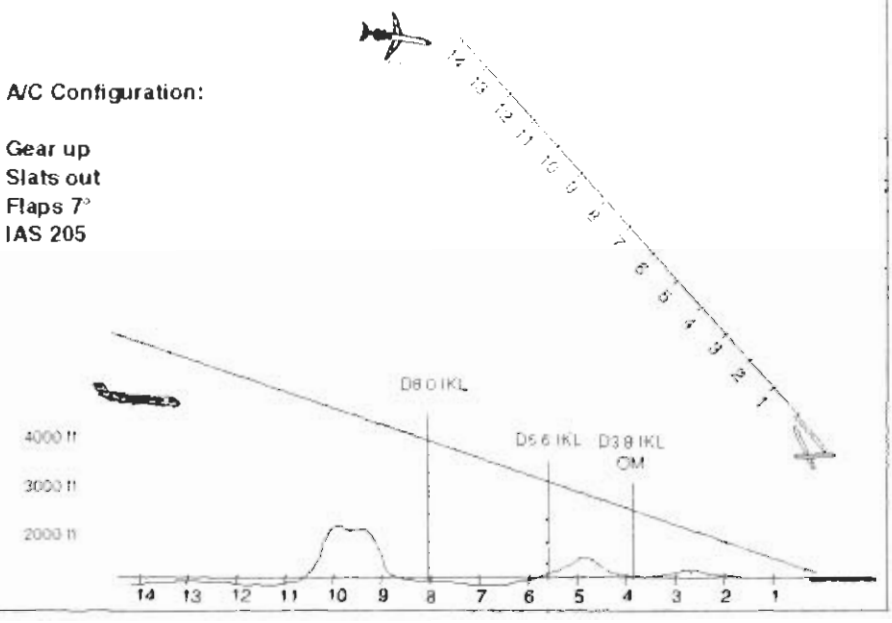
Cockpit Indications

Geographical Situation

Not to scale

A/C Configuration:

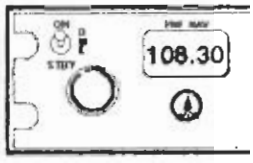
Gear up
Slats out
Flaps 7°
IAS 205

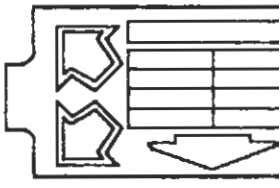


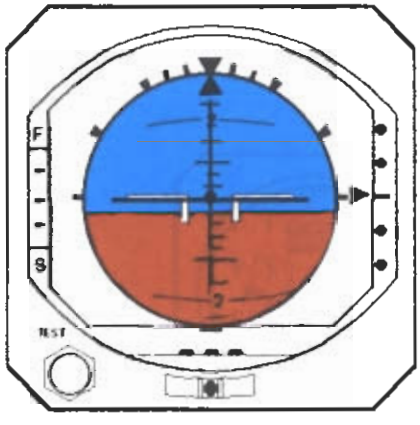
Cockpit Voice Recorder

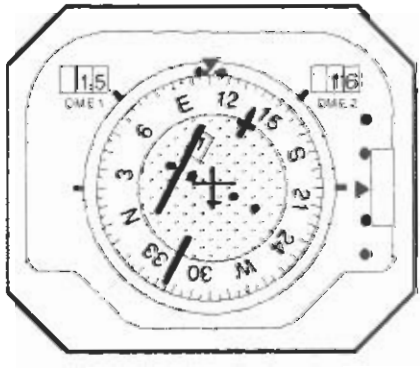
(Next portion barely understandable)

1907.45	P/P	...Do you have the glide?
1907.52	A/P	...on the 1
1907.57	P/P	I don't... have it.
1907.59	A/P	Great, so let's do it on one.
	P/P	Radio 1 (order)



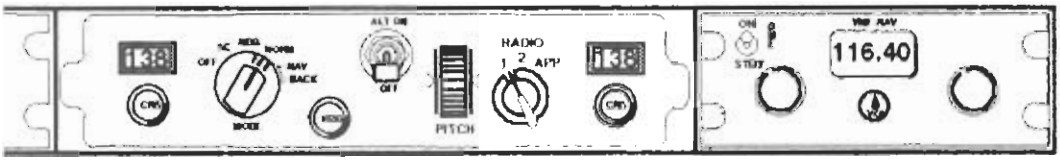


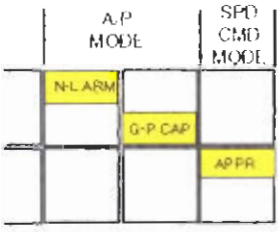


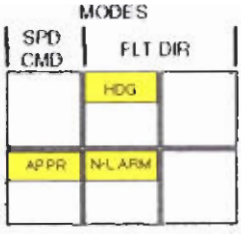


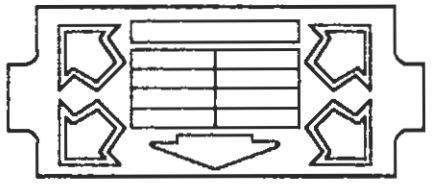
19:08:00 UTC

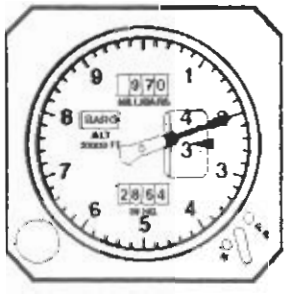
Figure 5

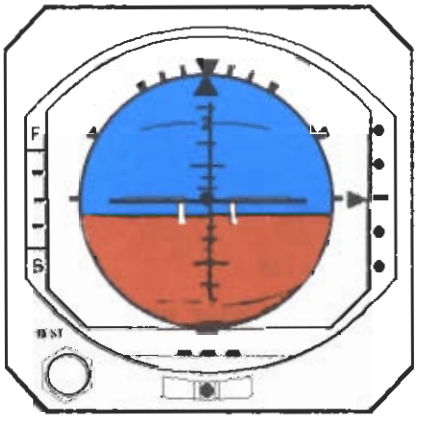


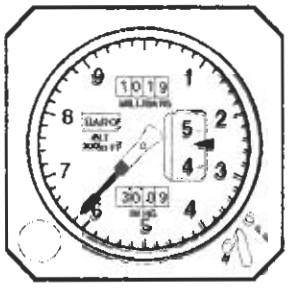


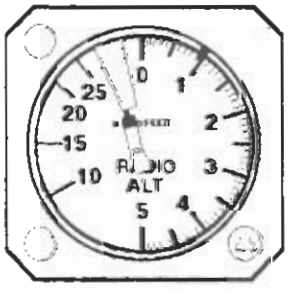


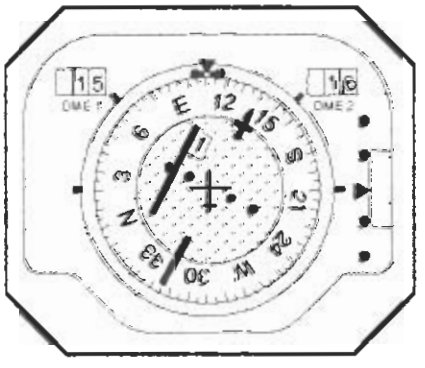


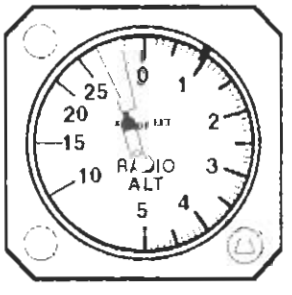


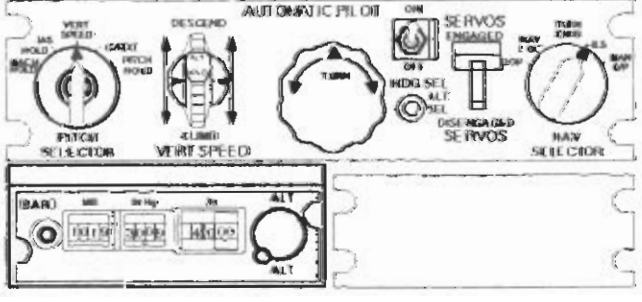












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Operations Group 25.11.91

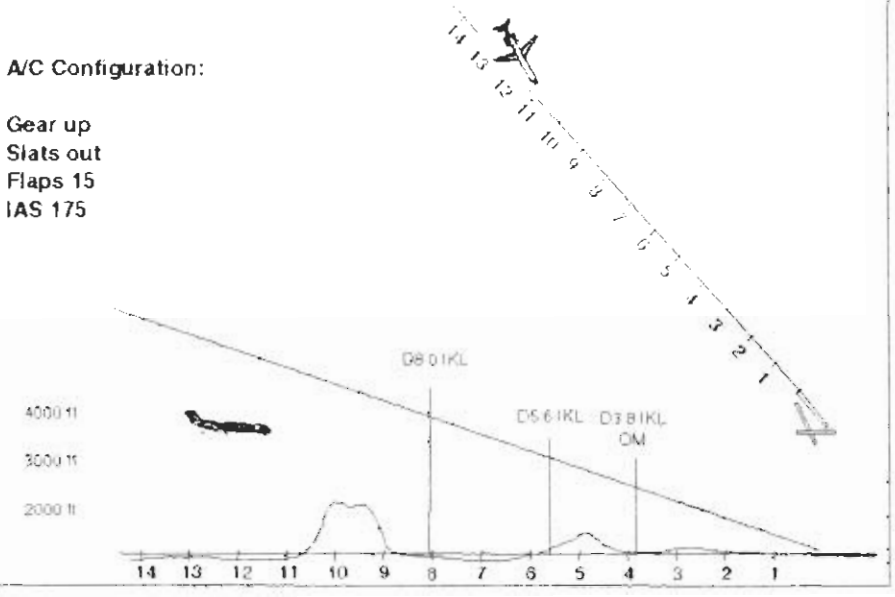
Cockpit Indications

Geographical Situation

Not to scale

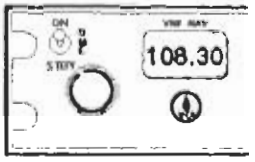
A/C Configuration:

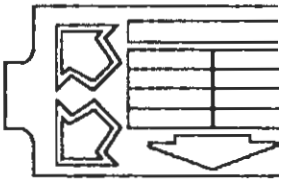
Gear up
Slats out
Flaps 15
IAS 175

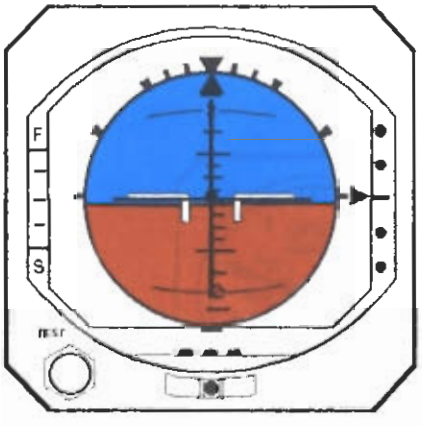


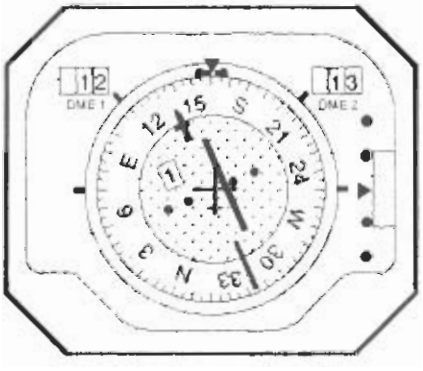
Cockpit Voice Recorder

1908.07	F/P	Flaps...
1908.20	A/P	Reduce the speed a little
		TAPPING NOISE (*perhaps indicating/showing something*)
	ATP	AZA 404 reduce to 160 knots
1908.35	404	Reducing 160
1908.47	A/P	...capture LOC capture Glide path capture. so we are on the beam a little off track but...



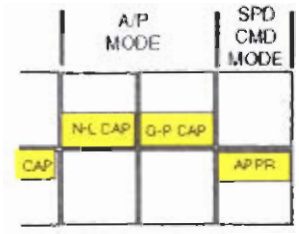


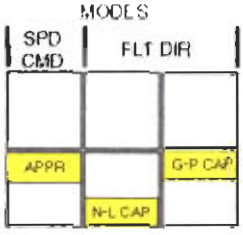


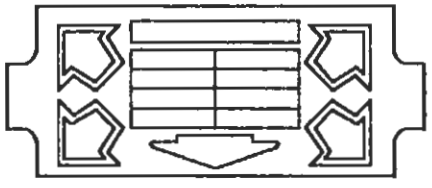


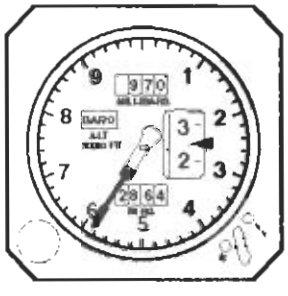
19:08:47 UTC

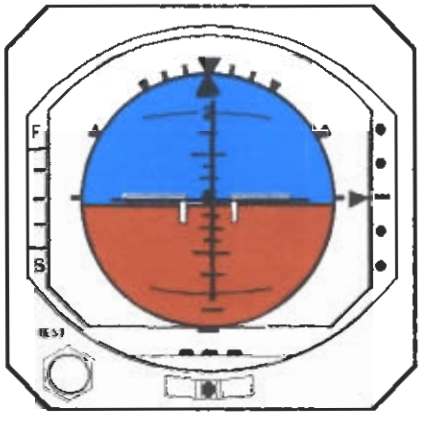
Figure 6

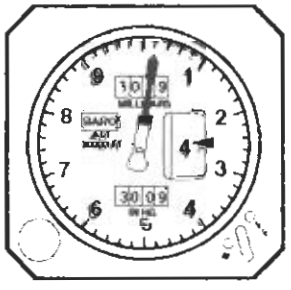


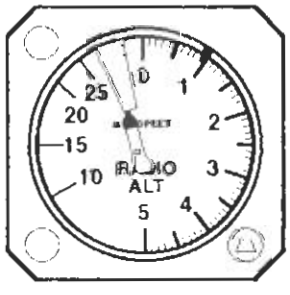


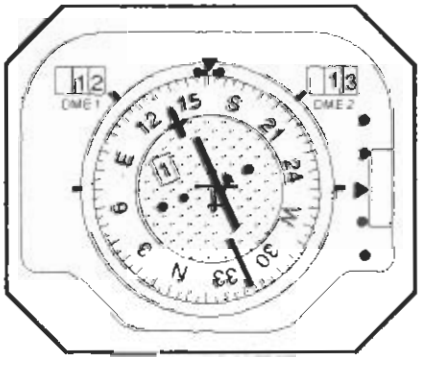


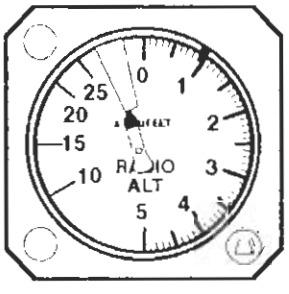


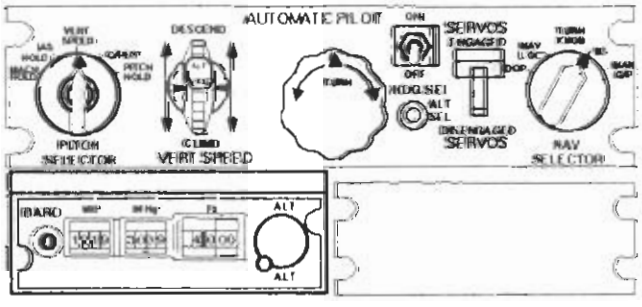












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Operations Group 1.1091

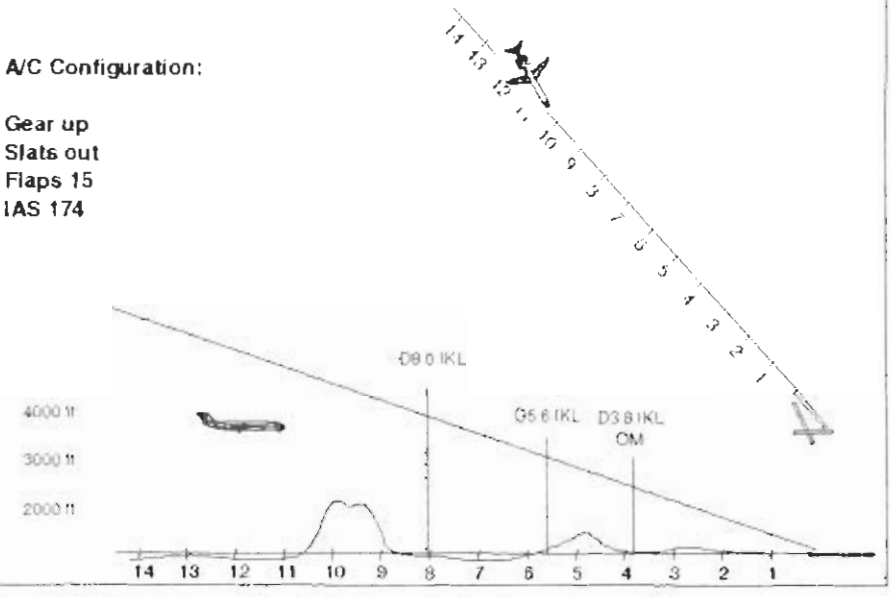
Cockpit Indications

Geographical Situation

Not to scale

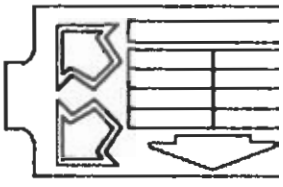
A/C Configuration:

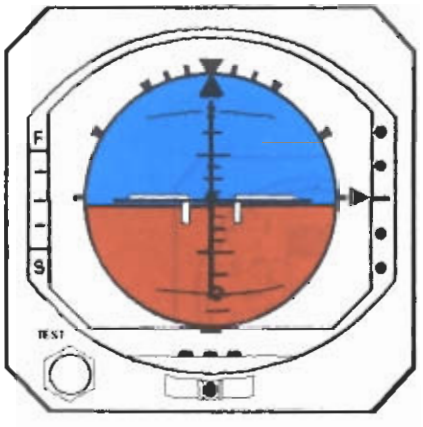
Gear up
Slats out
Flaps 15
IAS 174

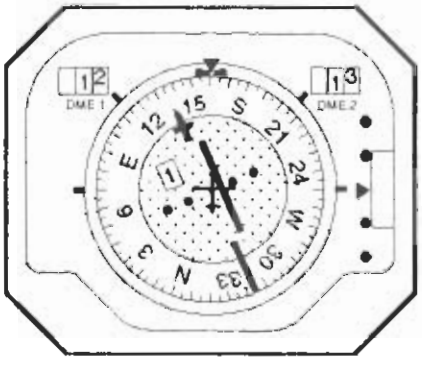


Cockpit Voice Recorder

1908.53 F/O 370 for me too

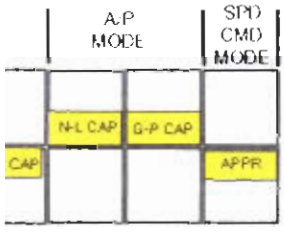


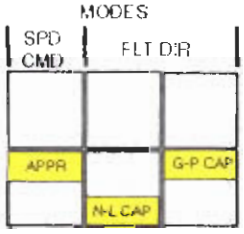


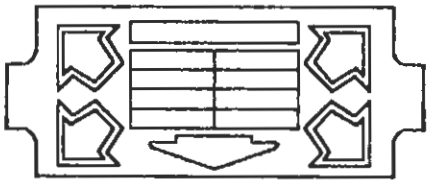


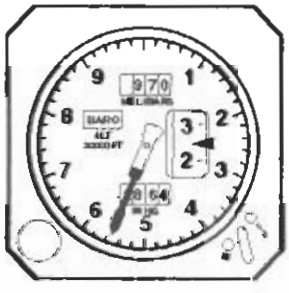
19:08:53 UTC

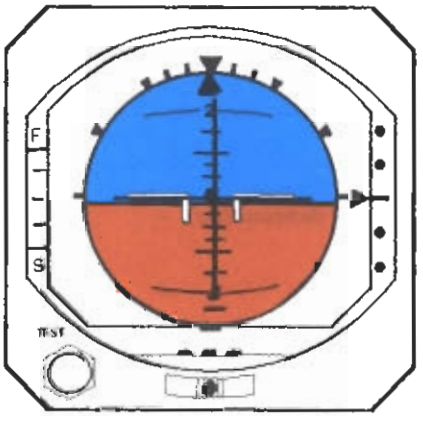
Figure 7

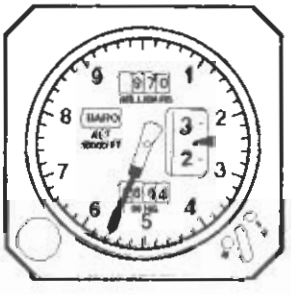


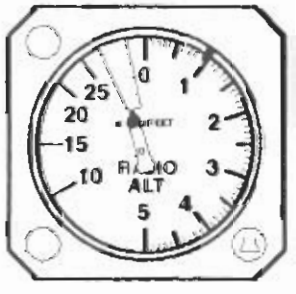


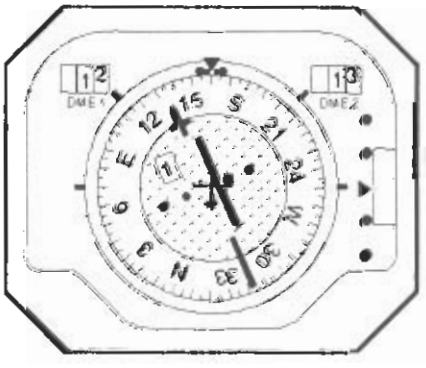


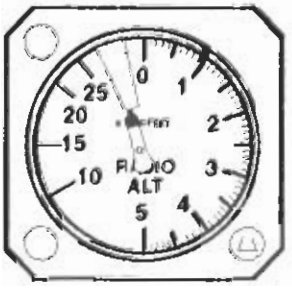


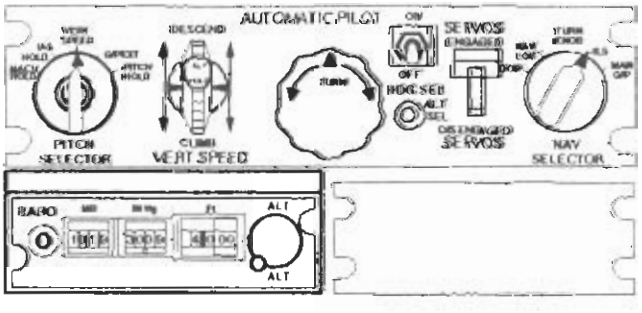












Unfall AZ404 / 14. November 1990

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Operations Group 1.10.91

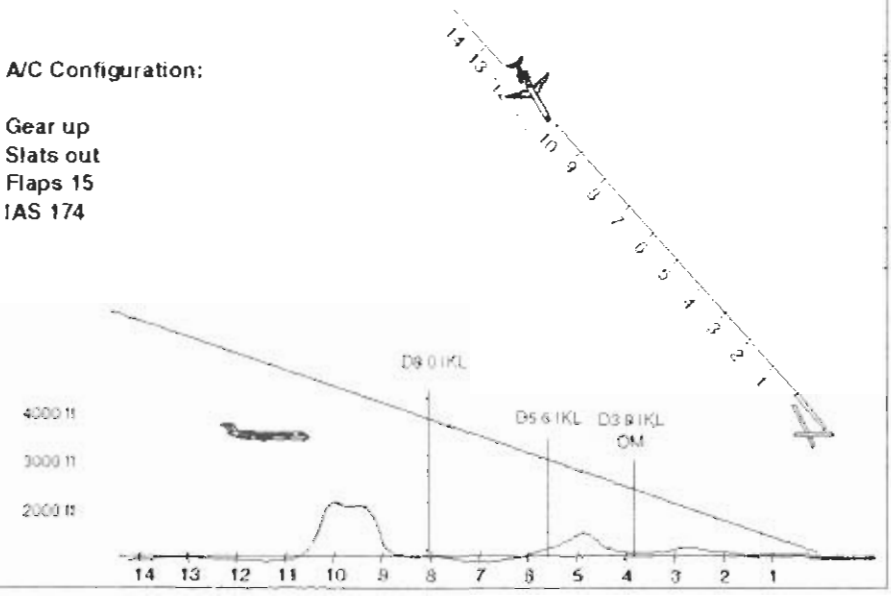
Cockpit Indications

Geographical Situation

Not to scale

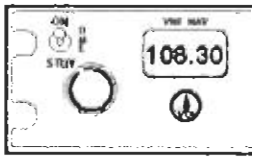
A/C Configuration:

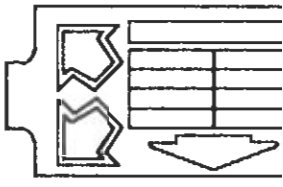
Gear up
Slats out
Flaps 15
IAS 174

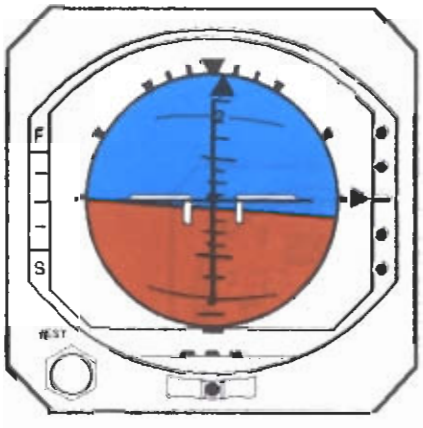


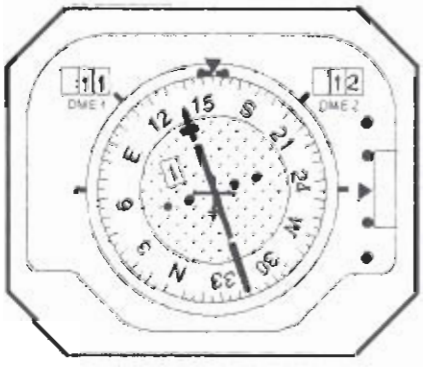
Cockpit Voice Recorder

1908.58 - ALTITUDE ALERT SOUNDS (*3700' descending*) -



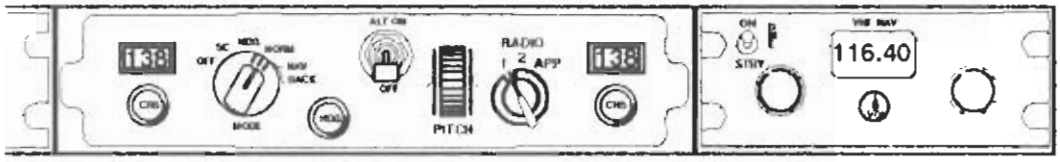


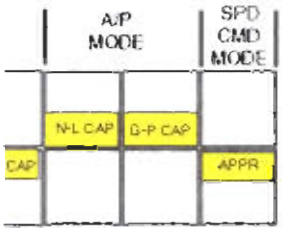


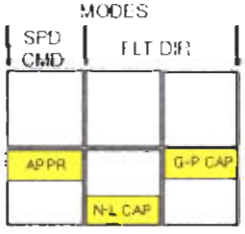


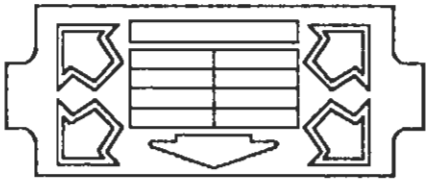
19:08:57 UTC

Figure 8

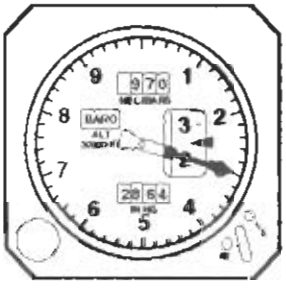


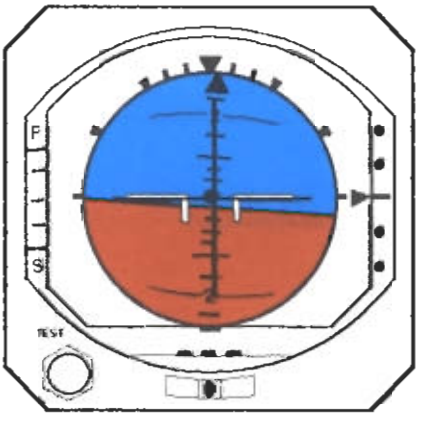


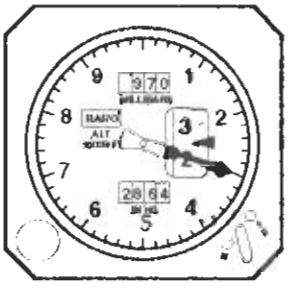


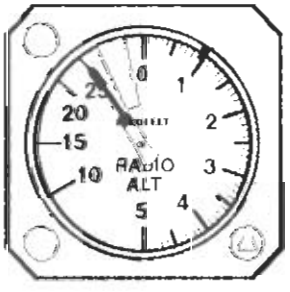


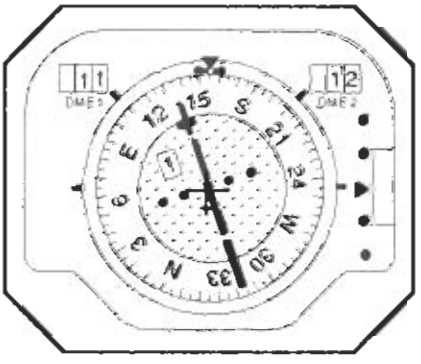
ALTITUDE EXIT ALERT
(VISUAL & AURAL)

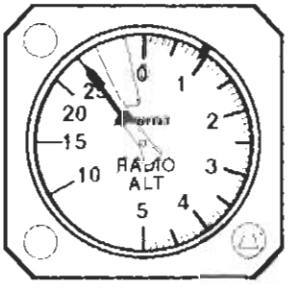


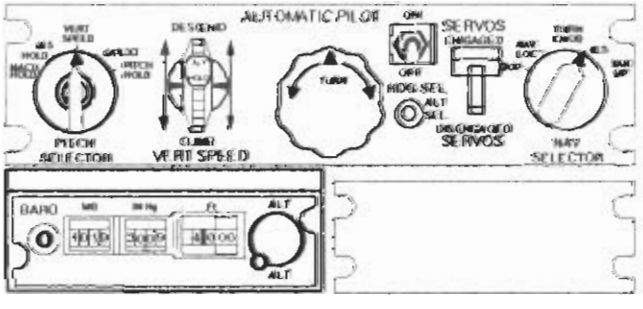












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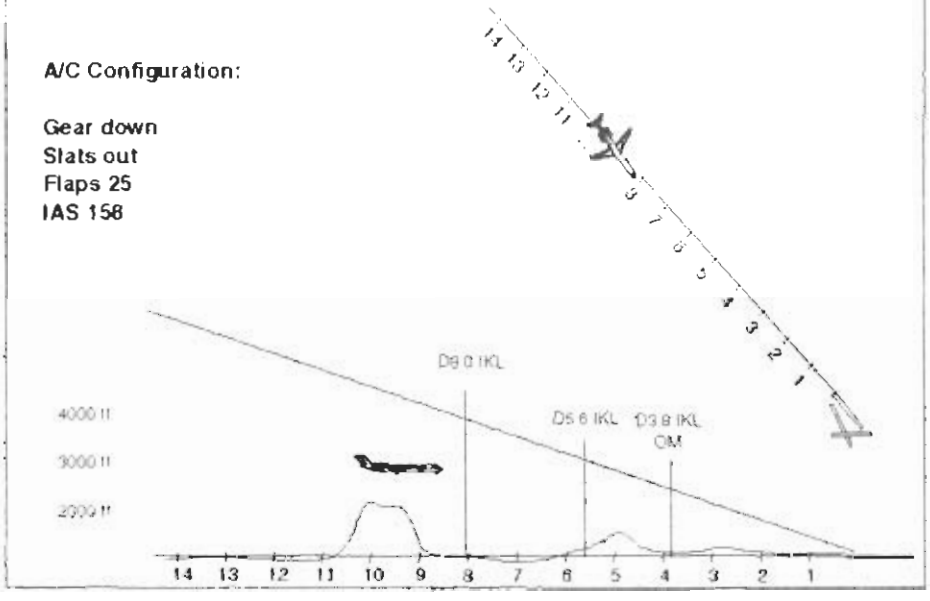
Cockpit Indications

Geographical Situation

Not to scale

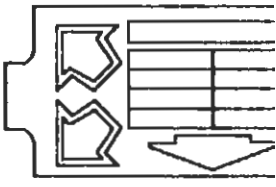
A/C Configuration:

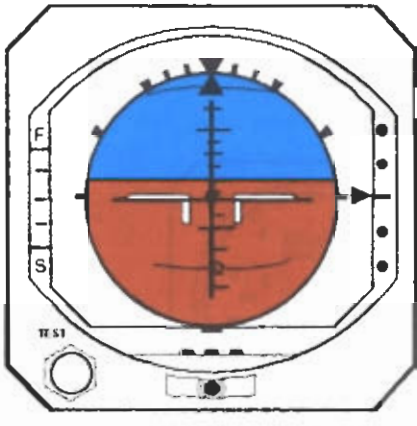
Gear down
Slats out
Flaps 25
IAS 158

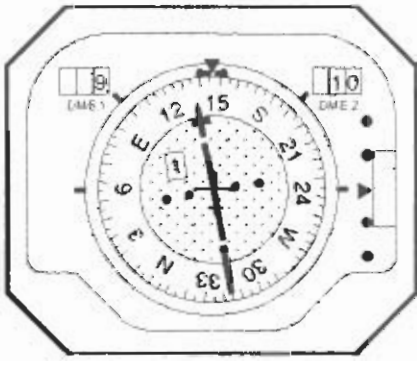


Cockpit Voice Recorder

1908.58		- ALTITUDE ALERT SOUNDS (*3700' descending*) -
1909.01	A/P	16?
1909.09	A/P	I cancel and insert 5000'
		- change of noise heard (*could indicate gear extension*) -
1909.18	A/P	There is another one in front quite close, you can reduce even further to 150 otherwise we'll end up with a 'go around'.
1909.33	F/P	Is there some icing?
1909.35	A/P	No no, in fact we have 10 degrees and 10 degrees on the ground.
1909.41	F/P	Flaps twenty five
	A/P	Flaps twenty five (*No gear warning*)
1909.47	A/P	Outer Marker check is at 1250'
	F/P	Flaps fifty let's set...123
1909.52	A/P	Bravo
		- Switching is heard (*could be the final check*) -

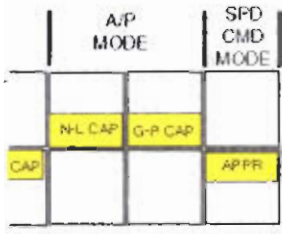


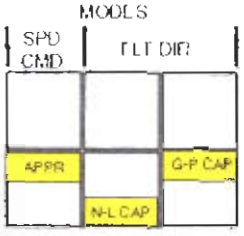


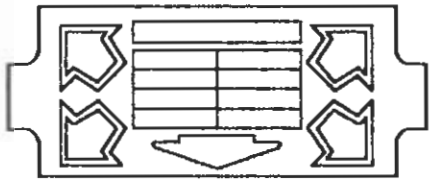


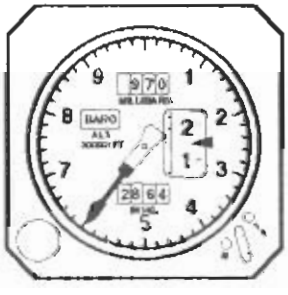
19:09:43 UTC

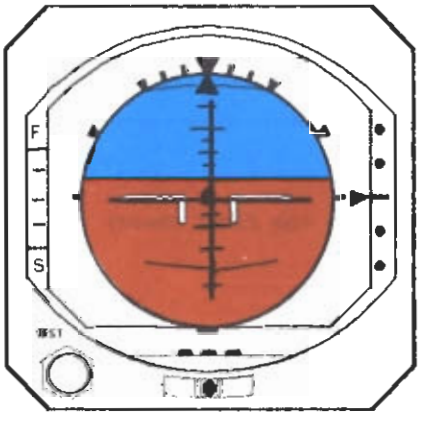
Figure 9

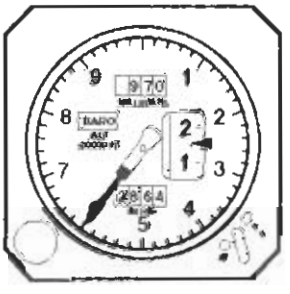


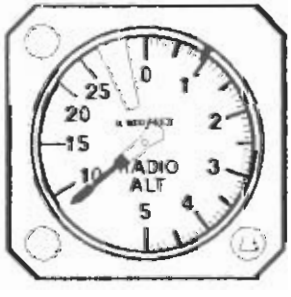


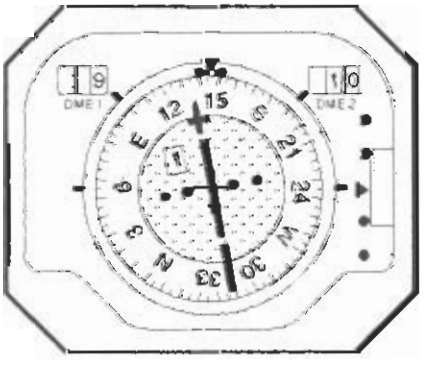


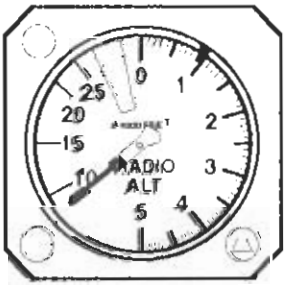


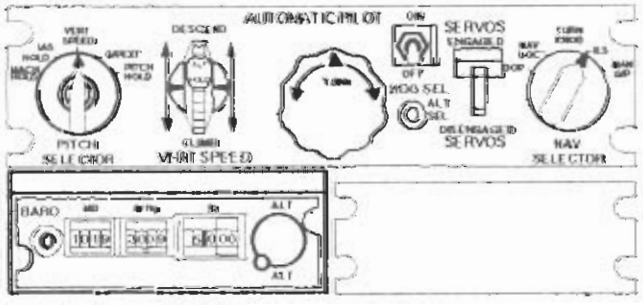












Unfall AZ404 / 14 November 1990

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Operations Group 1.10.91

Visualisation: Initiative Computing AG 1997

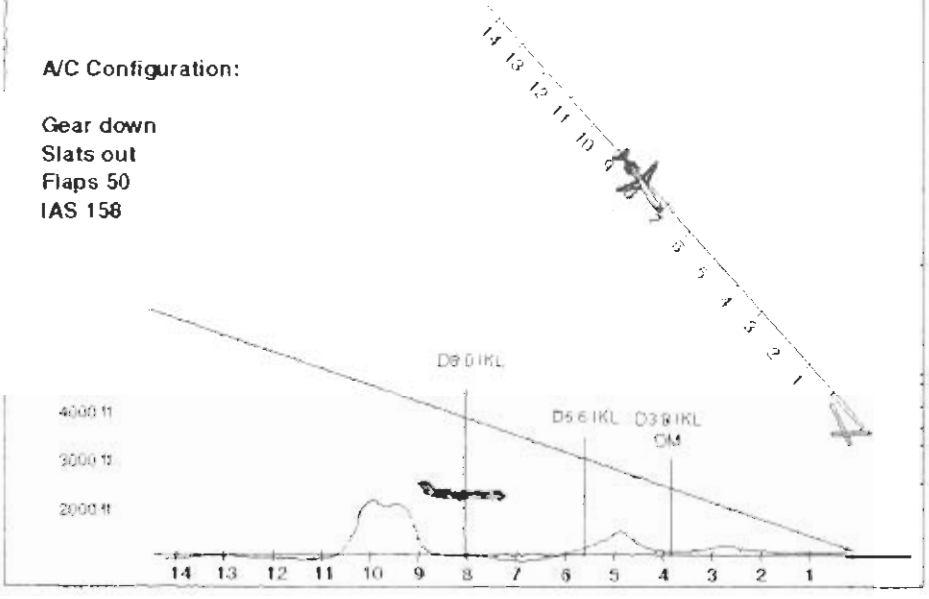
Cockpit Indications

Geographical Situation

Not to scale

A/C Configuration:

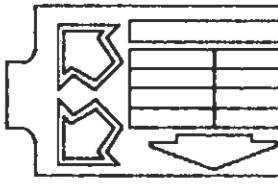
Gear down
Slats out
Flaps 50
IAS 158

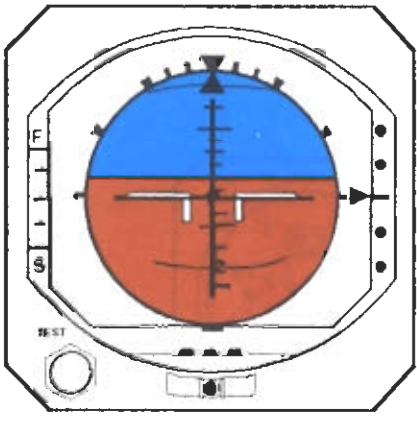


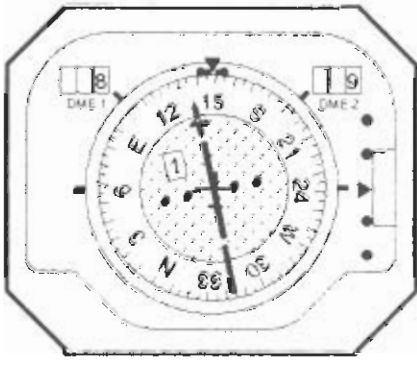
Cockpit Voice Recorder

- Switching is heard - *(could be the final check)*

1910.1[illegible]	A/P	...3.8 almost 4 miles
1910.[illegible]7	F/P	...Didn't we pass it...?
1910.[illegible]9	F/P	Didn't we pass the outer marker?
	A/P	No no it hasn't changed yet...

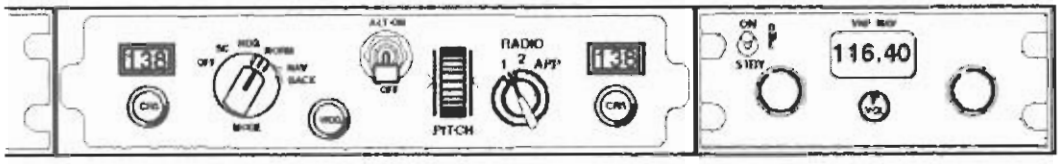


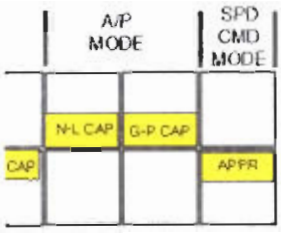


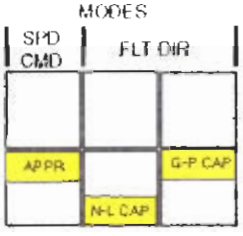


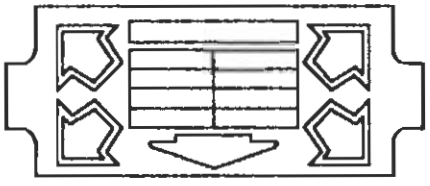
19:10:12 UTC

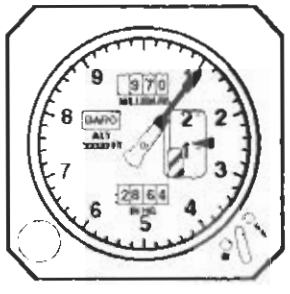
Figure 10

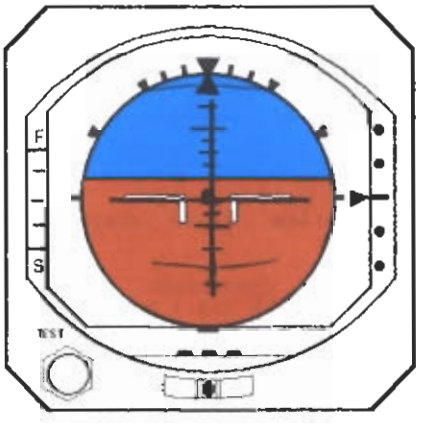


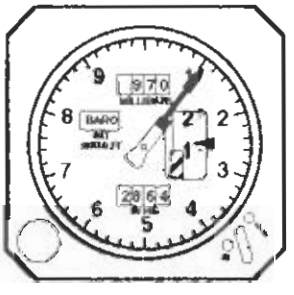


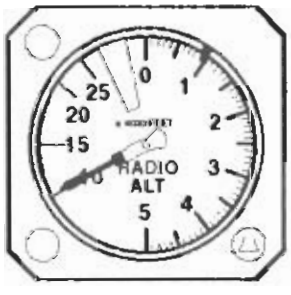


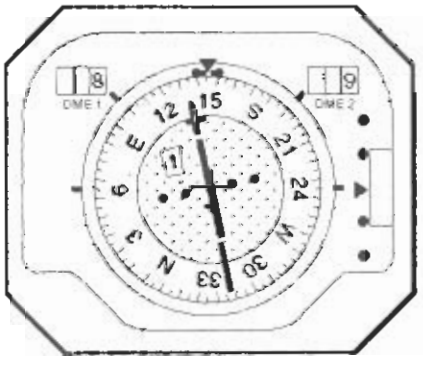


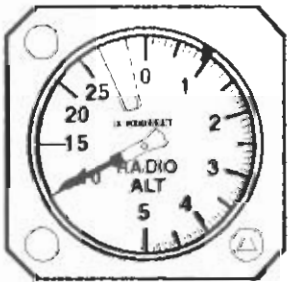


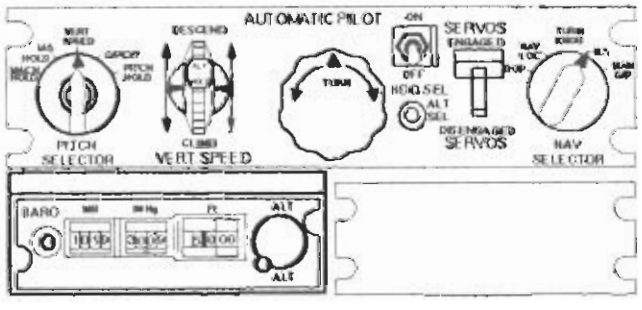












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Operations Group 1.10.91

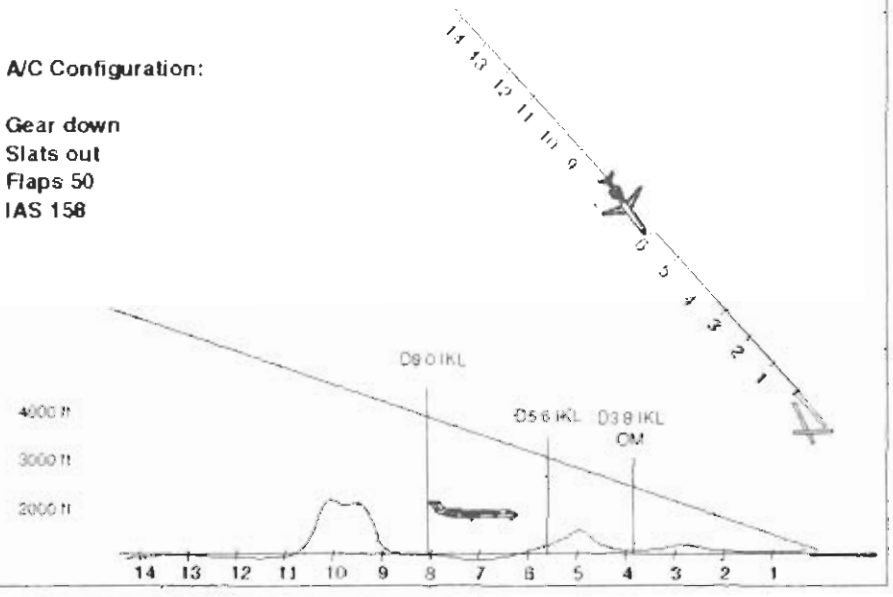
Cockpit Indications

Geographical Situation

Not to scale

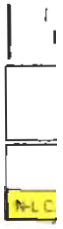
A/C Configuration:

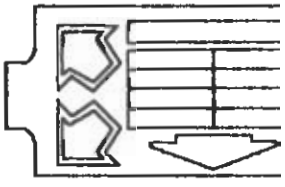
Gear down
Slats out
Flaps 50
IAS 158

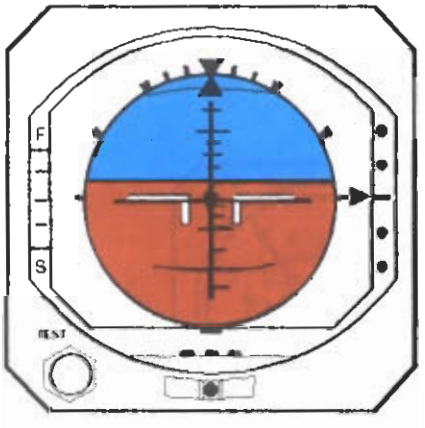


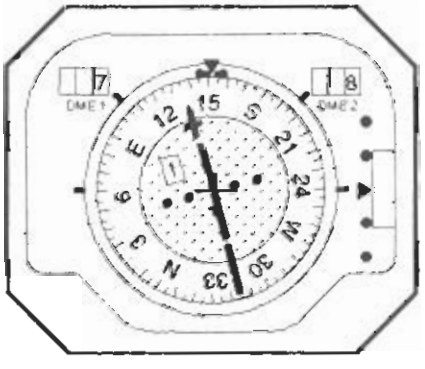
Cockpit Voice Recorder

1910.43	A/P	Oh it shows 7 (*Miles, maybe starting a cross check*)
	APP	AZA 404 speed now as convenient. 4 miles behind a DC-9, contact TWR 118.1 Good night.
1910.50	404	118.1 Good Bye
1910.56	F/P	...That doesn't make sense to me...
	A/P	Nor to me...



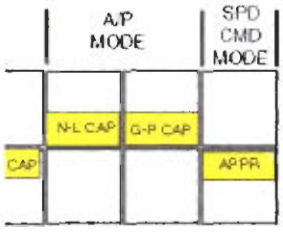


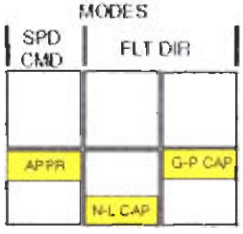


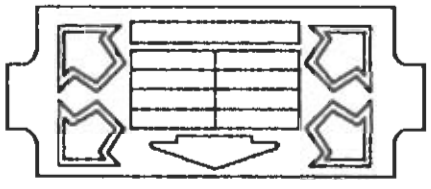


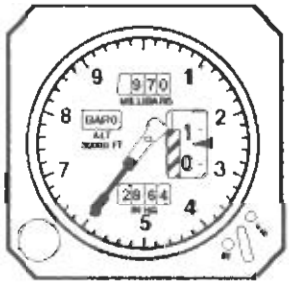
19:10:43 UTC

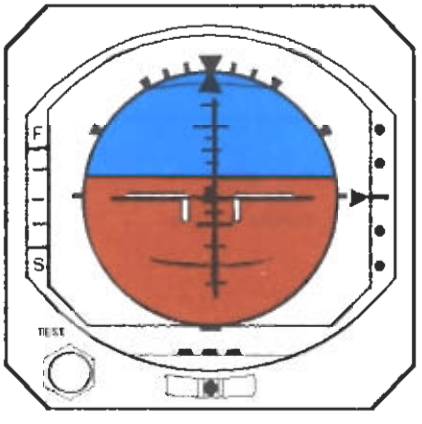
Figure 11

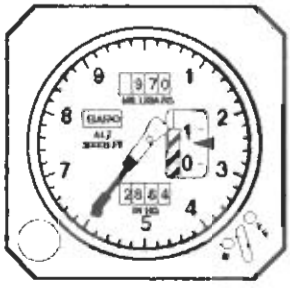


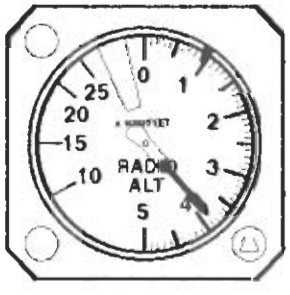


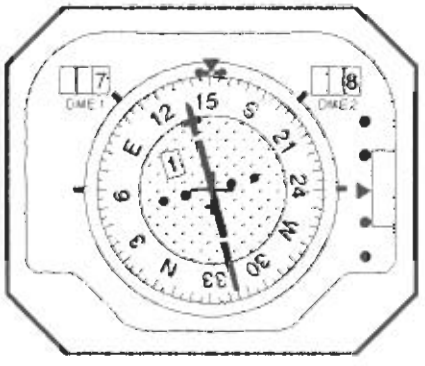


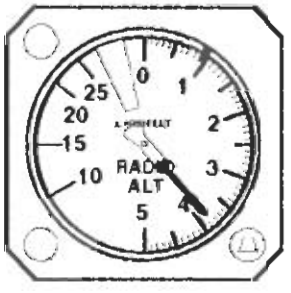


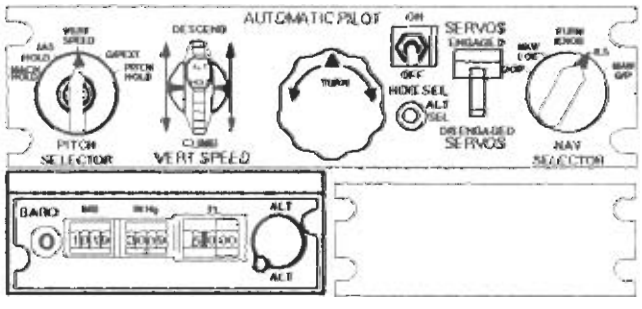












Unfall AZ404 / 14. November 1990

Büro für Flugunfalluntersuchungen
Operations Group 1.10.91

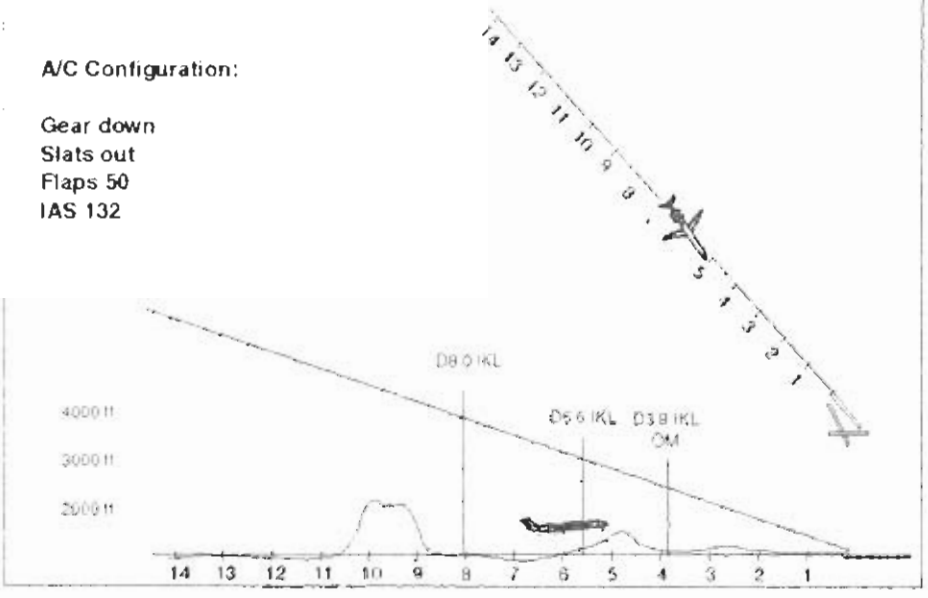
Cockpit Indications

Geographical Situation

Not to scale

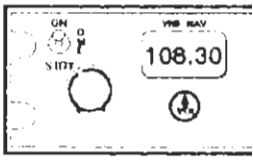
A/C Configuration:

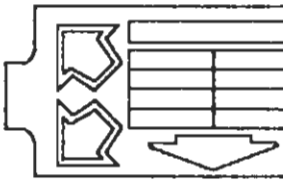
Gear down
Slats out
Flaps 50
IAS 132

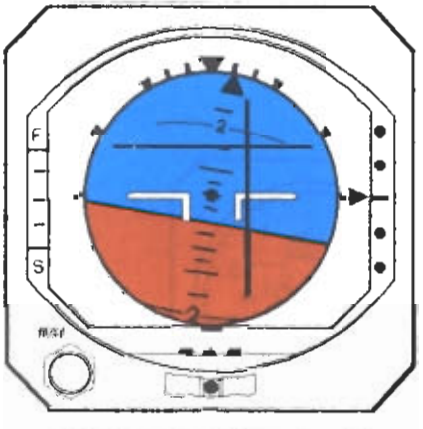


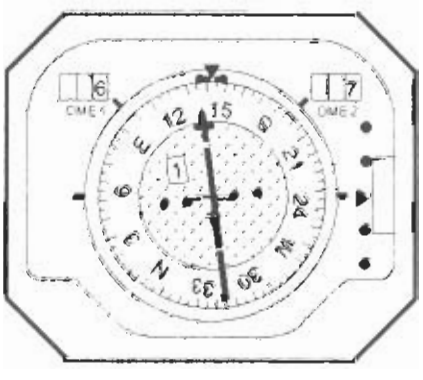
Cockpit Voice Recorder

1910.56	F/P	...that doesn't make sense to me...
	A/P	Nor to me...
1910.57	A/P	Pull, pull, pull, pull!
	- Click of Auto-pilot disengage is heard	
1910.59	F/P	... AROUND



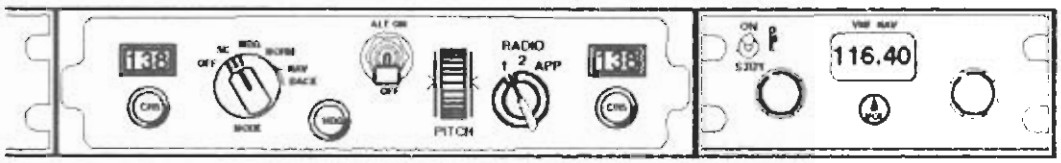


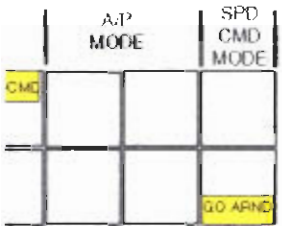


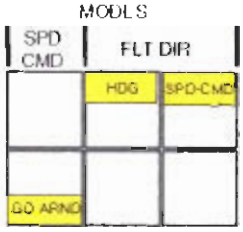


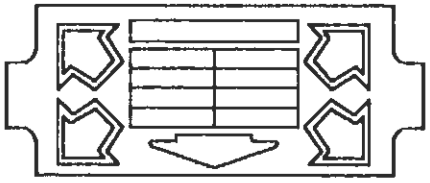
19:10:59 UTC

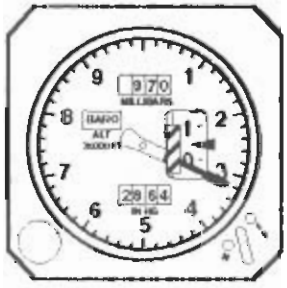
Figure 12

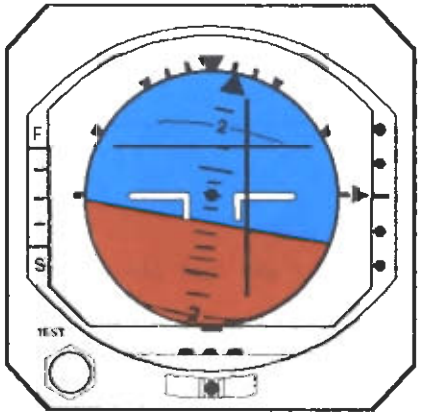


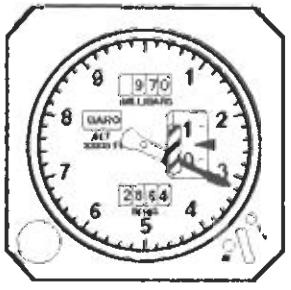


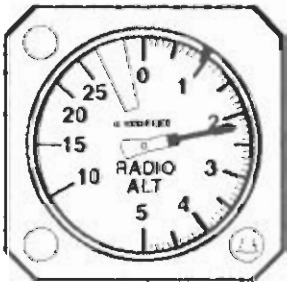


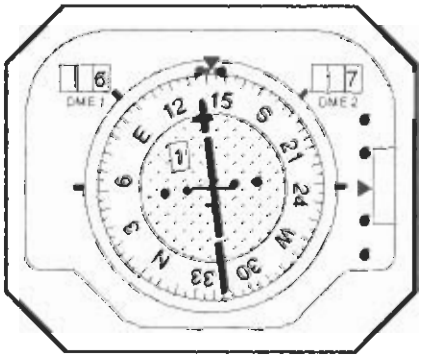


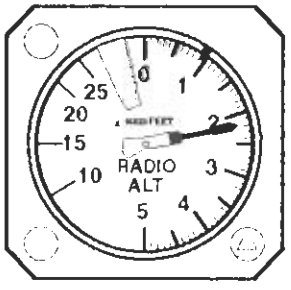


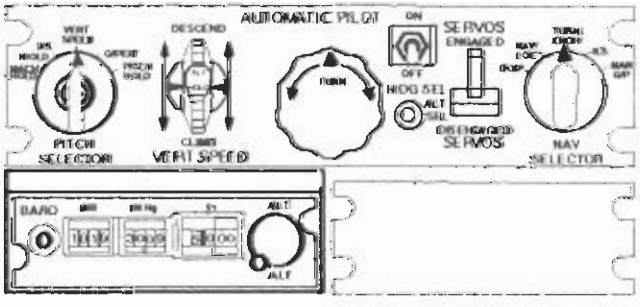












Unfall AZ404 / 14. November 1990

Büro für Flugunfalluntersuchungen
Operations Group 1.10.91

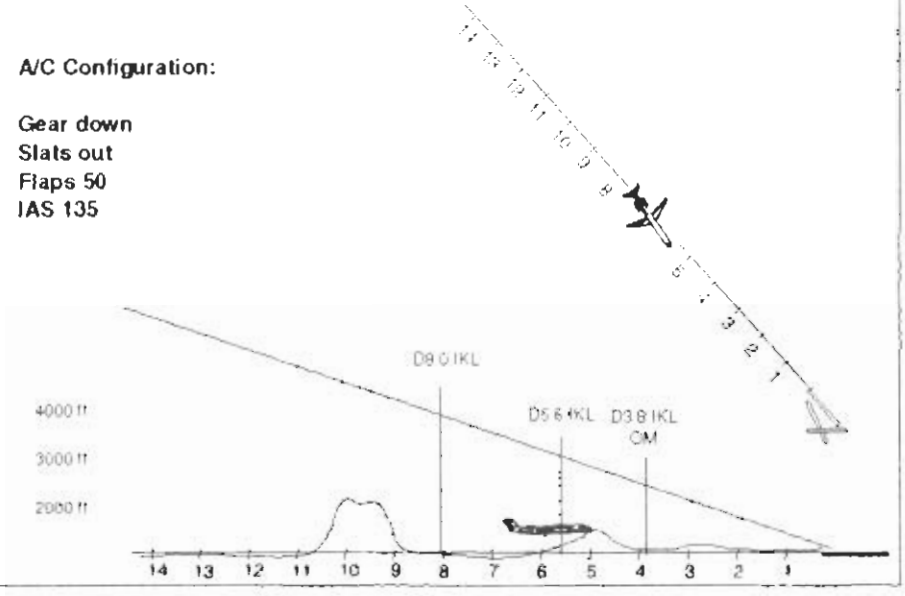
Cockpit Indications

Geographical Situation

Not to scale

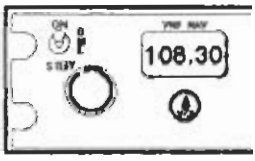
A/C Configuration:

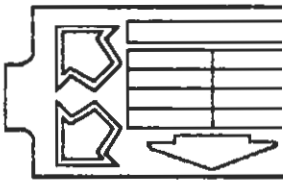
Gear down
Slats out
Flaps 50
IAS 135

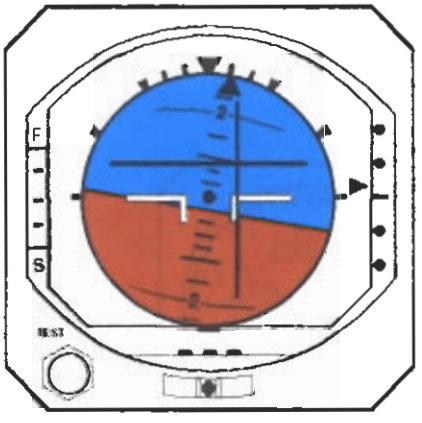


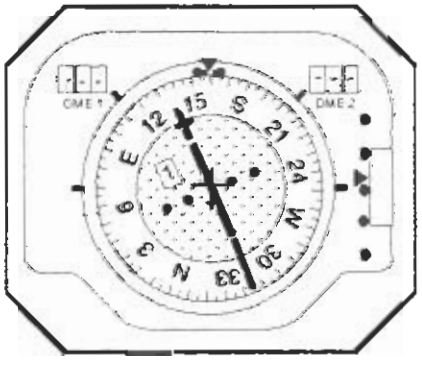
Cockpit Voice Recorder

1910.59	F/P	G- AROUND
1911.00	A/P	No no no no ... [hold / ask for] the glide
1911.11	A/P	Can you hold it?
1911.13	F/P	Yes
1911.14	- pip pip pip pip pip pip (*radio altimeter passing 200'*)	
1911.16	A/P	Hold on let's try to put on...
1911.18	- Crash sounds heard -	



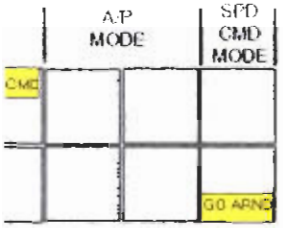


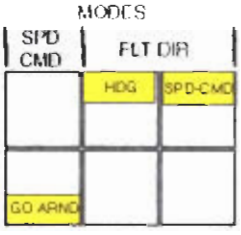


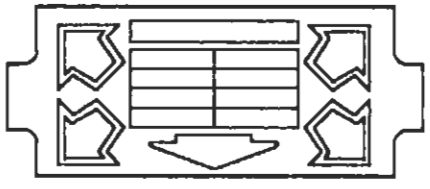


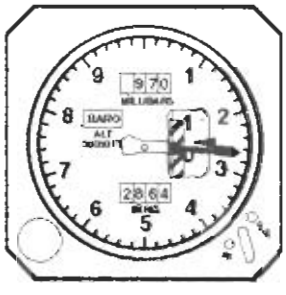
19:11:17 UTC

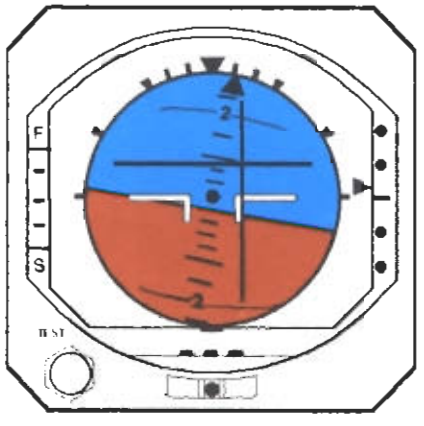
Figure 13

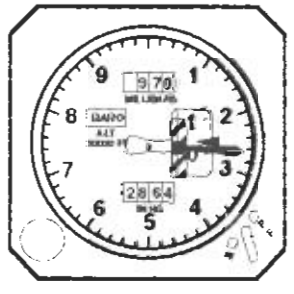


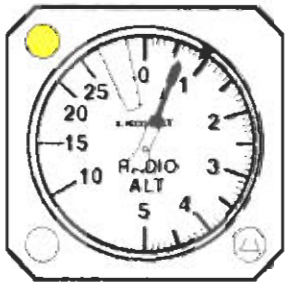


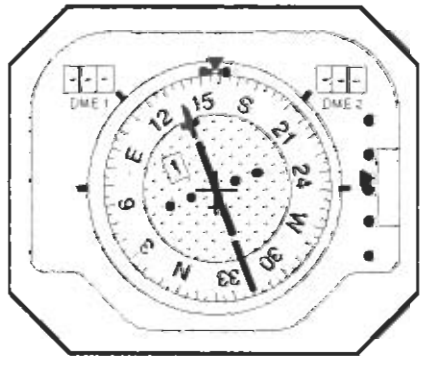


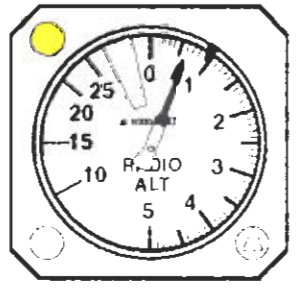


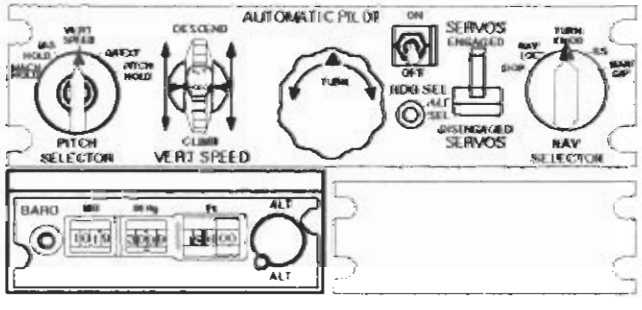












Unfall AZ404 / 14. November 1990

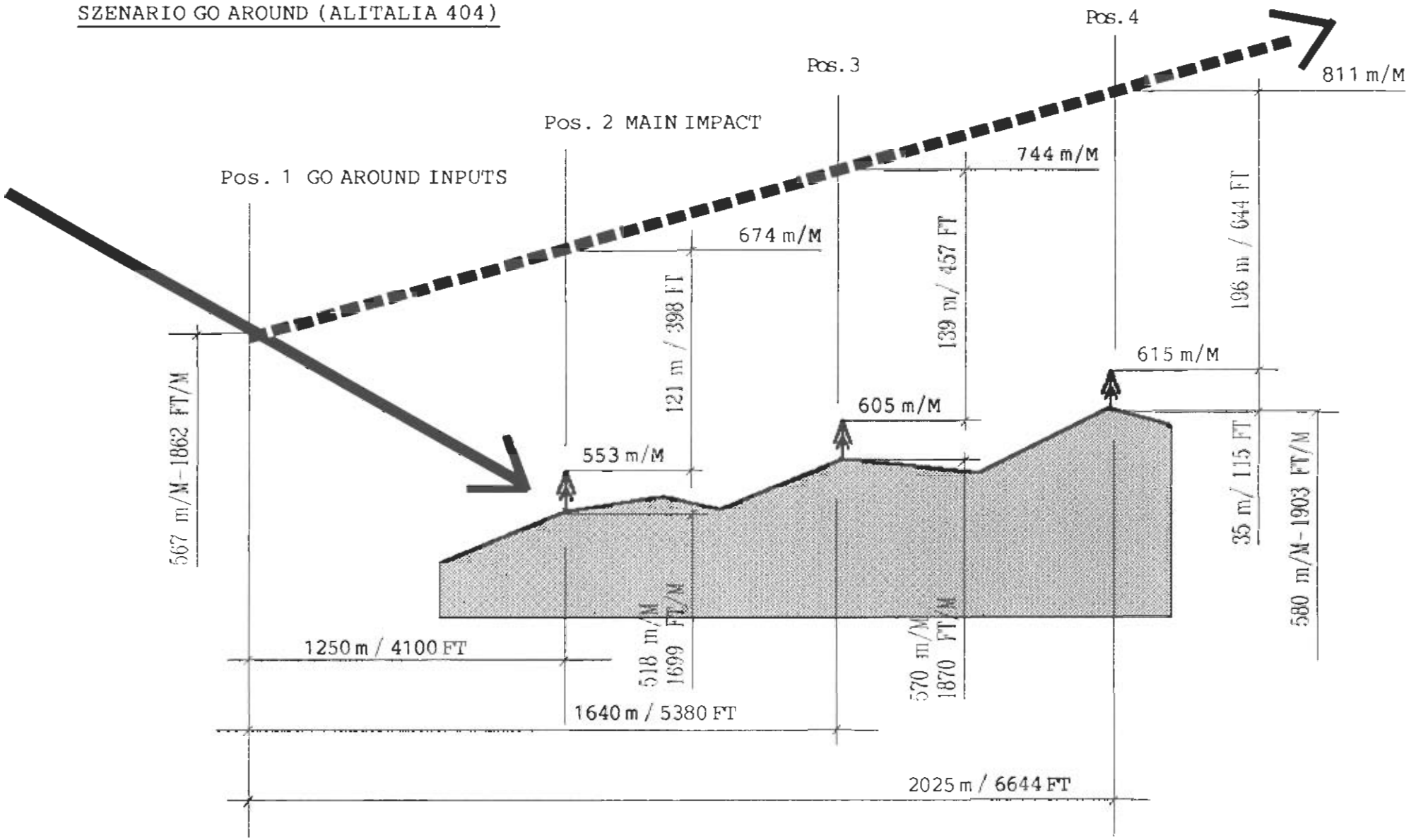
Büro für Flugunfalluntersuchungen
Operations Group 25.11.91

Visualisation: Initiative Computing AG 12/91

Beilage / Annesso / Annex 14

Graphische Darstellung des Flugweges von AZ 404 bei Fortsetzung des Durchstartmanövers um 19:10:59
Rappresentazione grafica della traiettoria di volo se la riattaccata fosse stata continuata dopo le 19:10:59
Grafical flight path presentation of AZ 404 with continued go around after time 19:10:59

SZENARIO GO AROUND (ALITALIA 404)



Beilage / Annesso / Annex 15

Von ALITALIA getroffene Massnahmen
Provvedimenti presi dall'ALITALIA
Measures taken by ALITALIA

Alitalia

Centro Direzionale
Via della Magliana, 886
00148 Roma

telefono (06) 65621
telegramma Alitalia - Roma
telex 626211

Roma, 11.5.1992

Federal Aircraft Accident Investigation Commission

Bern/ Switzerland

Dear Sir

We respond to your request concerning our actions taken in the interest of future safety.

1. Technical / Maintenance

- Introduction of MARK VII GPWS with automatic callout of altitudes during approach. This program started on DC-9 and concerns the whole fleet to achieve a standardisation to the MD-11 status
- A special task force has been set up in order to monitor more strictly the reliability of Navigation Systems.
- Introduction of automatic test procedures for the Switching Box
- New restrictions concerning the consequences of any swapping of suspect devices within or between A/C.

./.

Linee Aeree Italiane S.p.A.
Cap. Soc. L.975.000.000.000
interamente versato
R.T. Roma 202946
C.C.I.A.A. Roma 135156
Cod. fiscale 00476680582
Partita IVA 00903301000

2. Operational

- DC-9 Operational Bullettins concerning "Possible VOR/ILS Failure Mode" (Last issue 18 October 1991).Similar Bulletins were issued also for MD-80, A300 and B747.
- Amendment to DC-9 Operations Manual (25 May 1991) concerning the setting of the radioaltimeter "selected height bug" in order to further increase crew awareness about terrain proximity. Similar amendments were issued also for MD-80, A300 and B747.
- Several amendments to the Manuale Operativo (Company Procedures Manual) concerning callout's and go-around procedures.

3. Training

- Modification of the DC-9 transition course.It now contains extensive coverage of possible VOR/ILS failure modes.
- Modification of the simulator ewpanding the capability to show discrepant VOR/ILS indications beyond the previous level.

A L I T A L I A
Linee Aeree Italiane S.p.A.
Com.te Silvano SILENZI
Responsabile Politiche Sicurezza Volo

Beilage / Annesso / Annex 16

Vom BAZL getroffene Massnahmen
Provvedimenti presi dall'UFAC
Measures taken by FOCA

Bundesamt für Zivilluftfahrt (BAZL)
Office fédéral de l'aviation civile (OFAC)
Ufficio federale dell'aviazione civile (UFAC)
Federal Office for Civil Aviation (FOCA)

3003 Bern, 28.8.1992

922/ I-ATJA -Kz

Unfall Alitalia AZ 404 vom 14.11.1990; Zusammenfassung der getroffenen Massnahmen.

1. Weisung an die Flugverkehrsleiter, die Flughöhe bis zur Meldung "established"im Rahmen des "monitoring" zu überwachen.

2. Ueberprüfung der Machbarkeit von Gleitwinkelbefeuerungen auf Instrumentenlandepisten in der Schweiz; nach ersten Abklärungen problematisch. Vertiefte Prüfung z.Z. im Gange.

3. Hindernisbefeuerung auf dem Stadlerberg wird erstellt.

4. Ueberarbeitung der ATC -Manuals I und II an die Hand genommen. Abschluss im Jahre 1993.

5. Ein "Minimum Safe Altitude Warning" System (MSAW) wird beschafft und dürfte im I. Quartal 1993 in Betrieb genommen werden.

6. Weisung betr. Sperrung der Anflughilfen nach einem Unfall.

7. Weisung betr. Sicherstellung der Datenträger(Radar,FANOMOS,Funk,Verbindungen) nach einem Unfall.

8. Weisung betr. Zusammenarbeit der Mitarbeiter Swisscontrol mit dem BFU nach Unfällen.

9. Realisierung der arbeitsplatzrelevanten Kommunikationsaufzeichnungen auf dem gleichen Band.

BUNDESAMT FÜR ZIVILLUFTFAHRT
Sektion Flugsicherung

(Englischer Text siehe Rückseite)

Accident Alitalia AZ 404 on 14 November 1990: Summary of Measures Taken

1. Instructions to the Air Traffic Controllers to include Flight Altitude in their monitoring until the "established" report.

2. Examine the feasibility of Angle of Approach lighting on Instrument Landing Runways in Switzerland; first results indicate problems. Detailed examination now in progress.

3. Obstacle lighting on the Stadlerberg will be built.

4. Revision of the ATC Manuals 1 and 2 is in hand. Completion in 1993.

5. A "Minimum Safe Altitude Warning" System (MSAW) will be acquired and should be in service in the first quarter on 1993.

6. Instructions concerning the suspension of approach aids after an accident.

7. Instructions concerning the securing of the data sources (Radar, FANOMOS, Radio, connections) after an accident.

8. Instructions concerning the cooperation of Swisscontrol employees with the BFU after accidents.

9. Enabling the recording on the same tape of all communications relevant to the work stations.

FEDERAL OFFICE OF CIVIL AVIATION
Air Traffic Control Section