AIRCRAFT ACCIDENT INVESTIGATION REPORT

China Airlines
Airbus A300B4 – 622R, B-1814
Da-Yuang, Tao-Yuang
February 16,1998

May 18,2000

Civil Aeronautics Administration

M.O.T.C.

Abbreviations Used In This Report Are As Follows :

AD : Airworthiness Directive
ADC : Air Data Computer
AFS : Automatic Flight System
AGL : Above Ground Level
AI : Airbus Industrie
ALT : Altitude
ALT SEL : Altitude Selected
AMPS : Advanced Mobile Phone System
AOA : Angle Of Attack
AP : Auto-Pilot
APU : Auxiliary Power Unit
A/THR : Automatic Thrust
ATS : Auto Throttle System
ATC : Air Traffic Control
ATIS : Automatic Terminal Information Service
ATP : Air Transport Pilot
ATT : Attitude
BASI : Bureau Air Safety Investigation, Australia
BEA : Bureau Enquetes-Accidents, France
BKN : Broken
CAA : Civil Aeronautics Administration, Taiwan, ROC
CAL : China Airlines
CAP : Captain
CAS : Calibrated Airspeed
CAT : Category
CDU : Control Display Unit
CG : Center Of Gravity
CGCC : Center Of Gravity Control Computer
CKS : Chang Kai-Shek International Airport, Taiwan
CMD : Command
CP : Commercial Pilot
CRM : Crew Resource Management
CTL : Control
CVR : Cockpit Voice Recorder
CWS : Control Wheel Steering
DFDR : Digital Flight Data Recorder
DME : Distance Measuring Equipment

DPS : Denpasar Ngurah Rai International Airport, Bali
ECAM : Electronic Centralized Aircraft Monitoring
EFCU : Electronic Flight Control Unit
EFIS : Electronic Flight Instrument System
ENG : Engine
EPR : Engine Pressure Ratio
FAC : Flight Augmentation Computer
FADEC : Full Authority Digital Electronic Control
FCC : Flight Control Computer
FCOM : Flight Crew Operating Manual
FCU : Flight Control Unit
FD : Flight Director
FL : Flight Level
FMA : Flight Mode Annunciator
FMC : Flight Management Computer
FMS : Flight Management System
F/O : First Officer
FPA : Flight Path Angle
ft : Feet
FWC : Flight Warning Computer
G : Gravity
GCU : Generator Control Unit
GPWC : Ground Proximity Warning Computer
GPWS : Ground Proximity Warning System
G/S : Glide Slope Track Mode
G/S* : Glide Slope Capture Mode
GSM : Global System Mobile
HDG : Heading
HDG/SEL : Heading Selected
hPa : hectopascal
HPC : High Pressure Compressor
HPT : High Pressure Turbine
IAS : Indicated Air Speed
ICAO : International Civil Aviation Organization
IGV : Inlet Guide Vane
IM : Inner Marker
IMC : Instrument Meteorological Conditions
IND : Indicator
ILS : Instrument Landing System
KT : Knot
KHH : Kao-Hsiung Airport

LAND	**: Landing**
L/D	**: Landing**
L/G	**: Landing Gear**
LOC	**: Localizer**
LPC	**: Low Pressure Compressor**
LPT	**: Low Pressure Turbine**
LVL/CH	**: Level Change**
MAC	**: Mean Aerodynamic Chord**
MAN THR	**: Manual Thrust**
MDA	**: Minimum Descent Altitude**
MM	**: Middle Marker**
Mn	**: minute**
MIC	**: Microphone**
MTP	**: Maintenance And Test Panel**
N/A	**: Not Applicable**
NAV	**: Navigation**
ND	**: Navigation Display**
NM	**: Nautical Mile**
NTSB	**: National Transportation Safety Board**
OM	**: Outer Marker**
OVC	**: Overcast**
PF	**: Pilot Flying**
PFD	**: Primary Flight Display**
PIC	**: Pilot In Command**
PNF	**: Pilot Not Flying**
QAR	**: Quick Access Record**
QNH	**: Pressure Setting To Indicate Elevation Above Mean Sea Level**
RA	**: Radio Altitude**
RABR	**: Rain and Mist**
RET	**: Retract**
RMI	**: Radio Magnetic Indicator**
RWY	**: Runway**
R/W	**: Runway**
SB	**: Service Bulletin**
SCT	**: Scattered**
SGU	**: Symbol Generator Unit**
SPD	**: Speed**
SPD/MACH	**: Speed/Mach**
SRS	**: Speed Reference System**
SW	**: Switch**

SYS : System
TCC : Thrust Control Computer
TO : Take-Off
TOD : Top of Descent
TOD : Take-off Distance
THR : Thrust
THR L : Thrust Latch
THS : Trimmable Horizontal Stabilizer
TLA : Thrust Lever Angle
TIPS : Technical Instruction Processing Sheet
TK : Tank
TOGA : Take-Off Go Around
TPE : Taipei CKS Airport
TRP : Thrust Rating Panel
UR : Unsatisfactory Report
UTC : Coordinated Universal Time
V_{APP} : Approach Target Speed
VHF : Very High Frequency
VMC : Visual Meteorological Conditions
VOR : VHF Omni directional Radio Range
V/S : Vertical Speed
V_{S} : Stall Speed
V_{TG} : Target Speed

Note: UTC sources for ATC recordings and the flight data recorder were not synchronized and may vary by up to 30 seconds. UTC recorded by flight data recorder was chosen as the reference time and UTC recorded by ATC and CVR recordings were adjusted accordingly.

1. FACTUAL INFORMATION

1.1 History of Flight

On 16 February 1998, flight Dynasty 676 from DPS to CKS by Aircraft B1814 of China Airlines, type A300-600R was flown by KANG, LONG-LIN as PIC and JIANG, DER-SHENG as First Officer with 12 cabin crew and 182 passengers. This was the first flight the two pilots had flown together. The flight took off from DPS International Airport at 15:27L (07:27 UTC). The preflight check report shows no abnormality and take-off conditions revealed no problems.

The flight crew flew from DPS to CKS via route B584、B591, W4. They contacted Taipei area control center at 11:23:05 UTC, 10 miles from DRX, FL290, estimating Shi-Kang (TNN) at 11:43:00 UTC. The flight was under radar control and was cleared to descend at 11:45:12 UTC.

The crew contacted approach control at 11:53:56 UTC and was given descent clearance to 7000ft, QNH 1014 and was told to expect runway 05L. The crew was given radar vectors and at 11:57:43 UTC, the approach controller issued an instruction for the crew to descend to 4000ft. This instruction was not acknowledged by the crew and the controller did not challenge the crew about the lack of response.

At 11:59:10 UTC the crew reported approaching 7000ft and approach control again issued a clearance to descend to 4000ft. This instruction was acknowledged at 11:59:23 UTC.

The crew was instructed to contact the tower at 12:02:33 UTC, which was acknowledged at 12:02:36 UTC.

The crew contacted the tower at 12:02:44 UTC, 9 miles from TIA DME, on final approach. The tower controller informed them of the runway in use, the wind, and cleared them to land: runway 05L, wind 360° at 5 knots, QNH 1015. At 12:04:20 UTC, the crew reported that the aircraft was at 3 miles on final. At 12:05:38 UTC the crew said: 'Tower Dynasty 6…' This was the last communication from the aircraft. The controller asked: 'Dynasty 676 confirm go-around?' There was no response.

During its go-around, the aircraft stalled and then, at approximately 12:05:58 UTC, impacted highway 15 of Da-Yuan, Tau-Yuan next to runway 05L. The aircraft crushed 5 residences and damaged 3. The 14 crew and 182 passengers, and 6 residents were killed. The aircraft was totally destroyed and the wreckage scattered. Fire-extinguishing and rescue actions were performed immediately.

1.1.1 General Information

<table>
<tr><td>1. Station Code
CKS Airport</td><td>2. Date of Accident
February 16,1998</td><td>3. Time of Accident
20:06 (12:06 UTC)</td><td>4. Day /Dawn/ Night /Dusk
___ ___ _X_ ___</td></tr>
<tr><td>5. Accident Location
Approximately 300m abeam the midpoint of RWY 05L of CKS Airport</td><td>6. Airfield of Last T/O
Ngurah Rai International Airport, Bali, Indonesia</td><td>7. Destination
Chiang Kai-Shek International Airport</td></tr>
<tr><td>8. Aircraft Type / Registration
A300B4-622R / B1814</td><td>9. Aircraft Weight During Accident
Approximately 302,200 lbs.</td><td>10.Crew / Passengers No.
14 / 182</td></tr>
<tr><td>11. Estimated Flight Time
5h:05Mn</td><td>12. Flight No./Flight Plan Route
DYNASTY 676 / DPS B 584 B 591 W4TPE</td></tr>
</table>

1.2 Injuries to Persons

Fatalities	Crew	Passengers	Others
Fatal	**14**	**182**	**6**
Injuries	**-**	**-**	**-**
No Injuries	**-**	**-**	**-**

1.3 Damage To Aircraft

1.3.1 Damage To The Aircraft

General Information	
a. Damage Category : Destroyed __X__ Substantial ____ Minor ____ Other ____	
b. Estimated Direct Man-hours For Repair? **N/A**	c. Can Aircraft Damage Be Repaired Economically? **N/A**
d. Fire Before Accident : _____ Fire After Accident : __X__ No Fire : _____ Did Explosion Occur :____	
e. How Many A.D. Have Not Been executed? **None**	f. Has Unsatisfactory Report of This Accident Been Submitted? **None**
g. Is Tear Down Report Requested? **Reference item 15**	h. Has Wreckage Been Transported to Home Base? **Storage at C.K.S. Airport**

1.4 Other Damage

Several surrounding buildings were damaged by the impact of aircraft parts and by the severe fire that followed the accident.

1.5 Personnel Information

1. Pilot In Command

a. Name	Position	License No.	Nationality	Date of Birth
KANG,LONG-LIN	**Captain**	**ATP/101091**	**R.O.C.**	**11/11/1948**

b. Position In Aircraft At Time Of Accident	c. PF / PNF
Left Seat	**PF**

d. Medical Exam. Expiration Date	e. Proficiency Check Exp. Date
February 28,1998	**Jun 27,1998**

f. Total Flying Hours	g. Flight Hours On This Type
7226h:28Mn	**2382h:36Mn**

h. Rest Period Prior to the Flight: **More than 45 hours.**

i . Last Month Flight Time: **28h:53Mn**

j. Last Three Months Flight Time: **148h:04Mn**

2. First Officer

a. Name	Position	License No.	Nationality	Date of Birth
JIANG,DER-SHENG	**First officer**	**CP/301452**	**R.O.C.**	**11/15/1953**

b. Position In Aircraft At Time Of Accident	c. PF / PNF
Right Seat	**PNF**

d. Medical Exam. Expiration Date	e. Proficiency Check Exp. Date
Jun 30,1998	**July 12,1998**

f. Total Flying Hours	g. Flight Hours On This Type
3550h:53Mn	**304h:16Mn**

h. Rest Period Prior to the Flight: **More than 45 hours.**

i. Last Month Flight Time: **57h:34Mn**

j. Last Three Months Flight Time: **154h:43Mn**

3. Flight Attendant

Name	Position	Sex	Age	Qualification as Attendant	Total Flight Time	Latest training on Emergency Procedures	Rest Period Prior to the Flight
Fong Chu-Yen	**Purser**	F	43	Issued 06/01/1976	16739h	Issued. 12/29/1997	**More than 45 hours**
Hsu Wei-Fen	**FA**	F	42	Issued 07/01/1988	7713h	Issued 08/15/1997	**More than 45 hours**
Ou Yang Fu-Sheng	**FA**	M	36	Issued 07/29/1988	7394h	Issued 09/09/1997	**More than 45 hours**
Yu Lai-Dih	**FA**	F	29	Issued 11/29/1990	5598h	Issued 08/08/1997	**More than 45 hours**
Tai Ling-Ru	**FA**	F	32	Issued Apr. 04/23/1991	5451h	Issued 06/06/1996	**More than 45 hours**
Chu Hsin-Yi	**FA**	F	28	Issued 02/25/1994	3210h	Issued 07/19/1997	**More than 45 hours**
Chang Hui-Ya	**FA**	F	28	Issued 10/17/1995	2077h	Issued 08/15/1997	**More than 45 hours**
Shen Tzu-Chieh	**FA**	M	25	Issued 03/23/1997	713h	Issued 07/29/1997	**More than 45 hours**
Yeh Shung-En	**FA**	F	26	Issued May 05/24/1997	622h	Issued 09/20/1997	**More than 45 hours**
Lai Li-Ling	**FA**	F	25	Issued 05/24/1997	564h	Issued 06/01/1996	**More than 45 hours**
Yang Shu-Wen	**FA**	F	22	Issued 10/31/1997	256h	Issued 12/23/1997	**More than 45 hours**
Lin Wei-Chih	**FA**	M	26	Issued 01/07/1998	110h	Issued 12/22/1997	**More than 45 hours**

1.6 Aircraft Information

a	AIRCRAFT Registration No: **B-1814**	b	Manufacture Date **12/14/1990**
c	Reg. Certificate No **79-455**	d	Airworthiness Certificate No. **86-11-155**
e	Total Flight Hours **20197h:55Mn 8829 Cycles**	f	Last Shop Visit Date **02/01/1997 (C-Check)**
g	Shop Visit Activity (Name&Location) **CHINA AIRLINES , Tao-Yuang**	h	Hours Used Since Shop Visit **3014h:08Mn**
i	Hours Used Since Last A-Check. **250h:58Mn**	j	Date of Last A-Check **01/21/1998**
k	Type of Last A Check **2A Check**	l	Total Engine Hours **#1:17012h:48Mn #2:15548h:32**

Engine Historical Data

a	Engine Model **PW 4158**	b	Engine Serial No. **#1 : 724064 #2 : 724017**
c	Total Engine Hours **#1 :17012h:48Mn #2 :15548h:32Mn**	d	No. of Major Shop Visit **#1 : 3 times #2 : 4 time**
e	Hours Used Since Last Major Shop Visit **#1 : 4854h:54Mn #2 : 3636h:25Mn**	f	Data of Last Shop Visit Date **#1 : 05/31/96 #2 : 11/05/96**
g	Shop Visit Activity (Name & Location) **CHINA AIRLINES, Tao-Yuang**	h	Date of Last Installation **#1 : 06/22/96 #2 : 11/08/9**
i	Hours Used Since Last Installation **#1 : 4854h:54Mn #2 : 3636h:25Mn**	j	Date of Last Period Insp. **01/21/98**
k	Type of Last Period Insp. **2 A CHECK**	l	Flight Maint. Log and Release Recor **Normal**
m.	Enumerate the Situation of Engine Overheat and Correction Measures Ad (Latest 3 Months) **None**		
n.	List The Major Malfunction of Aircraft Engine Concerning This Accident (Latest 3 Months) **Flight technical log book records review showed no evidence indicating th aircraft was unairworthy.**		

1.6.1 Manifest, Weight and Balance

Dry Operating Weight:	199,942 lb.
Payload:	76,923 lb.
Fuel on Board:	90,001 lb.
Ramp Weight:	366,866 lb.
Max. TO Limit:	375,891 lb.
Fuel Consumption (DPS-CKS)	64,701 lb.
Estimated Weight at The Time of the Accident:	302,200 lb.
Estimated Fuel at The Time of the Accident:	25,300 lb.
Landing Weight Limit:	308,651 lb.
CG:	29% MAC
Fore and Aft CG Limits:	18-33.5% MAC

1.7 Meteorological Information

Time UTC	Cloud type , Amount & Ceiling	Visibility	W/D & W/V	Temp.	D/P	Altimeter Setting	Other
1200	**SCT 100ft** **BKN 200 ft** **OVC 1000 ft**	**1000 m** **R05** **P1500m**	**350° / 05kt**	**15**	**15**	**1015**	**TEMPO 0800 FG**
1215	**SCT 100ft** **BKN 200 ft** **OVC 1000 ft**	**1200 m** **R05** **P1500m**	**360° / 05kt**	**15**	**15**	**1016**	**TEMPO 0800 RABR**

SUMMARY：

Weather observation for CKS Airport on 16 Feb. 1998 when CAL CI676 Aircraft A300-600R accident occurred.

162000L (161200UTC) 35005KT 1000 R05 P1500 R06 P1500 BR SCT001 BKN002 OVC010 15/15 Q1015 TEMPO 0800 FG=

(Wind direction 350°, speed 5 KT, visibility 1000m. RWY 05 RVR greater than 1500m, RWY 06 RVR greater than 1500m, mist; scattered cloud 100ft., broken 200ft., overcast 1000ft.; temperature 15°, dew point 15°C, altimeter setting 1015mb; 2 hour forecast, within short period of time visibility may reduce to 800m due to fog.

Analyzing 16 Feb. 1998 weather data, it indicates that at the time of accident surface wind at R/W 05 of CKS Airport was negligible. Visibility was above CAT I landing minimum and there were no signs of horizontal or low level wind shear disturbances. At the time of accident, weather conditions at CKS airport were above minimum of landing and take-off.

Detailed METARs information is provided in appendix 1.

1.8 Aids To Navigation

Runway 05L of CKS airport is equipped with an ILS/DME of CAT II. Seven aircraft performed ILS approaches on runway 05L between 11:00 (UTC) and 12:00 (UTC) without any reported difficulty. At 13:48 (UTC) runway 05L was used again with ILS approaches without problem. The Jeppesen approach chart for ILS approach on runway 05L is provided in appendix 3.

1.9 Communications

The flight contacted Taipei Area Control Center at 11:23:00 UTC. The crew received radar vectoring instructions. The crew requested to start the descent from FL 290 at 11:45:08 UTC. They were initially cleared to FL 250, then to lower levels. They were transferred to the approach control of CKS airport.

The crew contacted the approach at 11:53:56 UTC. They were cleared to 7000ft QNH 1014 for runway 05L. They were radar vectored to intercept the Localizer 05L and were asked to descend and maintain 4000 ft. They were asked to contact the tower at 12:02:33 UTC and they acknowledged receipt at 12:02:36 UTC.

At 12:02:42 UTC the controller asked 'Dynasty 676 is it too high for you '. The crew did not answer. At the same time, the crew contacted the tower indicating that they were at 9 miles on final ILS 09 approach.

The controller gave them the runway in use, the wind, QNH and cleared them to land. The crew acknowledged receipt. At 12:04:20 UTC the crew indicated that the aircraft was at 3 miles on final. At approximately 12:05:37 UTC a noise (the auto pilot disconnect warning) was heard by the ATC.

At 12:05:38 UTC the crew said: 'Tower Dynasty 6' This was the last communication received by air traffic control.

The transcripts of the radio communications between the crew of B1814 and Taipei area control center, CKS approach and CKS tower are provided in appendix 2.

1.10 Aerodrome Information

Airfield Data

Field Elevation	Length Of Runway In Use	Runway Heading
107 ft (73 ft RWY05L threshold)	**3660 m (12008 ft)**	**053**
Composition Of RWY	Surface Condition	Distance of actual TOD point in relation to beginning of RWY
☒ **Concrete** ☐ Asphalt ☐ Other	☒ **Dry** ☐ Wet ☐ Other	**N/A**
Ground Facilities	Length Of Overrun	Composition Of Overrun
Not involved	**N/A**	**N/A**

1.11 Flight Recorders

1.11.1 Introduction

The aircraft was equipped with a Sundstrand digital flight data recorder (part number 980-4100-DXUS, serial number 7359) and a Fairchild A100 cockpit voice recorder (serial number 4874).

A CAA representative brought both recorders to the Australian Bureau of Air Safety Investigation for read out. (appendix 4, 5)

The CVR was replayed successfully. All the DFDR Data was read out and decoded, except for a 1.1 second period before the end of the recording. This part of the tape had been damaged during impact.

The DFDR tape was then sent to the French Bureau Enquetes-Accidents for a read out of the damaged portion. The BEA has a microscope fitted with a garnet lens which can give a visual representation of the data. Using this technique all the data was recovered, except for four words in the last second. (refer to appendix 6)

1.11.2 CVR Chronology

CVR recording consists of the last 30 minutes of flight while the aircraft is in cruise flight.

At 11:35:46 UTC, the first officer said ‘there are seven minutes before descent’.

Between 11:36:50 UTC and 11:39 UTC, there was some discussion concerning an ECAM message related to a Trim Tank System fault, and the associated procedure.

Then the CKS airport ATIS was heard until 11:47:00 UTC on VHF 2.

Between 11:43:53 UTC and 11:45:04 UTC, the captain, pilot flying, urged the copilot to ask quickly for the descent.

At 11:46:36 UTC, following a question from the first officer, the captain said that they would make a CAT II approach.

He then told the first officer to prepare for the approach as soon as possible because he feared that the weather would deteriorate.

He urged the first officer several times to expedite the descent procedure and not to lose time on other tasks. This concern about the need to descend quickly, and about the bad weather conditions reappeared periodically until the go around.

At 11:48:23 UTC, the captain confirmed 'Let's prepare for CAT II approach. Check the CAT II' On request of the first officer, the APU was switched On at 11:54:52 UTC.

At 11:57:14 UTC, the captain started calculating the fuel needed to divert to Kao-Hsiung, and the approach checklist was performed immediately afterwards.

At 11:57:43 UTC, the approach control gave the instruction, '676 descend and maintain 4000' this instruction was not acknowledged by the crew nor repeated by air traffic control.

At 11:59:35 UTC, the F/O said 'only 16 miles to runway, now altitude 7000 feet' The captain announced 'LOC star' at 12:01:45 UTC and asked for gear extension.

At 12:03:31 UTC, the captain said, 'We are too high. Go down further, it doesn't matter'.

At 12:03:44 UTC, The captain made some calculations with comments ‘ It won’t work. 2 times 3 are 6. OK. Two thousands. 2 times 6 12. It should work. No, it’s not OK. ‘He commented the altitude ‘It’s 1000 feet higher’ at 12:04:42 UTC, and ‘It’s coming. 1000ft’

At 12:04:56 UTC, Landing checks-list was performed between 12:04:56 UTC and 12:05:13 UTC. At 12:05:08 UTC, the auto-pilot disconnec warning was heard in the cockpit.

At 12:05:14 UTC, the captain announced ‘Go lever, go around’. This was confirmed by the copilot.

At 12:05:19 UTC, the captain asked ‘positive, Gear up’ As the copilot answered ‘Gear down?’, the captain repeated at 12:05:20 UTC ‘Gear up!’

At 12:05:23 UTC, the F/O said ‘Heading select, plus’. Then a continuous repetitive chime indicating gear retraction before flaps retraction was heard, as well as the sound indicating the movement of the trim wheel for two seconds. The stall warning was heard at 12:05:37 UTC for two seconds with aerodynamic sounds characteristic of the stall. Then there were GPWS warnings Terrain and Whoop Whoop Pull up from 12:05:52 UTC until the end of the recording at 12:05:58 UTC.

1.11.3 Chronology established from DFDR data

Elevator and THS sign convention: positive signs for nos down, and negative signs for nose up.

DFDR
Time
12:03:28 UTC, the aircraft configuration was:
Flap 15,
Indicated Airspeed (IAS) = 187 kt,
Trimmable Horizontal Stabilizer (THS) = -3.52°

Auto Pilot (AP) On,
Thrust IDLE, Alt = 3187 ft (reference 1013 hPa) descending, Gear Down.

12:04:02 UTC, over OM, Flaps had started to move toward Flap 20, AP was ON and Thrust IDLE, Alt = 2483 ft, IAS = 185 kt, Elevator moved nose up from +1.02°to +0.32°.

From 12:04:08 UTC To 12:04:46 UTC, IAS between 182 knot and 187 knot; Thrust IDLE, AP ON. small pitch and elevator movements.

12:04:46 UTC,IAS started to decrease slowly (reaching 142 knot at time 12:05:10).

12:04:56 UTC, Alt =1395 ft, slight elevator nose up movement from +1.38°to –0.35°.

12:04:57 UTC, Pitch angle started to move up while aircraft's flight path angle is reducing to Zero.

12:04:58 UTC, THS started to move nose up from –4.22°to –4.92°

12:05:00 UTC, Flaps started moving toward Flap 40, IAS = 167 knot.

12:05:02 UTC, thrust increased slightly.

12:05:03 UTC, Alt = 1323 ft (lowest altitude reached during approach), EPR = 1.06

12:05:04 UTC, elevator pitch down movement, while THS was moving nose up. Pitch reached +10°nose up. IAS = 159 knot, flight path was becoming slightly positive and flaps were still travelling towards Flap 40.

12:05:07 UTC, AP disconnection. THS = –5.98° (nose up), Elevator =2°, (nose down), IAS = 149 knot

12:05:08 UTC, elevator pitch down movement +4.2°, pitch reducing slowly.

12:05:10 UTC, IAS = 142 ft, Flap 40 obtained.

12:05:13 UTC, Pitch +3.16°(minimum before pitching up).

12:05:16 UTC, thrust increased toward GA thrust. THS = –5.98°, Elevator +0.32°, IAS = 142 knot starting to increase slowly.

12:05:20 UTC,TOGA thrust obtained.

12:05:21 UTC,IAS = 150 knot started to decrease, pitch +19°, THS = -5.98°, elevator remained at +0.32°

12:05:26 UTC, gear was no longer down and locked and flaps start moving towards Flap 20, Pitch was +35 going up.

12:05:28 UTC, Elevator pitch down movement from +0.67°to +5.27°, Pitch +41°.

12:05:34 UTC, THS started to move from –5.98°to reach 0°at time 12:05:36. IAS 104 knot, Roll 10°left.

12:05:34 UTC, Maximum pitch down elevator movement +10.21°, Pitch +42.5°.

12:05:36 UTC, Flap 20 obtained.

12:05:37 UTC, Roll reversed to 9°to the right.

12:05:40 UTC, pitch up elevator movement –1.06°vertical acceleration 0.21 g (minimum). Roll 48.5°to the right.

12:05:42 UTC, maximum altitude 2751 ft., Minimum IAS = 43 knot

12:05:44 UTC, slight thrust lever reduction. Roll 38°to the left.

12:05:45 UTC, IAS started to increase, pitch going down through 0°.

12:05:46 UTC, Roll 79°to the left, Pitch –7°, going further down.

12:05:50 UTC,THS moved nose down from 0°to +0.32°.

12:05:51 UTC, Pitch -45°nose down, Roll 20°right.

12:05:53 UTC, Alt = 1319 ft, IAS = 203 knot, Pitch –37° , THS = +0.32°.

12:05:54 UTC, Alt = 1087 ft, Radio height 566ft, IAS = 214 knot, Pitch -30°, Roll 1.76°Right, 1.85g

12:05:55 UTC, Alt = 807 ft, Radio height 340ft, IAS = 228 knot, Pitch -24°, 2.1g

12:05:56 UTC, Alt = 599 ft, Radio height 136ft, IAS = 237 knot, Pitch -18°, Roll 6° Left, 2.2g Last available data.

1.11.4 Approach Profile Chart

An approach path map was prepared based on the accident aircraft final approach path in correlation with CVR, DFDR data and control tower communication data or transcript. This chart is produced below:

1.12 Wreckage And Impact Information

1.12.1 Diagram Map Of The Scene

Refer to appendix 7 for a crash site diagram including significant traces left by the aircraft on the ground and wreckage of aircraft parts.

1.12.2 Wreckage Distribution Map

The aircraft was totally destroyed.

The aircraft crashed west of CKS Airport, off airport limits about 300 meters abeam the midpoint of runway 05L. There were about 200 meters between the first and last points of impact.

The wreckage was distributed in a fan shape and roughly formed a 30° triangle from the runway. (see appendix 8)

1.12.3 Wreckage Site Examination

The following observations were derived from on-site examinations and from wreckage examination in storage facilities at CKS airport. Investigators took photos of the site and the wreckage. (see appendix 9)

1.12.4 Impact Marks And Wreckage Distribution

The aircraft hit the ground on waste land and broke up progressively. Some parts came to rest on the highway No. 15 alongside the field, and some others badly damaged several multi-storied buildings on the far side of the highway.

The wreckage was removed from the highway to storage facilities at CKS airport as soon as practicable, to reestablish traffic flow.

On-site inspection of ground scars and measurements helped to determine that the first ground scar on the wreckage path was a triangular mark made by the tail fuselage. The scar was oriented at a magnetic heading close to 020°. Within the scar, a small frame part of the rear fuselage was identified. This part embedded in the ground was found at 3 meters from the extremity of the triangle.

Several branches of trees were found broken 7.5 meters before the first ground scar, 5.5 meters to the right of the trajectory, and 5 meters above the ground scar level.

Going further along the wreckage path, two holes were found approximately equidistant from the triangular mark. Due to the shape and the distance (16 meters), these two traces were identified as having been made by the engines. The fan cases of each engine were found in front of these holes on the wreckage path.

The 4 outer flap tracks and fairings made holes on the left side of the mark made by the left engine. The other marks on the ground further along the wreckage path could not be related to specific parts of the aircraft.

The impact marks and the aircraft wreckage distribution suggest that the aircraft impacted the ground with a slight left bank angle, with the engines hitting the ground prior to the rear part of the fuselage. The alignment of the first ground scar with the impact marks of the cockpit in a building, gave a magnetic heading between 018°and 020°and a horizontal distance between 210 and 220 meters.

1.12.5 Wreckage Examination

Aircraft Structure

1. **Horizontal Tail:**
   The two sides of the horizontal tail separated from the center box. The center box itself fragmented and few components were identified. The main body of the elevators was still attached to each part of the THS.

2. **Vertical Stabilizer:**
   The upper part of the rudder was detached and lay on the left side of the wreckage path. The lower part of the vertical tail was attached to the upper fuselage from frame 75 to frame 95.

3. **Wings:**
   The left wing box was broken in several parts and the lower skin was fully detached from the main box. Sections of the upper parts showed traces of fire. Most of the control surfaces were detached from the wing and the engine pylon was also separated.
   The right wing box was broken in several parts. One of the ruptures was at the level of the engine pylon. The engine pylon was detached. Most of the control surfaces were detached from the wing.

   The center wing box was completely destroyed, the skin of both the upper and lower wing surfaces was sheared off in several pieces.

4. **Fuselage:**
   The largest pieces found were the:
   - upper section of the fuselage at the level of the vertical tail;
   -left fuselage from frame 54.1 to frame 57 with its emergency exit; and
   -left fuselage between frame 57 and frame 68.

Aircraft Systems

1. **Landing Gear**
   The three landing gear elements and the brakes were retrieved but were broken in several parts. Absence of landing gear marks at the first point of impact as well as findings on the main landing gear and nose landing gear actuators indicated that the landing gear was retracted.

2. **Flight Controls**
   All primary flight control servo actuators (aileron, rudder, elevator) were retrieved with the corresponding

input spring rods. Most of these were still attached to the aircraft structure and movable surfaces.

The position of the ballnut on the trimmable horizontal stabilizer ball screw indicated that at the time of the impact THS was around +0.25°.

The measurements and the observations of the slats and flaps screw jacks showed that the configuration control surface was slat 15 / flap 20.

Cockpit

The cockpit was severely damaged but the following observations were made.

The fully retracted position of the airbrake control lever on the center pedestal corresponded to the airbrake position. This was confirmed by the positioning pin, which was in good condition, indicating that the lever was in the fully retracted position at the time of impact.

The center instrument panel was found, but all instruments were missing. The landing gear lever was close to the up position, but not in the notch.

The slat/flap control lever was in the fully extended position (notch 5) but the lever pin was not engaged in the corresponding slot. In addition the lever was bent rearwards and the gate protection cover was missing. All the above findings indicated that the slat/flap control lever moved during the impacts with the ground and/or obstacles.

In addition, the engine master switches were in the following positions: Eng. 1 Off, Eng. 2 On. The Eng. 1 thrust lever was bent, stuck in the fully forward position. The Eng. 2 thrust lever was severely damaged and was at the idle position. It is probable that these levers have been shifted during the time the aircraft moved on the ground after the impact.

Aircraft Engines

Components from both engines were examined at the crash site and the wreckage storage facility. The type of damage noted was similar for both engines. For each engine, the fan, Low Pressure Compressor (LPC), and Low Pressure Turbine (LPT) modules were separated from the high rotor assemblies. The High Pressure Compressor (HPC), diffuser/burner, and High Pressure Turbine (HPT) modules remained attached to each other for both engines. Damage to engine static structure was consistent with impact, with fracture surfaces typical of overload failures. There was no evidence of previous non-containment or external fire. All damage to engine fan, compressor, and turbine blades was consistent with rotation, with either blades bent opposite rotation, tearing and gouging of remaining leading and trailing edges, or the fracture surfaces of broken blades smeared opposite rotation.

Additional propulsion system hardware was recovered and examined at the wreckage storage facility. One side of a thrust reverser cowl was examined. The engine position for this component was not determined. The reverser cowl was identified by reference to the attached thrust reverser actuator. The cowl was intact and confirmed to be in the stowed position.

One variable stator vane (VSV) actuator was also examined. By examining engine records this actuator was identified as belonging to the number 2 engine. The actuator arm was found in an extended position that corresponded to N2 above 70%.

Damage to the engines indicated that both engines were operating. There was no evidence of engine failure or engine fire before impact.

1.13 Medical And Pathological Information

1. General

a.. Name Position

Kang, Long- Ling Captain

Jiang, Der-Sheng

Other Crew : 12 Flight Attendants

b. Degree Of Injury: None____ Minor____ Major____
Fatal_X__ Missing____

c. Was Post Accident Interview Accomplished ?(If Yes, Present In Item 6)

(Yes) ________ (No)___X_____

d. If Fatal, Was Autopsy Report Submitted ? (Yes)_X (PF/PNF) (No)____

e. Diagnosis : Describe Fatalities And Causes

Refer to 16.1 other information.

2. Psychophysiological Factors

Factor	Mark	Factor	Mark	Factor	Mark
Alcohol	N/A	Dysbarism	N/A	Take Over-Saturation	N/A
Air Sickness	N/A	Motional Disturbances	N/A	Unconsciousness	N/A
Auditory Restriction	N/A	Fatigue	N/A	Cardiovascular Disease	N/A
Boredom	N/A	Illness	N/A	G-Force	N/A
Discipline	N/A	Language Barrier	N/A	Hypoxia	N/A
Disorientation	X	Missed Meal	N/A	Visual Restriction	N/A
Distraction	X	Motivation	N/A	Other Related Factors	N/A
Drugs	N/A	Sensory Deprivation	N/A		

'X' And Describe in Detail in Last Column.

3.Environmental Factors

Factor	Mark	Factor	Mark	Factor	Mark
Air Pressure Rapid Decompression	N/A	Noise	N/A	Weather	N/A
Blast Effects	N/A	Heat	N/A	Wind blast	N/A
Cold	N/A	Toxic Contamination	N/A	Other Factors	N/A
Deceleration Force	N/A	Radiation	N/A		
Light Intensity	N/A	Vibration	N/A		

If Any Factors Exist, Please Mark 'X' And Describe in Detail in Last Column.

4. Personal & Protective Equipment

Specify Any Equipment Which Influenced Operation And Accident.

Item	Type	Explanation

5. Escape And / Or Survival

General : Fill in if Appropriate

Rescue/Survival Was Involved: N/A

Ground ☐ Type of Terrain : N/A

Water ☐ Water Condition : N/A

6. Medical Examiner Comments And Conclusion

(1) Fatality of Capt. and F/O caused by severe direct impact.

(2) Recording of CVR and DFDR indicated that there were 11 seconds the airplane was in a state of not under control after go around. Nightfall began and cloud condition effected. There's a possibility of spatial disorientation.

(3) Recording of CVR revealed the inadequacy of communications between Capt. and F/O might cause distraction.

Date	Name of Medical Examiner	Signature
Sept. 29 '98	Chin-Ming Li	李晉明

1.14 Fire & Survival Aspects

1.14.1 Firefighting Equipment

According to ICAO Annex 14, CKS International Airport is a category 9 airport which has the following fire fighting equipment.

Type of Vehicle	Number
1. Fire Fighting Foam	8
2. Fire Fighting Ladder Car	1
. Fire Fighting Command Car	1
4. Fire Fighting Water Tank	1
5. Fire Fighting Lighting Truck	1
6. Fire Fighting Wrecker	1
7. Injured Carrying	1
8. Ambulance	1
9. Intensive care Ambulance	2

1.14.2 Fire fighting Manpower and Supporting Units

A total of more than 60 fire fighters rushed to the accident scene.

The units that have agreement or contract with CKS Airport for fire fighting and medical support are:

No.	Name of the Institution
(1)	Chinese Air Force 401 Wing at Tao-Yuang
(2)	Chinese Petroleum Refinery at Tao-Yuang
(3)	Fire Fighting Brigade of Tayuan
(4)	Fire Fighting Brigade of Luchu
(5)	Fire Fighting Brigade of Tao-Yuang
(6)	Chang Gong Memorial Hospital at Linkou
(7)	Ming Sheng Hospital at Tayuan

1.14.3 Personnel Training

Type of Training	Institute of Training
Professional Training for CKS fire fighters	1.360 hours training given by the Chinese Air Force Mechanics School. 2.360 hours training given by the CAA Training Center.

1.14.4 Annual Fire Fighting Exercise and Other Maneuvers

Name of Exercise	Date	Item of Exercise
1st of 1996	Aug.03 1995	Aviation Science Museum Fire Exercise.
2nd of 1996	Dec.18 1995	Control Tower Fire Exercise.
1st of 1997	Jul.30 1996	Fuel Tank Fire Exercise.

2nd of 1997	Dec.27 1996	Aircraft Accident Rescue and Exercise.
1st of 1998	Aug.29 1997	Airport Hotel Fire Fighting Exercise.
2nd of 1998	Dec.31 1997	Fire Fighting Equipment Inspection and Operations Exercise.

1.15 Rescue Operations

1. Airport operations division received the accident alarm from the tower at 12:06 UTC and fire vehicles and ambulances rushed to the scene. The airport management established the 'CAL B-1814 Aircraft Accident Crisis Management Team'.

   Airport operations division reported the accident to CAA headquarters and notified concerned units (CAF wing, Chinese Petroleum Refinery, Neighbor Fire Fighting brigade and hospitals). Eleven types of fire truck and ambulance arrived at the scene within 6 minutes and began rescue operations. Additionally 3 foam trucks, each with a capacity of 1500 gallons, assisted with the fire fighting. At 12:18 UTC the fire was brought under control with the application of foam. At about 12:25 UTC the fire was completely extinguished and no survivors were discovered. However, at 12:27 UTC an infant from one of the damaged houses was found and was taken to the nearest hospital.

2. At about 12:41 UTC CKS Airport established the accident scene fire fighting command post and with the coordination with Aviation Police cordoned off the crash site. Vice Minister S.Y. Chen, Ministry of Transportation and Communication, and Deputy Director General K. C. Chang, CAA assumed supervision of rescuing activities at the post. Mr. T.H. Wang Airport Manager coordinated rescuing efforts.

3. At about 13:08 UTC ice slabs, corrugated cardboard, tarpaulins, sacks, white terry clothes were provided for rescuers who were handling victims' remains.

4. At about 13:30 UTC China Airlines provided 160 rooms for the relatives of victims at the Airport Hotel and pitched tents for the use of relatives of victims while visiting the accident site.

5. Joint efforts by Aviation Police, local police, emergency rescue volunteer groups, Army and Military police expedited the operation, including evacuation, search and rescue and removal of bodies.

1.15.1 Manpower and Equipment from Various Units in Support of CI676 Accident Search and Rescue

Date	Units	MP	Remarks
02.16	Tao-Yuang County Police	470	
	Taipei County Police	81	
	Aviation Police	161	
	Provincial Highway Police Group	13	
	Coast Guard Police 1st Brigade	6	2 Lighting Trucks
	Army 6th Corps	350	
	401St Wing Chinese Air force	100	3 Fire Engines and 3 Ambulances
	205th Command Military Police	130	
	Volunteer Fire Fighter	267	25 Fire Engines and 41 Ambulances
	Civil Search and Rescue Group	150	

	CKS Airport	105	9 Fire Engines、1 Lighting Truck、1 Water Tank Truck、1 Large evacuation Lorry、1 Ambulance in support of transporting ice cube, corrugated card, tarpaulins, sacks and terra to the scene.
Total		1833	
02.17	Tao-Yuang County Police	450	
	Taipei County Police	80	
	Aviation Police	154	
	Provincial Highway Police Group	12	6 Patrol Car
	Coast Guard Police 1st Brigade	6	2 Lighting Trucks
	Army 249th Division	60	
	401st Wing Chinese Air force	111	1Mountain Climbing Jeep
	205th Command Military Police	30	
	Civil Search and Rescue Group	47	12 Fire Engines
	Veterans Utilities Company	4	1 Lighting Truck
	CKS Airport	15	1 Lighting Truck, half of the fire fighters remained at the scene. Dispatched 5 to stay at the Pan-Chiao mortuary. Assisted in leasing backhoe and arranged 8 mobile toliets.

Total		969	
02.18	Tao-Yuang County Police	487	
	Coast Guard Police 1st Brigade	6	2 Lighting Trucks
	Army 6th Corps	450	
	401St Wing Chinese Air force	160	
	205th Command Military Police	50	
	Veterans Utilities Company	4	1 Lighting Truck
	CKS Airport	16	1 Lighting Truck, 1 back hoe, personnel went to the scene to console the grieved families. Dispatched 4 men to stay at the Pan-Chiao mortuary.
Total		1173	

1.16. Tests And Research

Aircraft B-1814 was equipped with a total of 34 items of computer equipment, (see list in appendix 10) among which 11 items were retrieved (see list in appendix 11). Most of them sustained severe damage. Read-outs were conducted on the following 3 items which appeared to have stayed in one piece to a certain degree (see list in appendix 12).

DADC	P/N : 4045053-903	S/N : 89080875

This item was sent to Honeywell on June 1st, 1998 for a read-out. Examination determined that it was a spare part on the aircraft and stored no data. (see Honeywell's report in appendix 13)

LRRA	P/N：955-607-14932	S/N：4593

This item was sent to Thomson on June 2nd, 1998 with the intention of conducting a read-out together with Sextant. But upon opening it, it was found the memory had been destroyed in the accident, there was no data for read out. (see company's report in appendix 14)

EEC	P/N：791100-6-095L11	S/N：4000-0230
EEC	P/N：791100-6-090L11	S/N：4000-0302

This item was sent to Hamilton Standard on April 28th , 1998 with the participation of Pratt & Whitney where a read-out was conducted. Both EECs' memories were intact. Data were correlated with DFDR and they matched: It showed both engines were operating normally. It also showed surge during high angle of attack and low speed. (see Hamilton's report in appendix 15)

1.17 Organization and Management Information

1.17.1 Organization and Management of China Airlines

After the Nagoya accident involving an A300-600R/B1816 in April 26, 1996, the Chairman, President, Director of Flight Operation Division, Director of Flight Safety Office and many others were replaced with a whole new set of management team.

Other than the restructuring of top management, China Airlines signed a technical support agreement with Lufthansa Technik to provide technical support for the improvement of flight operation, engineering & maintenance, etc. The technical support was named as "Chi-Chiang Project" to do the following: "To enhance the comprehension of autopilot systems and it's training", "To enhance the comprehension of aviation language and it's training", "To enhance the crew's comprehension of aviation weather and the relationship of aircraft operations", "To enhance crew's comprehension on aircraft performance", "To provide the training operation philosophy via cockpit procedure trainer and flight training device (FTD), etc. but the improvement and efficiency was not significant.

1.17.2 Self Auditing System of China Airlines

The internal audit program at China Airlines is established as part of the responsibility of its Flight Safety Office. It is to monitor the daily performance of line operations, and to conduct the analysis of Quick Access Recorder data. The flight crew met the standards of the annual proficiency check which was conducted twice a year by its check pilot.

There is a great need therefore to improve their overall internal audit program.

1.17.3 The Remedial Actions After The Ta-Yuan Accident

After the Ta-Yuan accident involving an A300-600R/B1814, the President, the V.P., Technical, Director, Flight Operations Div., Director, Flight Safety Office of China Airlines were replaced, and a "0216 Special Project Team" was organized by the direct order from CAA to conduct the overall review of China Airlines. This project team outlined 128 items as remedial actions which were approved by CAA and implemented according to schedule. CAA also organized a team to supervise its implementation. The remedial actions of this project include the rectification of designated examiners of A300-600R fleet in China Airlines, and the recheck of its A300-600R flight crew. During the first and second simulator checks 13 and 14 pilots failed respectively. Among them, one expatriate pilot did not pass his check until th0e third simulator check. This "0216 special project" was fully implemented and verified by CAA on January 15, 1999.

1.17.4 The Organization And Supervision of CAA

CAA organization and manpower was set up according to the Chinese Civil Aviation Law of 1972, this law did not however comply with the recommendations of ICAO Annex 6 to establish the required manpower regulations and training.

In order to meet international flight standards and safety oversight, the CAA started its system renovation from mid of 1995 until February, 1997. During that period, inspectors were recruited and trained. CAA also concluded the mini-certification of all Taiwanese carriers.

1.17.5 Civil Aviation Regulations of CAA

1.17.5.1 Aircraft Accident Investigation and Handling Regulation

CAA Aircraft Accident Investigation and Handling Regulation was updated on Dec. 16, 1993, which didn't comply with ICAO Annex 13. Therefore, CAA should establish a non-punitive policy on fact finding and witness interview in order to facilitate the process of accident investigation and to modify its accident investigation regulation to comply with the recommendation and practices of ICAO Annex 13.

1.17.5.2 Crew Resource Management Training

CAL has developed a cockpit/crew resource management training program for initial and recurrent training. This was approved by CAA.

1.18 Additional Information

1.18.1 Alcohol Test

1. Autopsy on Capt. L.L. Kang was performed at 20:30 UTC on February 17, 1998 and no evidence of alcohol or drug intoxication was found.

2. Autopsy on F/O D.S. Jiang was performed at 19:45 UTC on February 17, 1998 and no evidence of alcohol or drug intoxication was found.

1.18.2 The possibility of Cellular Phone's Interference with Flight

1. Cellular phones used between 12:01 UTC and 12:07 UTC and with signals strong enough to be received by CKS Airport, were recorded by the Advanced Mobile System Communication and Global System Mobile Communication. These subscribers did not match the passengers' names in the manifest.

2. According to all information available including CVR and DFDR data, no evidence was found that indicated cellular phones interfered with aircraft flight operations.

1.9 Useful or Effective Investigation Techniques

With the use of a garnet microscope, the last seconds of the phase signal on the DFDR magnetic tape were decoded.

The signal consists of cells equal length. Each cell corresponds to one bit as 1, if not, the value is 0.

A binacular microscope equipped with a special garnet lenses enables the operator to visualize the magnetic transitions of the signal.

Practically,
-the operator determined the position of the part of the tape to be studied.
-he makes photographies with the microscope of the tape（showing the magnetic transitions）.

-with the help of software. He determines the lengths between the transitions and deduces from them the values of the bit (0 or 1) by comparing the lengths with the constant value of the cell.

-then the series of bits are decoded for a normal read out.

The study of the B1814 DFDR tape with the garnet microscope was performed in the French Bureau enquetes accidents laboratory.

It provided：

-Values of some DFDR RECORDED parameters of the last seconds of flight.

-Approximately 1.5 seconds additional DATA.

It was also proved that there were no other data after the DATA recovered by the garnet reading.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The analysis that follows, established from the CVR recording and DFDR parameters and the other factual data, is a chronological review of the flight from the beginning of the CVR recording to the end, with comments about:

- communications between the crew;
- management of the descent and approach; and
- determination of auto-pilot modes

Note: all time references are based upon DFDR UTC time.

Analysis

From the CVR it was determined that the Captain was the pilot flying (PF) and the copilot was the pilot not flying (PNF).

11:35:08 UTC, CVR recording begins. The aircraft was in cruise flight at FL290. Its speed was 300 knots.

11:35:46 UTC, the first sentence recorded was by the F/O who said: **' I will talk to the cabin. There are seven minutes before descent.'** The F/O anticipated a descent at approximately 11:43:00 UTC.

The crew may have obtained that time by three different means:

- by calculating themselves, using aircraft's parameters at the time.
- by reading it on the leg page of the FMC CDU,
- by calculating from the top of descent arrow indicated on the map display of the ND.

11:36:50 UTC, the captain noticed something on the ECAM and shortly after a Trim Tank System Fault message was displayed on the ECAM. The crew handled this minor malfunction according to the manufacturer's recommended procedure.

11:38:50 UTC, the captain referring to the fault called **'Auto, ok complete'.** The F/O cleared the fault message and completed the abnormal procedure checklist.

11:39:14 UTC, ATIS information was heard on VHF 2 and the aircraft was switched to Taipei control.

11:40:59 UTC, Taipei control cleared Dynasty 676 to depart Shi-kang (TNN VOR) HDG 360 for final approach course. The F/O replied **'After Shi-kang HDG 340 Dynasty 676.'** ATC corrected him **'Dynasty 676 depart Shi-kang HDG 360'** to which the F/O replied correctly.

11:41:42 UTC, the captain instructed the F/O **'Don't leave the switch here after contacting the ground. It may interfere your listening.'** He was probably referring to VHF 2 and the ATIS broadcast interfering with ATC communications.

11:42:59 UTC, ATIS G was heard indicating deteriorating weather. **'Rwy 05L RVR 1300m downward.'**

11:43:53 UTC, the captain stated **'Downward....., Downward.'** He was possibly referring to the weather conditions at Taipei.

11:44:57 UTC, the captain stated ' **Descent'** to which to F/O replied ' **Sir, my side...'** and the captain repeated ' **Descent'.** The copilot did not repeat his remark and what he was referring to was not determined.

11:45:08 UTC, the F/O requested and received descent clearance from Taipei control to FL 250.

11:45:17 UTC, The F/O replied to ATC ' **Descend FL 250, HDG 360. Right now we are leaving.'** The DFDR parameters confirmed that descent was started at 11:45:27 UTC. Speed was approximately 300 knots and auto-pilot one was in command. The descent was approximately 3 minutes later than originally anticipated by the F/O.

Immediately after the communication with ATC, the captain instructed the F/O to call CAL operations for the gate position. The F/O said **'yes'** but the captain appeared to change his mind because he realized that it was not the priority and told the F/O to defer the call without giving him a new instruction. The F/O answered yes, a kind of polite remark, but he called operations anyway. He made his call on Taipei control frequency instead of operation frequency.

11:45:59 UTC, the F/O transmitted **'Operation, Dynasty 676'** Taipei control answered **'Dynasty 676, go ahead.'** The captain noticed the mistake made by the F/O and replied to Taipei control **'Disregard Dynasty 676.'** The F/O then called operations, at 11:46:16 UTC, on the correct frequency and gave them an estimated time of arrival (ETA) of 12: 10 UTC. Operations asked if they were able to make a CAT II approach. The captain replied **'yes we do'** to the F/O who transmitted the answer to operations. After that, operations indicated : RVR 1300, 05 for landing. The communication with operations concluded; then the captain told the F/O that he had to **'make plans as soon as possible'** and to switch off the ATIS to avoid distractions, to which the F/O replied **'Yes.'**

11:47:10 UTC, the captain informed the F/O: **'Approach 250. Contact them immediately. Don't write these things. We keep on descending. We don't want to stay here.'** Taipei Control gave them further descent clearance to FL 210.

The aircraft began to accelerate to 315 knots as the captain probably wanted to increase the descent rate. He then explained to the F/O: **'This is the most important thing. You see, if we don't descend, the visibility will be getting worse. Go back soon, it's important. These things, these things.. what are you doing?'** The F/O first answered **'Yes'** and after added **'Key in this data'.** The F/O was most likely referring to information he was inputting to the FMS. The captain gave him advice how to accelerate the procedure. **'Key in? Use this is OK. Just write down there, we need to be back as soon as possible. Later on, maybe we won't be able to descend, it (ATIS) said "downward". Don't waste too much time on these. What is the QNH? This is the most important.'** The F/O replies **'Yes 1014.'**

11:48:23 UTC, the captain started to brief the type of approach they would fly **'1014 OK just now we mentioned that QNH is 1014, using runway 05L. Let's prepare for CAT II approach, check the CAT II.'** ATIS was heard again on VHF 2, the captain spoke again to the F/O: **'Now we start listening and writing.'**

The Captain then expressed his concern about the weather' **We need to establish our aircraft status, when we reach 210. Later on we will hurry up again.'** He then added **'Look at that side, see there is the lightning quite strong !'**

The Captain seems to be concerned with the weather, especially visibility, and descent profile.

11:49:44 UTC, ATC instructed **' Dynasty 676 turn right HDG 010'** to which the F/O replied correctly. The Captain contacted ATC himself to report approaching flight level 210.

11:50:00 UTC, ATC answered **'Expect lower after 15 miles',** which was acknowledged by the captain.

The captain expressed concern about the weather again and then instructed the F/O to report when approaching cleared levels. At times when the F/O didn't respond or act quickly enough in communicating with ATC , the captain did it himself.

11:51:57 UTC, ATC cleared the aircraft to descend and maintain FL 150 to which the F/O replied correctly.

11:52:02 UTC, the captain announced **‘Level change’** and selected this mode on the FCU. As a result, the thrust automatically retarded to idle and the aircraft descended at the speed selected on the FCU.

11:53:04 UTC, ATC instructed **‘Dynasty 676 turn right HDG 020’** and the F/O replied correctly. After the new heading was given by ATC, the captain made another remark about altitude **‘Approaching FL 150, we should report 2000 ft to go, he hopes to let us keep descending.’**

11:53:30 UTC, the F/O responded **‘yes’** and the captain continued **‘If we delay that we may have to change something.‘** The actual altitude was 18000 ft, the captain was still focused on a quick descent and he was concerned with ATC clearances. The management of the descent seemed to be secondary to him. Though he was aware that they were above the optimum descent profile, no further action was taken, other than mentioning that they had to change something.

The crew could have achieved the optimum descent profile if they had taken corrective action earlier. There were two ways to accomplish this:

- start the descent earlier; and/or
- increase the rate of descent.

The rate of descent could have been increased in two ways:

- increase the indicated airspeed; and/or
- increase the drag on the airplane with the use of speed brakes.

It was noted that the speed brakes had been extended for approximately one minute (between 12:00:43 UTC and 12:02:04 UTC), without significant effect on the aircraft descent profile.

11:53:35 UTC, Taipei Control transferred the aircraft to Taipei Approach. The controller cleared the aircraft for descent to 7000 ft and the F/O responded correctly.

11:54:29 UTC, the F/O announced **'15000, APU'.** Thirteen seconds later, he asked the captain directly **'APU on. Do we switch on ignition? Do we switch on ignition?'** The captain agreed and the APU start procedure was performed.

11:55:31 UTC, the F/O said **'Altimeter 1014'** which indicated that they were passing the transition altitude.

11:55:37 UTC, ATC instructed **'Dynasty 676 turn right HDG 050'** and the captain responded to this correctly. ATC followed with **'Vector crossing localizer for spacing.'** Once again the captain took over radio communications from the F/O, he may have done so to expedite the clearance.

11:57:14 UTC, the captain was calculating the minimum fuel quantity in case of diversion. It included 8000 lbs. to reach the alternate airport (Kao-shiung) plus 4800 lbs. for a 30 minute-holding pattern at 1500 ft. This totaled 12800 lbs. to which he added a 2000 lb. reserve, which made around 15000 lbs. total. He then advised the F/O **'15 thousands we will go.'**

11:57:39 UTC, the captain called for the approach checklist. At this moment the speed was decreasing to 260 knots. Just before they began to perform the approach checklist, ATC cleared them to 4000 ft. Neither crew member acknowledged this message. The F/O, as we have already noted, when focused on a specific task, had difficulty coping with two things at once. The captain may have been preoccupied with managing the aircraft. ATC did not repeat the clearance when there was no response from Dynasty 676. The crew completed the approach checklist.

At this time the crew did not check the compatibility of height with distance to go, taking into account speed, as advised in the FCOM. The FCOM gives a rule of thumb of 9000 ft at 250 knots with 30 NM to touchdown. Actually, the aircraft was flying at 240 knots, altitude was 10000 ft and the distance was around 26 NM. The aircraft was high and there was no exchange about this between the two crew members.

Forty seconds after the completion of the approach checklist, the F/O informed ATC that they were approaching 7000 ft, which was their last acknowledged cleared level. It confirms that they did not hear the previous descent clearance given by ATC. ATC then gave them a new heading of 090 to intercept the 05L localizer and cleared them to descend and maintain 4000 ft and the F/O responded correctly.

The aircraft adopted the new heading and a few seconds later, speed began to decrease, which meant that a new target speed had been selected.

The speed steadily decreased to reach 180 knots two minutes later. The AP was still in LVL/CH mode, the rate of descent also decreased. It was around 1500 ft/min before reducing to between 500 and 800 ft/min during the deceleration phase.

12:00:35 UTC, the F/O said **'Only 16 miles to the runway currently the altitude is 7000 ft.'** The F/O may have realized at this time that there was something wrong with the descent profile. The approach chart for ILS 05L approach indicated that the normal altitude at 16 NM from TIA VOR was 4000 ft. It was the only reference during descent and approach to the height and distance to go. The F/O may have been trying to alert the captain about an unusual situation, but the message wasn't stressed. The answer from the captain was **'Flap 15'** probably to increase the rate of descent. The F/O checked the speed, selected the speed brake and later selected flap 15. The F/O may have assumed that this would increase the descent rate sufficiently to achieve the descent profile. The F/O made no further remarks about descent profile.

Vertical Trajectory Analysis

The ILS 05L approach chart, which was used by the crew, gave information about altitudes associated with DME distance and TIA VOR. The following table compares published and actual altitudes of the aircraft:

Distance to TIA	Published Altitude	Actual Altitude	Time
16 NM	**4000**	**7107**	**12:00:28**
11 NM	**3000**	**5139**	**12:02:12**
5.2 NM (OM)	**1400**	**2483**	**12:04:02**

12:01:22 UTC, ATC clearance for the ILS 05L approach was received. The captain remarked ' **LOC star'** and the F/O confirmed **'LOC star'.**

12:02:05 UTC, the landing gear was extended out of sequence on the captain's request. Normally the landing gear is not extended until after flap 20 has been selected. However, extending the landing gear early will increase the drag on the aircraft, which will slow the aircraft down and/or increase the rate of descent.

12:02:42 UTC, the F/O acknowledged a frequency change given to him by Taipei approach and switched frequencies. Due to the fact that they had changed frequencies they did not hear Taipei approach ask **'Dynasty 676, is it too high for you?'** The aircraft was at 4400 ft and 9.7 NM from TIA (8.6 NM from ITIA). According to the approach chart, at this distance the aircraft should have been descending from 3000 ft to 1400 ft.

12:02:44 UTC, the F/O made his first call to Taipei tower indicating that they were **'9 miles on final. ILS runway**

09 L approach.' Despite the confusion about runway orientation (F/O said '09 left' instead of 05 left), the controller cleared the aircraft to land on runway 05 left and gave them the wind **'three six zero at five.'**

12:03:18 UTC, the captain said **'Still have 2 miles to go'** the F/O answered **'Roger.'** The captain was probably referring to the distance to the outer marker. At this time the aircraft was 7.7 NM from TIA, approximately 2 NM from the outer marker. The altitude was 3400 ft. The aircraft was required to cross the outer marker at an altitude of 1400 ft. That meant that within the next 2.5 NM the aircraft would have to lose 2000 ft. With a constant speed of 190 knots, this would have required a descent rate of 3000 ft/min. The actual rate of descent was 1250 ft/min on average from this point to the outer marker. The aircraft crossed the outer marker at an altitude of 2500 ft.

12:03:31 UTC,The captain said **'Oh, we are high. Go down further, it doesn't matter.'** The F/O answered **'Yes.'** This exchange is characteristic of the communication between the two crew members. The meaning of the sentence by the captain was not clear, but the answer from the F/O was even more ambiguous. The 'Yes' was not an approval, as there was no action from the F/O.

The aircraft was already descending in LVL/CH mode. The captain may have wanted to change the aircraft descent parameters, but no action was taken.

12:03:42 UTC, the captain asked, **'Are we clear?'**, probably checking whether they had received a landing clearance. The F/O confirmed ' **Clear.. Clear ILS.'** The F/O had confirmed that they were cleared for the approach but did not confirm that they were cleared to land. The captain repeated his concerns about the aircraft's altitude problem. He said, **'Oh, it won't work'**, probably speaking about the continuation of the approach to a successful landing. Then he started a calculation '**2 times 3 is 6, OK, 2000. 2 times 6, 12. It**

should work. No, it's not OK.' As they crossed the outer marker, he ordered **'Flap 20.'** This increased the rate of descent from around 1200 ft/min to 1500 ft/min. Altitude over the outer marker was 2483 ft, which was more than 1000 ft too high.

12:04:08 UTC,the captain stated **'God, tail wind is too strong. 2 miles. Did you report? Report again.'** He thought that the aircraft was too high because of the presence of a tailwind. This was not really the case, as the wind was less than 5 knots below 2500ft. The captain was probably under a lot of stress at this time, as the aircraft was approaching the airport and was still too high. Again the captain ordered the F/O in a forceful manner **'Report, report to the control tower!'** Following the captain's command, the F/O advised the tower that the aircraft was 3 NM and on final. The DFDR and radar data confirmed that distance was correct. This demonstrated that the F/O was aware of the position of the aircraft relative to the runway. The F/O did not express any concerns about the situation and may still have thought that the captain was controlling it. This also indicated that the F/O probably still had confidence in the captain's plan and his ability to land the aircraft safely.

12:04:26 UTC,Taipei Tower confirmed the landing clearance. After that, the F/O announced the FMA modes, which were LOC green and G/S blue. This indicated that the AP was in LAND mode. For the lateral mode the AP had already captured the localizer. For the vertical mode, it means that the capture of the G/S was armed. The conditions for capture were not present. It requires less than two thirds of a dot to switch to G/S* (glide capture) mode. The AP can capture the glide even if the aircraft is arriving from above. But the normal and safe procedure is to arrive from below.

12:04:51 UTC,the captain states **it's 1000ft higher... . It's coming. 1000ft.'** His comment without action to stop the approach and he called for the final flaps to be extended. This is the start of the landing checklist. A new target speed had been set on the FCU and the speed began to decrease.

At 12:04:41 UTC, the glide slope signal, as recorded on the DFDR, began to move steadily from the maximum deviation indicating that the aircraft was well above the glide slope, or what is commonly referred as 'fly down' indication until it reached the opposite indication that the aircraft was going well below the glide slope, or a 'fly up' indication at 12:05:02 UTC.

At 12:05:04 UTC, it is noted that the auto pilot considering that the aircraft was below the glide slope began bring the nose up to level off as the glide slope deviation passed in the 'normal range' of the 'fly up' indication, and attempted to maintain speed by increasing thrust because of the decreasing speed caused by the increasing angle of attack.

At this time, the aircraft was at least 1000ft above the normal 3 degrees glide path which is outside the normal ILS approach tolerances.

Recorded data from DFDR and radar track have been matched with more general data coming from the litter on signals generated by glide antennas.

By conception, all the glide antennas send a signal which diagram forms a lobe centered on the glide path and which gives the indications to the receiver to display the deviation from the nominal path; but glide antennas also send signals forming secondary lobes which axes have much higher angles than the nominal glide path angle (9 degrees, 15 degrees, 21 degrees, etc.) and whose polarization are alternatively reverse and equal to the 3° nominal path. Note: a detailed diagram of primary and secondary lobes is provided in appendix 16 as well as a chart which shows the relative position of the aircraft and of the primary and secondary glide slope lobes.

Theoretical data, radar data, recorded glide slope indications and aircraft reactions are consistent; and show the following:
-the aircraft encountered a pseudo glide slope with sequence of appearance of 'fly down' and 'flying up' reverse from the 3 degrees glide path;
-the auto pilot attempted to capture this pseudo glide slope.

There is no evidence found on the CVR that would indicate that the flight crew believed that they had intercepted the glide slope and were reacting to that occurrence. But, there are several remarks on the CVR pointing the fact that they were aware that they were significantly high and were attempting to keep the aircraft descending.

At 12:05:03 UTC, elevator nose down movements were recorded while horizontal stabilizer had nose up movements. The direction of elevator movements indicates that the input on the control column was coming from one of the pilots, most likely the captain who had noticed that the aircraft was stopping its descent and who tried to force it down manually. Inputs were done while the A/P remained engaged.

Note: When an A/P is engaged with G/S capture longitudinal mode, the pilot is able to operate a deflection of the elevator proportional to the force applied on the control column. This operation is possible through a function of the A/P which is called Supervisory Override. When the A/P longitudinal mode changes to G/S track, the Supervisory Override function is no longer available. Any force above 33 lb. applied on the control column then causes the automatic disengagement of the A/P.

Between 12:05:06 UTC and 12:05:07 UTC, the signal passed the threshold value of one third of dot. Conditions for change to A/P mode G/S track (glide slope green) were then met.

12:05:07 UTC, in order to maintain the aircraft descending while the horizontal stabilizer had a nose up action, the crew had to apply a force on the control column which exceeded 33 lb. This caused the A/P, in G/S track mode, to automatically disengage.

12:05:12 UTC, the captain calls **'OK Landing Checklist complete.'** Though the associated warning, i.e. cavalry charge, recorded on the CVR, had been canceled five seconds before.

From 12:04:56 UTC to 12:05:12 UTC, the crew were performing the landing checklist.

12:05:13 UTC,the captain called **'Go lever, Go around'**. The parameters recorded on the DFDR are consistent with those of an aircraft in the go-around phase at this time. Thrust is increasing, the aircraft is pitching up and the altitude is increasing. This sudden change could be very confusing for the F/O. Until the last second he was prepared to land, even though there was no possibility that they could land from that position. The CVR contained no discussion of the eventuality of a go-around and the attempted go-around was not properly executed. From both CVR and DFDR recordings, there is no evidence to tell whether the go-around altitude was selected or not on the FCU. When the captain says **'Go lever, go around'**, the F/O out of reflex answers **'Go around, Go lever'** but he seems completely surprised.

12:05:18 UTC, the captain ordered **'positive, gear up.'** The F/O hesitated and asked **'gear down?'** The captain repeated **'gear up!'**, to this the F/O answered **'Gear up.'** This dialog lasted 3 seconds, after which the gear lever was moved toward the up position. It cannot be determined who selected the gear up. The request for gear retraction before flaps retraction does not correspond to the standard operating procedures and this may have added to the F/O's confusion. The gear retraction before the flaps retraction generated the continuous repetitive chime which is heard on the CVR.

From the moment the captain initiated the go-around, at 12:05:13 UTC, until 11 seconds later, there was no action on the control columns. Consequently with the trim in a position corresponding to a balanced aircraft for the approach descent, the AP not engaged and the thrust that was increasing toward TOGA, the pitch of the aircraft continuously increased, leading to a high nose-up attitude.

12:05:25 UTC, according to the DFDR, slight pitch down action was taken to modify the attitude of the aircraft after the pitch was more than 30° nose-up. This action was not sufficient to reverse the pitch up tendency and speed rapidly decreased as pitch continued to increase.

12:05:37 UTC, the stall warning was heard when the speed was 76 knots. Sounds, characteristic of a stall, were heard as the aircraft was reaching the top of its trajectory. Following the stall the crew regained control of the aircraft. However, because of the high rate of descent the crew was unable to prevent the aircraft from impacting the ground.

Neither crew member controlled the aircraft for 11 seconds during a critical phase of flight. With the AP off, trim and/or control inputs were required during the go-around to maintain control of the aircraft. The investigation could not determine why there were no control inputs. The following possibilities were considered by the investigation team:

1- Because AP disconnection was unintentional, the captain may not have realized that the AP was no longer controlling the aircraft.

2- During the go-around phase, there was misunderstanding and miscommunication between the captain and the F/O. One had transitioned to the go-around maneuver, while the other still expected that they would land. They lost time trying to understand each other and this difficulty in communication added to their confusion. This could explain why they did not control the aircraft during the initial portion of the go-around.

3- The captain's preoccupation with the first officer's response regarding the landing gear may have distracted him from monitoring his PFD and thus observing the continuing pitch up of the aircraft.

As they were in IMC at night and as the pitch increased smoothly, the crew may not have physically felt changes in the aircraft attitude. In daily VMC conditions, they may have recognized the excessive pitch angle much earlier.

During the stall phase, the F/O contacted the tower but said 'Tower Dynastic' only. The controller queried whether they were making a go-around. The F/O confirmed the go-around. Several GPWS alarms were recorded on the CVR, as well as two cavalry charges, the last one indicates that one of the crew members tried to connect the AP, perhaps to recover control of the aircraft. As the conditions for an AP engagement were not met, the AP automatically tripped, just after it had been connected and the cavalry charge rang.

12:05:50 UTC, the F/O **'Pull up! Altitude Low!'**

12:05:51 UTC, Numerous GPWS alerts (**' Whoop Whoop Pull Up'**) were heard until the end of the CVR recording.

12:05:57 UTC, CVR recording stopped.

3. Conclusions

3.1 Findings

(1) The flight crew members were properly certified and qualified in accordance with applicable regulations and company requirements.

(2) The captain and the first officer were flying together for the first time.

(3) The aircraft was properly certified, equipped, and maintained in accordance with approved regulations. The weight and balance were within allowable limits.

(4) All the airworthiness directives had been applied to the aircraft.

(5) The captain had received initial CRM training but had not received any of the required recurrent CRM training.

(6) The Airbus Industry and China Airlines training syllabus for the A300-600R crew did not have a requirement for unusual attitude recovery training.

(7) The crew treated successfully a 'Trim tank system fault' before the descent.

(8) ATC did not delay the descent except for a 34 second-period while the aircraft was at FL 210.

(9) During the winter time strong southwest winds are common and can have an effect on descent profiles.

(10) The aircraft remained above the normal descent profile during the entire descent.

(11) The flight crew did not acknowledge an ATC instruction to descend to 4000 ft. The approach controller did not challenge the crew about this lack of response.

(12) The approach controller questioned whether the aircraft was too high on the approach after issuing the crew with frequency transfer instructions. The crew had commenced

the frequency transfer prior to this question being asked.

(13) The meteorological conditions at CKS airport at the time of accident would normally require a CAT I approach.

(14) The aircraft over-flew the outer marker at 12:04:02 UTC, 1000 ft higher than the published minimum altitude.

(15) Forty seconds later, at 12:04:42 UTC the captain said **'It's 1000 feet higher.'**

(16) A crew member applied sufficient pressure to the control column to override the AP and cause it to disconnect during the landing checklist. The subsequent AP disconnection sound was canceled by the crew.

(17) After the end of the landing check list , the captain initiated a go-around and announced **'Go lever, Go around'**, at 12:05:14.

(18) Company procedures require a go-around if the aircraft is not stabilized at 1000 ft. AGL.

(19) There was no positive action on the control column nor the pitch trim during a 11second period after the go around was initiated.

(20) During this period, there was a misunderstanding between the pilots concerning the actions to be performed.

(21) The landing gear was retracted before the flaps, while standard operating procedures require one step of flap retraction before the landing gear is retracted. This led to a continuous repetitive chime audio warning.

(22) The pitch attitude increased as a consequence of engine thrust increase by go around power.

(23) When the pitch reached 30 degrees nose-up, there was a slight pitch down action on the control column, but insufficient to stop the increase in pitch up.

(24) At 12:05:34 UTC when the aircraft reached 43 degrees and 93 knots, the control column was placed to 10.21 degrees

nose down corresponding to approximately 2/3 of the full forward position.

(25) The stall warning started at 12:05:37 UTC, before the aerodynamic noises characteristic of the stall buffet.

(26) The aircraft stalled.

(27) The aircraft pitched down abruptly and the altitude decreased quickly with significant roll variation.

(28) The aircraft hit the ground before recovery was completed.

(29) Some of the aircraft wreckage hit cars and buildings and a severe fire developed.

(30) The accident was not survivable.

3.2 Causes

The investigation team recognized that the following combination of factors contributed to the accident:

(1) During the entire descent and approach, the aircraft was higher than the normal descent profile and the pilot did not intercept the normal glide path.

(2) During the go around phase, The crew coordination between the captain and the F/O was inadequate.

(3) For 11 seconds during the go around, the crew did not counteract the pitch up tendency which was caused by the increase in thrust. The subsequent reaction of the crew was inadequate. As a consequence the aircraft's pitch attitude increased until the aircraft stalled.

4. RECOMMENDATIONS

To China Airlines

1. China Airlines re-examine and enhance flight crew training to include:
    (1) Cockpit discipline and coordination
    (2) Clear defining of responsibilities between PF and PNF
    (3) Positive acknowledgment and distinct call out procedures
    (4) Adherence to standard operating procedures.

2. China Airlines conduct A300-600R simulator training in a more realistic manner for auto and manual go-around, normal and abnormal maneuvers, preventing and recovering from unusual attitudes.

3. China Airlines adopt and implement 'Airplane Upset Recovery Training' to improve flight crew ability to confidently handle recovery from unusual attitudes.

4. China Airlines enhance the company safety culture by strengthening CRM training and improving communications between members of flight crew.

5. China Airlines adopt an on-going education program to instill in flight crew members the conviction that human factors play a significant role in flight safety.

6. China Airlines must conscientiously and realistically carry out required training programs and inspection systems.

To CAA

1. During instrument approach procedures, if there are any significant deviations noted, the ATC service position shall advise the pilot/crew of these deviations.

2. When ATC issues instructions it shall be required for the pilot/crew to acknowledge those instructions.
3. The CAA should review the airspace construction and evaluate the decent profile.
4. The CAA should conduct a special inspection of China Airlines with special emphasis on their pilot training program, including approach and missed approach procedures.
5. Modify the accident investigation regulations to comply with ICAO Annex 13.
6. The CAA should establish guidance for C.R.M. standing for operators use.

To operators

1. Review CRM training and procedures including the requirement for recurrent training.
2. Establish or review airplane unusual attitude recovery training and procedures.

To Airbus Industrie

According to the factual information contained in the DFDR, the maximum pitch angle reached by the aircraft was +42.5° .

So, Airbus industrie should review the A300-600 FCOM to remind the flight crew the basic data of flight dynamics for a go-around, the procedures and crew task-sharing that permit the flight crew to perform an approach and a go around safely.

(This recommendation has been implemented by Airbus Industrie which has issued on March 1999-and a revision on October 1999) the A300-600 FCOM Bulletin No. 13/1 (and the revision 13/2).

Appendix 1

Weather Information

**** FIVE SEQUENTIAL METAR ****

```
TIME    PORT   TEXT
161215  RCTP   161215Z  36005KT 1200 RI5/P1500 RO6/P1500 -DZ BR SCT001
               BKN002  OVC010  15/15  Q1016  TEMPO  0800  -RABK=
161200  RCTP   3500SKT  1000  R05/P1500  R06/P1500  BR SCT001  BKN002
               OVC010  15/15  O101S  TEMPO  0800  FG=
161139  RCTP   161139Z  O1004KT  0600  R05/13000  R06/13000 FG  SCT000
               RKN001  OVC010  O1014  TEMPO  0500  FG=
161130  RCTP   161130Z 36004KT  0800  R05/13000  R06/13000  FG  SCT000
               BKN001  OVC010  15/15  Q1014  TEMPO  0500  FG=
161118  RCTP   161118Z  O1004KT  0800  R05/P1500  F06/P1500  FG
               SCT000  BKN001  OVC010  15/15  Q1014  TEMPO  0500  FG=
```

Appendix 2

Communications Between CAL 676 and Taipei Approach, Taipei Tower

Communications Between CAL 676 And Taipei Approach, Taipei Tower

Date : Feb. 16 1998   Time : 11:54 UTC

TIME	CALL SIGN	Content
11.53:35	CAL676	TAIPEI APP GOOD EVENING, CAL676 HEADING 020APPROACHING FL 150 WITH GOLF.
11.53:49	APP	CAL676, TAIPEI APP DESCEND AND MAINTAIN 7000, TAIPEI QNH 1014. RUNWAY 5L.
11.53:55	CAL676	DESCEND AND MAINTAIN 7000, 1014, RUNWAY 5L CAL676.
11.55:12	APP	CAL676, TURN RIGHT HEADING 050.
11.55:16	CAL676	TURN RIGHT HEADING 050.
11.57:19	APP	CAL676, DESCEND AND MAINTAIN 4000 (Not Respond)
11.58:48	CAL676	TPE APP, CAL676 HEADING 050 APPROACHING 7000.
11.58:54	APP	CAL676 TURN RIGHT HEADING 090 INTERCEPT 05L LLZ, DESCEND AND MAINTAIN 4000.
11.59:00	CAL676	FLY HEADING 090 DESCEND 4000 INTERCEPT RWY 09, 05 L LOCALIZER, CAL676.
12.00:55	APP	CAL676 NOW 16 MILES FROM AIRPORT CLEARD ILS RWY 05L APPROACH.
12.01:02	CAL676	CLEARED ILS RWY 05L APPROACH CAL676.
12.02:08	APP	CAL676 CONTACT TOWER 118.7
12.02:12	CAL676	TOWER 118.7 CAL676.
12.02:18	APP	CAL676 IS IT TOO HIGH FOR YOU? (Not Respond)

Communications Between CAL 676 And Taipei Approach, Taipei Tower

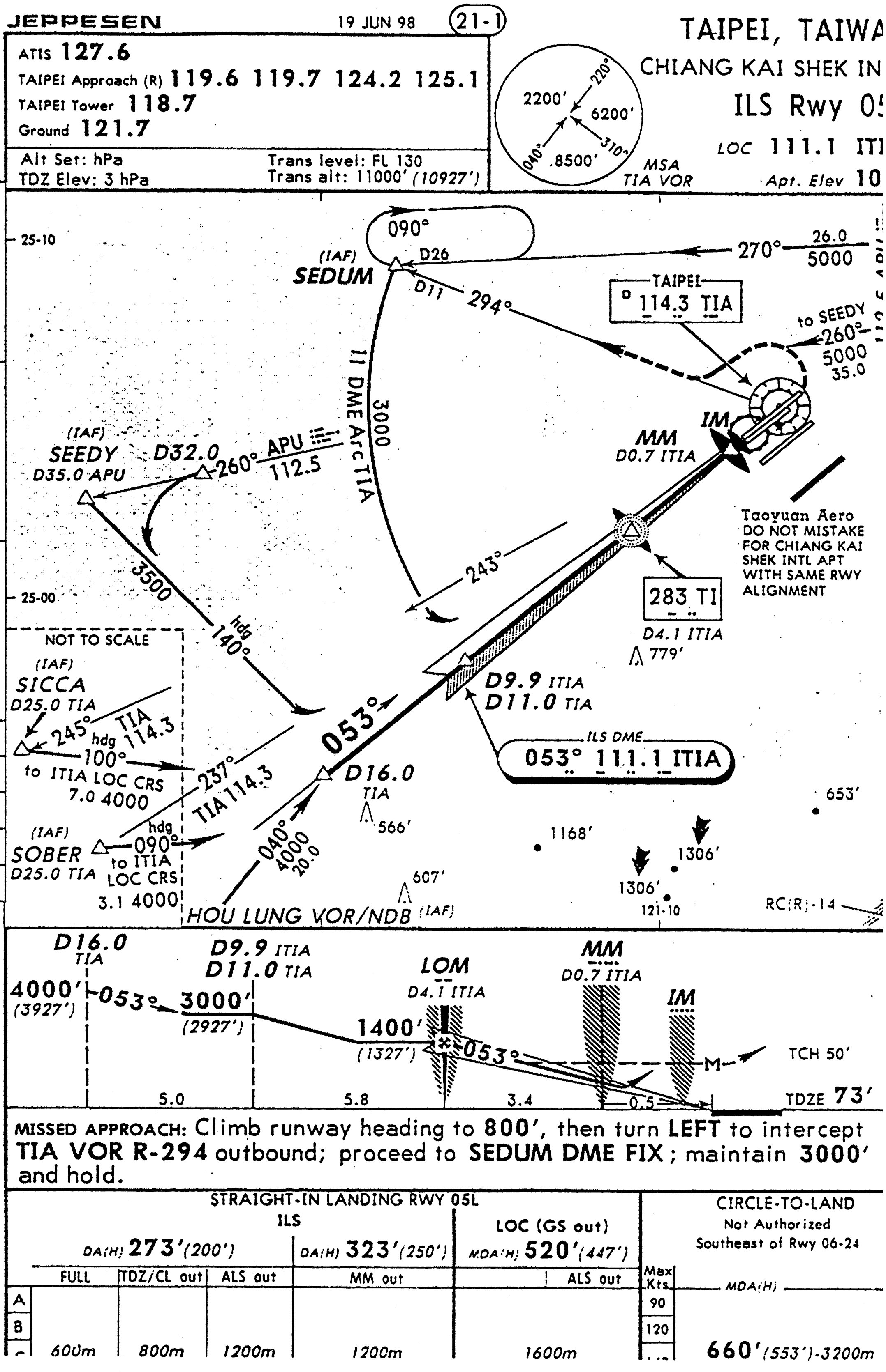
Date : Feb. 16 1998 Time : 12:02:18 UTC

TIME	CALL SIGN	CONTENT
12.02:18	CAL676	TPE TWR. GOOD EVENING. CAL676 9 MILES ON FINAL ILS RWY 09 (..?...)
12.02:26	TWR	CAL676 TP TWR RWY05L ; WIND 360 AT5, QNH 1015 CLEARED TO LAND.
12.02:33	CAL676	1015 CLEARED TO LAND CAL676.
12.02:55	CAL676	TWR CAL676 3 MILES ON FINAL.
12.04:00	TWR	CAL676 CLEARED TO LAND WIND 360 AT3.
	CAL676	ROGER CLEARED TO LAND, CAL676
12.05:12		RING RING
12.05:13	CAL676	TWR CAL ....
12.05:21	TWR	CAL676 CONFIRM GO AROUND.

Appendix 3

Jeppesen Approach Chart for ILS Approach on Runway 05L

Appendix 3 ILS 05L Jeppesen Approach Chart



JEPPESEN 19 JUN 98 (21-1)

TAIPEI, TAIW

CHIANG KAI SHEK IN

ILS Rwy 0

ATIS **127.6**

TAIPEI Approach (R) **119.6 119.7 124.2 125.1**

TAIPEI Tower **118.7**

Ground **121.7**

Alt Set: hPa Trans level: FL 130

TDZ Elev: 3 hPa Trans alt: 11000' *(10927')*

LOC **111.1** IT

Apt. Elev **10**

MISSED APPROACH: Climb runway heading to **800'**, then turn **LEFT** to intercept **TIA VOR R-294** outbound; proceed to **SEDUM DME FIX**; maintain **3000'** and hold.

	STRAIGHT-IN LANDING RWY 05L						CIRCLE-TO-LAND Not Authorized Southeast of Rwy 06-24	
	ILS				LOC (GS out)			
	DA(H) **273'**(200')			DA(H) **323'**(250')	MDA(H) **520'**(447')			
	FULL	TDZ/CL out	ALS out	MM out		ALS out	Max Kts	MDA(H)
A							90	
B							120	
	600m	800m	1200m	1200m	1600m			**660'**(553')-3200m

Appendix 4

CVR Data Read Out

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
11:35:46	F/O	I will talk to the cabin. There are seven minutes before descent.					Din Don (cabin call)
11:35:47	Capt	O.K. Thank you.					
11:35:50	F/O	Ground temperature is 16 degrees.					
11:35:56	F/O	Hello, seven minutes before descent. Ground temperature 16 degree, cloudy. No wheelchair requirement, am I right? all right.					To cabin
11:36:50	Capt	Look at the ECAM, this one after reading zero, Trim tank.					
11:37:29	Capt	Look, look that.					
11:37:31	F/O	NIL					
11:37:33	Capt	CG. Look this CG. See what we can do.					
11:37:42	F/O	Auto trim.					
11:37:53	F/O	Seems we don‘t need to do anything.					
11:37:55	Capt	Yes, we do. The original case is like this. Do you see the trim tank					Don (single chime) (ECAM Message)

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
		system fault?					
11:38:15	F/O	Trim tank system fault.					
11:38:20 11:38:29	Capt	Trim tank system.... Trim tank system in flight. Trim tank mode forward. Trim tank pump one and two check on, on ok. If no forward transfer, but yes .So not our case. Center tank above, not our case. Trim tank empty.					Don (single chime)
11:38:40	Capt	Already empty.					
11:38:41	F/O	Empty					
11:38:42	Capt	Trim tank. Pump 1 and 2 off.					
11:38:45	F/O	Off.					
11:38:46	Capt	Trim tank mode auto.					
11:38:48	F/O	Auto.					
11:38:50	Capt	Auto, O.K. complete!					
11:38:53	F/O	Clear					

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
1:38:57	Capt	O.K. Clear. That is , the thing so you see, that is the thing.					
1:38:59	F/O	Yes.					
1:38:59	Capt	That is the Auto trim tank inoperative procedure: Trim tank system fault procedure. Do the clear action.					
1:39:14					ATIS	F	
1:39:59					ATIS	F	
1:40:34			TPE CTL	Dynasty 676, contact TPE CTL 126.7. So long.			
1:40:37			F/O	126.7 Dynasty 676, Good-night			
1:40:53			F/O	TPE CTL, Good evening, Dynasty 676, level 290.			
1:40:59			TPE CTL	Dynasty 676, TPE depart Shikang. HDG 360, vector to final approach			

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
				course.			
11:41:09			F/O	After Shikang HDG 340, Dynasty 676			
11:41:11			TPE CTL	Dynasty 676. Depart Shikang HDG 360.			
11:41:15			F/O	Depart Shikang, HDG 360, Dynasty 676			
11:41:42	Capt	Don't leave the switch here after contacting the ground. It may interfere your listening.					
11:41:49	Capt	You are using it....					
11:41:49	F/O	Yes.					
11:41:49	Capt	Switch off this side , because the volume may increase suddenly					
11:41:55					ATIS	F	
11:42:59					ATIS	G(Rwy 05L RVR 1300m downward)	
11:43:53	Capt	Downward...., Downward			ATIS	G	
11:44:19	Capt	It report again. We will change it .			ATIS	G	

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
		Golf. Remember, it's Golf.					
11:44:24	F/O	Golf.					
11:44:47					ATIS	G	
11:44:57	Capt	Descent.					
11:44:57	F/O	Sir, my side....					
11:45:04	Capt	Descent.					
11:45:05	F/O	Yes.					
11:45:08			F/O	TPE CTL, Dynasty 676 require descent			
11:45:12			TPE CTL	Dynasty 676 descent and maintain FL 250			
11:45:17			F/O	Descend FL 250, heading 360. Right now we are leaving.			
11:45:25	Capt	Check the gate.					
11:45:26	F/O	Yes.					
11:45:28	Capt	Wait a moment until you have time, and then take care.....					
11:45:33	F/O	Yes.					

16 February 1998 CI-676 B-1814
Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
11:45:59			F/O	Operation. Dynasty 676?			
11:46:02			TPE CTL	Dynasty 676, go ahead.			
11:46:12	Capt	This side!	Capt	Disregard, Dynasty 676.			
11:46:16					F/O	Operation Dynasty 676	
11:46:18					OPR	Dynasty 676, go ahead	
11:46:21					F/O	We expect to arrive at Taipei at twelve ten.	
11:46:23					OPR	O.K. 676, expect Taipei at 1210. Parking gate is 7, number 7. Confirm 1814 can perform CAT II approach?	
11:46:36	Capt	Yes, we do.					
11:46:38					F/O	Yes, we do.	
11:46:39					OPR	Currently visibility at Taipei is 600, 05 RVR 1300, 06 RVR is 1300.	
11:46:39	Capt	Copy!				Please use runway 05 for	

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Time UTC	CAM		VHF-1		VHF-2		Remark
						landing. Over.	
11:46:48					F/O	Roger, 05L runway for landing, parking 7.	
11:46:51					OPR	Good day, sir.	
11:46:53					ATIS	G	
11:46:56	Capt	Make plans as soon as possible. Don‘t leave this matter above there. Cut it off once you have listened. Don’t interfere your normal ...That‘s very important.					
11:47:09	F/O	Yes.					
11:47:10	Capt	Approach 250. Contact them immediately. Don‘t write these things. We keep on descending. We don’t want to stay here.					
11:47:20			F/O	TPE CTL, Dynasty 676 HDG 360, approaching level 250.			
11:47:27			TPE	Dynasty 676, descend			

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Time UTC	CAM		VHF-1		VHF-2		Remark
			CTL	maintain FL 210.			
11:47:32			F/O	Clear, descend FL 210, Dynasty 676			
11:47:36	Capt	This is the most important thing. You see, if we don't descent, the visibility will be getting worse. Go back soon, it's important. These things, these things...What are you doing?					
11:47:43	F/O	Yes.					
11:47:49	F/O	Key-in this data.					
11:47:52	Capt	Key-in, use this is OK, just write down there....We need to be back as soon as possible. Later on, maybe we won't be able to descend. It said 'Downward...' Don't waste too much time on these.					

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Time UTC	CAM		VHF-1		VHF-2		Remark
11:48:19	Capt	What is the QNH, This is the most important.					
11:48:20	F/O	Yes, 1014.					
11:48:23	Capt	1014, O.K. Just now we mentioned that QNH is 1014, using runway 05 left. Let‘s prepare for CAT II approach. Check the CAT II.					
11:48:41	Capt	Now we start listening and writing...We need to establish our aircraft status, when we reach 210. Later on we will hurry up again.					
11:48:47	F/O	Yes.	ATIS	G			
11:48:50	Capt	Look at that side, see there is the lightning quite strong.					
11:49:44			TPE CTL	Dynasty 676. Turn right HDG 010.			
11:49:48			F/O	Right head 010, Dynasty 676.			
11:49:49	Capt	Remember Golf. O.K. wait a					

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Time UTC	CAM		VHF-1		VHF-2		Remark
		moment.					
11:49:54	F/O	Yes.					
11:49:57			Capt	TPE CTL, Dynasty 676 approaching 210.			
11:50:00			TPE CTL	Expect lower after one five miles.			
11:50:04			Capt	676.			
11:51:13	F/O	ALT star					
11:51:14	Capt	O.K. Do you see how big energy is! That‘s terrible.					
11:51:30	Capt	ALT star, ALT star. These things ,report 21000.					
11:51:32	F/O	Yes.					
11:51:43	Capt	O.K. We have flown 10 miles.					
11:51:57			TPE CTL	Dynasty 676. Descend maintain FL 150			
11:52:01			F/O	Descend FL 150. Dynasty 676			
11:52:02	Capt	Level change					

Time UTC	CAM		VHF-1		VHF-2		Remark
11:52:03	F/O	Retard speed, heading select					
11:52:21	Capt	Auto thrust blue					
11:52:24	F/O	Auto thrust					
11:53:04			TPE CTL	Dynasty 676. Turn right HDG 020.			
11:53:07			F/O	Right head 020. Dynasty 676			
11:53:27	Capt	Approaching FL150, we should report 2000 feet to go, he hopes to let us keep descending.					
11:53:30	F/O	Yes.					
11:53:31	Capt	If we delay that we may have to change something.					
11:53:33	F/O	Yes.					
11:53:35			TPE CTL	Dynasty 676. Contact APP 125.1			
11:53:39			F/O	125.1, Dynasty 676. Good night.			

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Time UTC	CAM		VHF-1		VHF-2		Remark
11:53:56			F/O	TPE APP. Good evening. Dynasty 676 HDG 020. Approaching level 150 with Golf.			
11:54:04			APP	Dynasty 676, TPE APP. Descend and maintain 7000. TPE QNH 1014. Runway 5L.			
11:54:13			F/O	Descend 7000, 1014, runway 05L, Dynasty 676.			PA cabin announcement become softer and softer English announcement has been cut half way.
11:54:29	F/O	Fifteen thousand, APU					
11:54:42	F/O	APU on. Do we switch on ignition? Do we switch on ignition?					
11:54:52	Capt	O.K.					
11:54:52	F/O	Ignition ON					

Time UTC	CAM		VHF-1		VHF-2		Remark
11:54:53	Capt	O.K.					
11:55:31	F/O	Altimeter, 1014					
11:55:37			APP	Dynasty 676. Turn right heading 050.			
11:55:38			Capt	Roger, HDG 050, Dynasty 676.			
11:55:42			APP	Vector crossing LOC for spacing.			
11:55:47			Capt	Dynasty 676. Understand.			
11:56:23	Capt	APU available。					
11:56:23	Capt	This one is no more,					
11:56:23	F/O	No more.					
11:56:39	Capt	This one is pull out, so that is why we use APU to transfer...					
11:57:14	Capt	25.8，when we get to Kaoshiung fuel burn is eight thousand, four thousand eight, six thousand eight					

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Time UTC	CAM		VHF-1		VHF-2		Remark
		left. Seven plus eight makes fifteen, fifteen thousand.					
11:57:28	F/O	Yes.					
11:57:29	Capt	Fifteen thousand we will go.					
11:57:39	Capt	Approach check list please!					
11:57:40	F/O	Yes.					
11:57:43			APP	676, Descend and maintain 4000.			
11:57:53	F/O	ECAM status: Trim tank system fault......INOP. Clear!					
11:57:59	Capt	Clear!					
11:58:03	F/O	Altimeter, MDA					
11:58:05	Capt	Altimeter 1014, MDA set 173, SET					
11:58:08	F/O	1014,MDA 173 set right, V bugs.					
11:58:10	Capt	O.K. Place it 140, Green dot 223.					
11:58:12	F/O	140, 223, Ignition continue relight, Signs ON, Landing elevation 107,					

Time UTC	CAM		VHF-1		VHF-2		Remark
		Cabin ALT 780. Approach briefing					
11:58:26	Capt	Complete					
11:58:26	F/O	Shoulder harness					
11:58:27	Capt	Fasten					
11:58:28	F/O	Fasten right. APP check list complete.					
11:58:30	Capt	Thank you, complete.					
11:59:10			F/O	TPE APP Dynasty 676. HDG 050 Approaching 7000.	ATIS	G	
11:59:15			APP	Dynasty 676. Turn right HDG 090, intercept runway 05L LOC. Descend and maintain 4000.			
11:59:23			F/O	Flight HDG 090. Descend 4000. Intercept runway 09, 05 LOC,			

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Time UTC	CAM		VHF-1		VHF-2		Remark
				Dynasty 676.			
12:00:35	F/O	Only 16 miles to the runway, currently the altitude is 7000 feet					
12:00:41	Capt	Flap 15					
12:00:42	F/O	Speed check.					
12:01:06	F/O	Flap 15.					
12:01:22			APP	Dynasty 676. Now 16 miles from airport. Clear ILS runway 05L approach.			
12:01:26			F/O	Clear ILS runway 05L approach. Dynasty 676.			
12:01:45	Capt	LOC star.					
12:01:47	F/O	LOC star.					
12:01:54	F/O	Clear for ILS.					
12:02:05	Capt	O.K. Gears down					
12:02:06	F/O	Gear down.					
12::02:09	F/O	Gear down three green					
12:02:14	Capt	Check					

Time UTC	CAM		VHF-1		VHF-2		Remark
12:02:33			APP	Dynasty 676, Contact TWR 118.7			
12:02:36			F/O	TWR, 118.7, Dynasty 676.			
12:02:41			APP	Dynasty 6.....			
12:02:44			F/O	TPE TWR, Good evening, Dynasty 676, 9 miles on final, ILS runway 09Left approach			
12:02:52			TWR	Dynasty 676, TPE TWR RWY 05L, wind 360 at 5 ,QNH 1015, clear to land.			
12:02:58			F/O	1015, clear to land. Dynasty 676			
12:03:02	F/O	1015					
12:03:18	Capt	Still have 2 miles to go.					
12:03:20	F/O	Roger.					
12:03:31	Capt	Oh, we are high. Go down further,					

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Time UTC	CAM		VHF-1		VHF-2		Remark
		it doesn't matter.					
12:03:32	F/O	Yes.					
12:03:42	Capt	Are we clear?					
12:03:43	F/O	Clear , clear ILS					
12:03:44	Capt	Oh, it won't work. 2*3 is 6. O.K. two thousand. 2*6 12. It should work. No, It's not O.K.					
12:03:59	Capt	O.K. Flap 20					OM
12:04:00	F/O	Flap 20					OM
12:04:08	Capt	God, tail wind is too strong. Two miles. Do you report? Report again.					OM
12:04:16	F/O	Yes.					
12:04:18	Capt	Report, report to the control tower.					
12:04:20			F/O	TWR, Dynasty 676, 3 miles on final. Confirm clear to land.			
12:04:26			TWR	Clear to land. Wind 360 at 3.			

Time UTC	CAM		VHF-1		VHF-2		Remark
12:04:27			F/O	Roger. Clear to land. Dynasty 676.			
12:04:32	F/O	O.K. G/S blue. LOC green.					
12:04:41	Capt	It's 1000 feet higher.					
12:04:51	Capt	It's coming. 1000 feet.					
12:04:54	Capt	O.K. Thirty forty					
12:04:55	F/O	Thirty forty					
12:04:57		Sound of selectors					Ka, (slats/flap handle moving sound)
12:05:01	F/O	Landing gear.					
12:05:02	F/O	Three green.					
12:05:03	Capt	Anti-skid.					
12:05:03	F/O	Normal and……					
12:05:05	Capt	Slat flap					
12:05:05	F/O	Thirty forty					
12:05:06	Capt	Spoiler					
12:05:07		Cavalry charge					Da La , Da La , Da La A/P disconnect 1 second

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Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
12:05:08	F/O	Armed.					
12:05:09	Capt	Landing light					
12:05:10	F/O	On					
12:05:11		Triple click.					Da, Da, Da. (change of landing capability category)
12:05:12	Capt	O.K. Landing check list complete					
12:05:13	Capt	GO lever, Go around.					IM begins.
12:05:14	F/O	Go around, GO lever.					MM ends.
12:05:16		Triple click.					
12:05:18	Capt	Positive gears up.					
12:05:19	F/O	Gears down ?					
12:05:20	Capt	Gear up !					
12:05:20	F/O	Gear up.					
12:05:21		Sound of selector.					
12:05:22	F/O	Heading select plus.					
12:05:23	F/O	Plus ten.					
12:05:24		Sound of gear up.					Ka (selector noise)
12:05:24	Capt	Flaps.					IM ends

Cockpit Voice Recorder

Time UTC	CAM		VHF-1		VHF-2		Remark
12:05:24		Sound of selector.					
12:05:25		Continuous repetitive chime warning.					Don, Don, Don (Warning 5.5 sec.)
12:05:32		C-chord					Du (Alt alert 1.5 sec.)
12:05:32		Sound of selector.					
12:05:33		Whooler.					Wu Lu, Wu Lu…(2 sec.) (pitch trim movement)
12:05:34		Sound of selector.					
12:05:36		Cricket.					D-ling(stall warning 1.5 sec.)
12:05:37			F/O	TWR, Dynasty.			
12:05:38		C-chord.					Du…(alert 0.5 sec.)
12:05:40		Single chime					Don(single chime)
12:05:42	Capt	Aio					Don(single chime)
12:05:43		Single chime					Don(single chime)
12:05:44	Capt	Aio					Start of single chime.
12:05:45		C-chord.	TWR	Dynasty 676, confirm go around?			Du(altitude alert 1.5 sec)
12:05:47		C-chord.					Du(altitude alert 0.7 sec)

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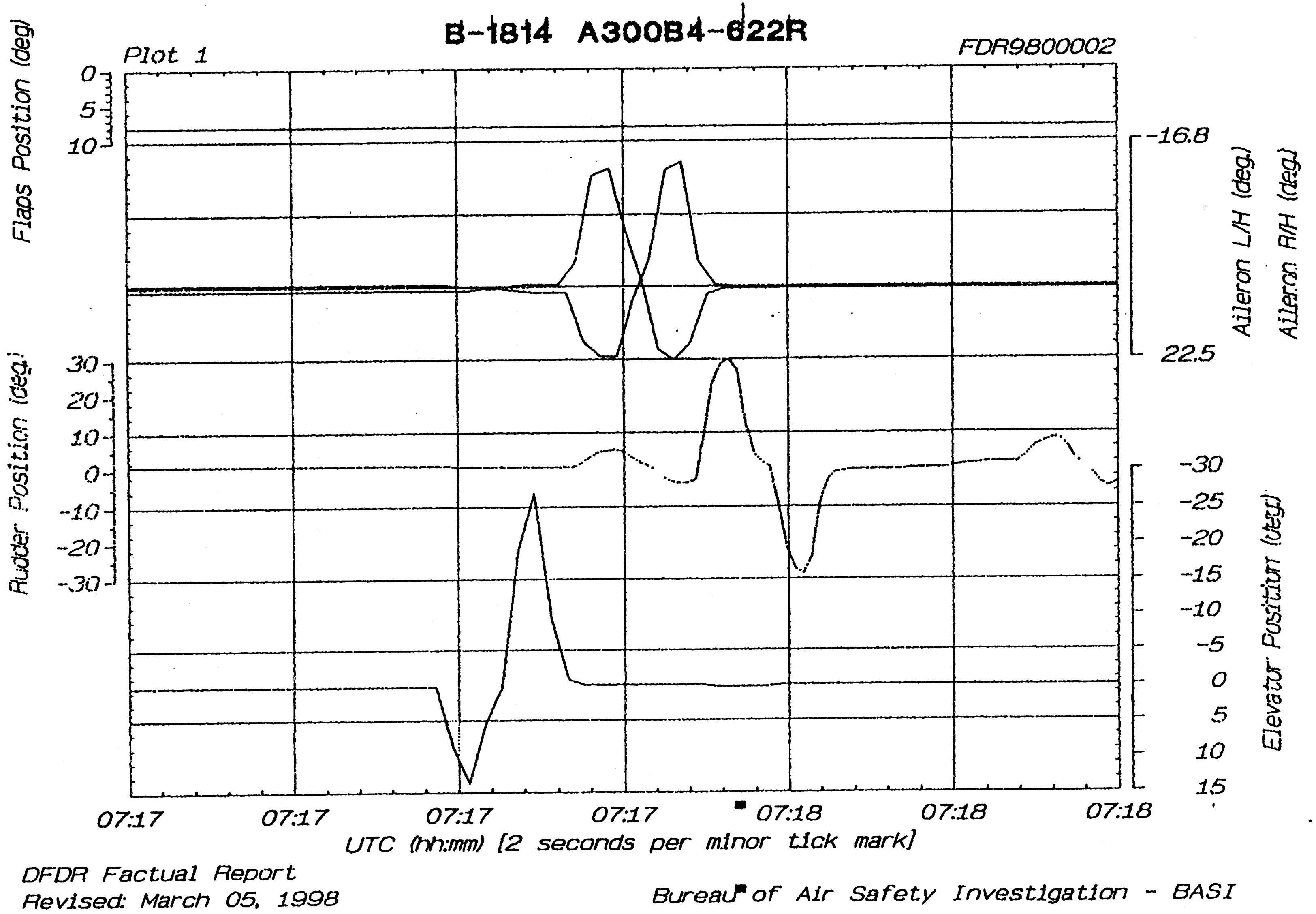
Time UTC	CAM		VHF-1		VHF-2		Remark
12:05:48		Cavalry charge.	F/O	Confirm go around.			A/P disconnect 0.3 sec.
12:05:49							GPWS: Ter..(Terrain)
12:05:50	F/O	Pull up, altitude low.					
12:05:51		Whoop, Whoop, Pull up.					
12:05:52		Cavalry charge.					Da La, Da La, Da La (A/P disconnect 1 sec.)
12:05:53		Whoop, Whoop, Pull up.					
12:05:56		Whoop, Whoop, Pull up.					
12:05:56		Cavalry charge.					Da La, (A/P disconnect 0.2 sec.)
12:05:57	End of Recording						

Appendix 5

DFDR Data Read Out


B-1814 A300B4-622R
Plot 1
FDR9800002
Flaps Position (deg)
0
5
10
Rudder Position (deg.)
30
20
10
0
-10
-20
-30
-16.8
22.5
Aileron L/H (deg.)
Aileron R/H (deg.)
-30
-25
-20
-15
-10
-5
0
5
10
15
Elevator Position (deg.)
07:17
07:17
07:17
07:17
07:18
07:18
07:18
UTC (hh:mm) [2 seconds per minor tick mark]
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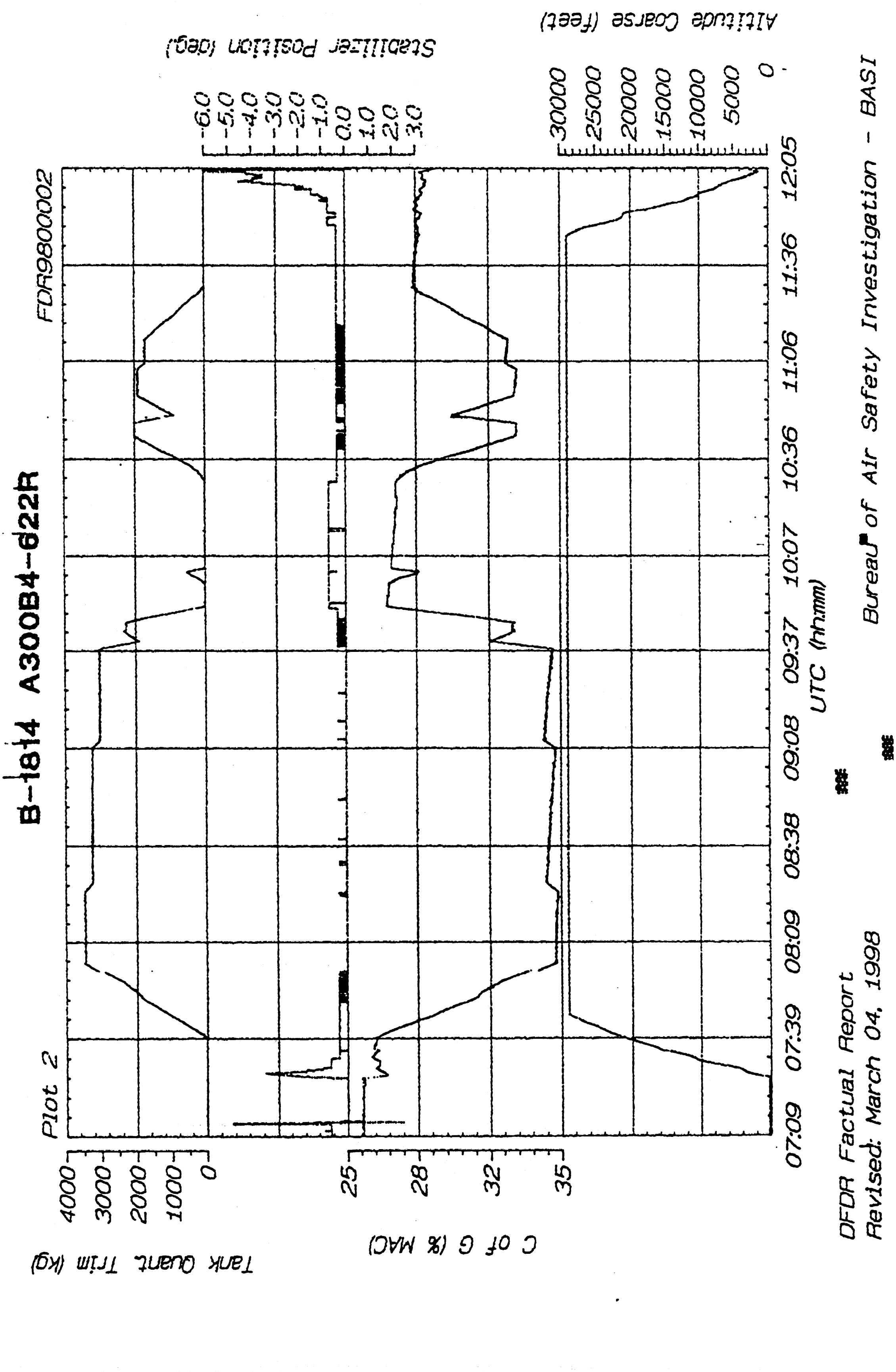
B-1814 A300B4-622R
Plot 2
FDR9800002
Tank Quant. Trim (kg)
4000
3000
2000
1000
0
C of G (% MAC)
25
28
32
35
Stabilizer Position (deg.)
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
Altitude Coarse (feet)
30000
25000
20000
15000
10000
5000
0
07:09
07:39
08:09
08:38
09:08
09:37
10:07
10:36
11:06
11:36
12:05
UTC (hh:mm)
DFDR Factual Report
Revised: March 04, 1998
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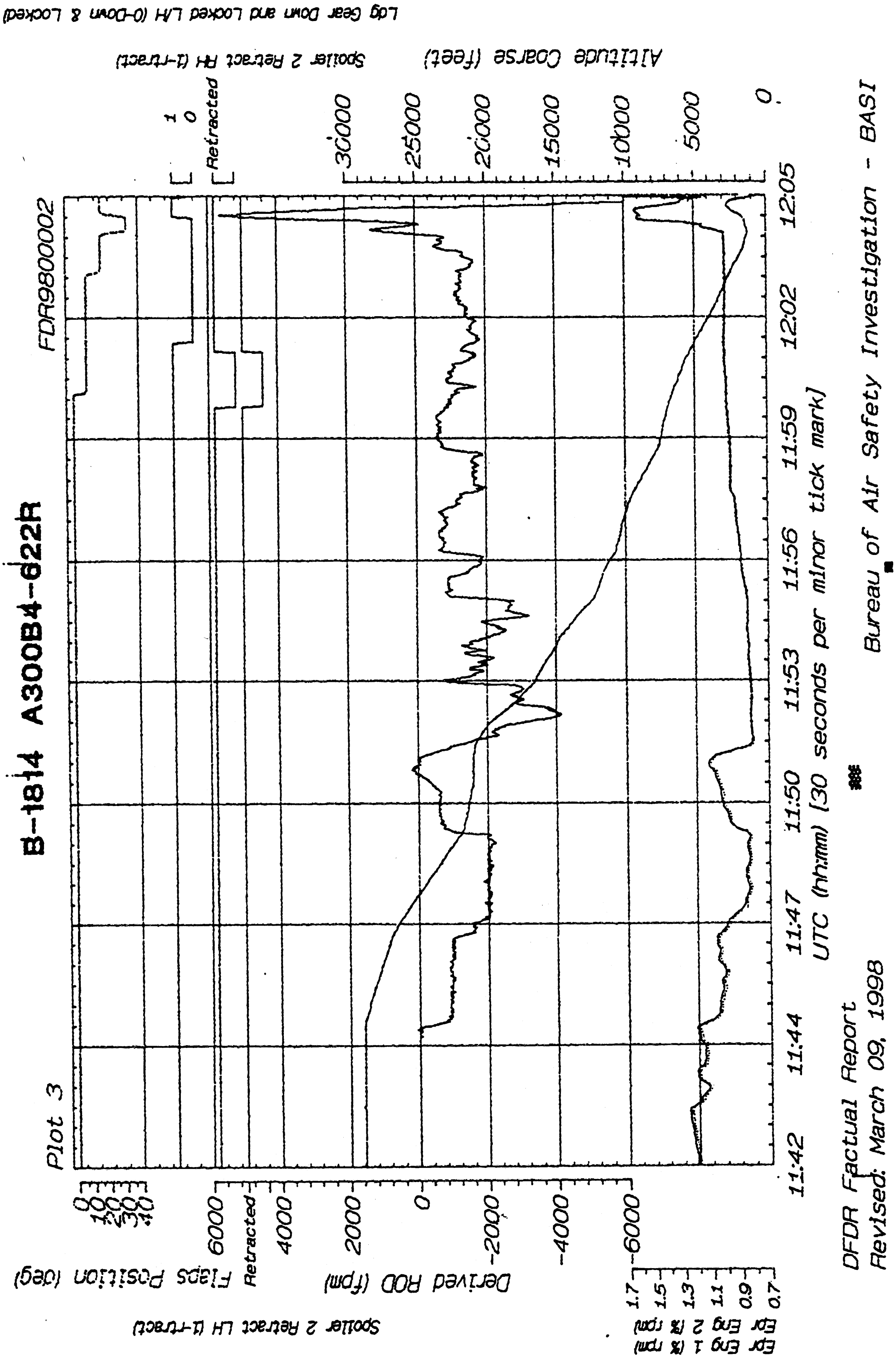
B-1814 A300B4-622R
Plot 3
FDR9800002
Ldg Gear Down and Locked L/H (0-Down & Locked)
Spoiler 2 Retract RH (1-rtract)
Altitude Coarse (feet)
1
0
Retracted
30000
25000
20000
15000
10000
5000
0.
Flaps Position (deg)
0
10
20
30
40
Spoiler 2 Retract LH (1-rtract)
Retracted
Derived ROD (fpm)
6000
4000
2000
0
-2000
-4000
-6000
Epr Eng 1 (% rpm)
Epr Eng 2 (% rpm)
1.7
1.5
1.3
1.1
0.9
0.7
11:42
11:44
11:47
11:50
11:53
11:56
11:59
12:02
12:05
UTC (hh:mm) [30 seconds per minor tick mark]
DFDR Factual Report
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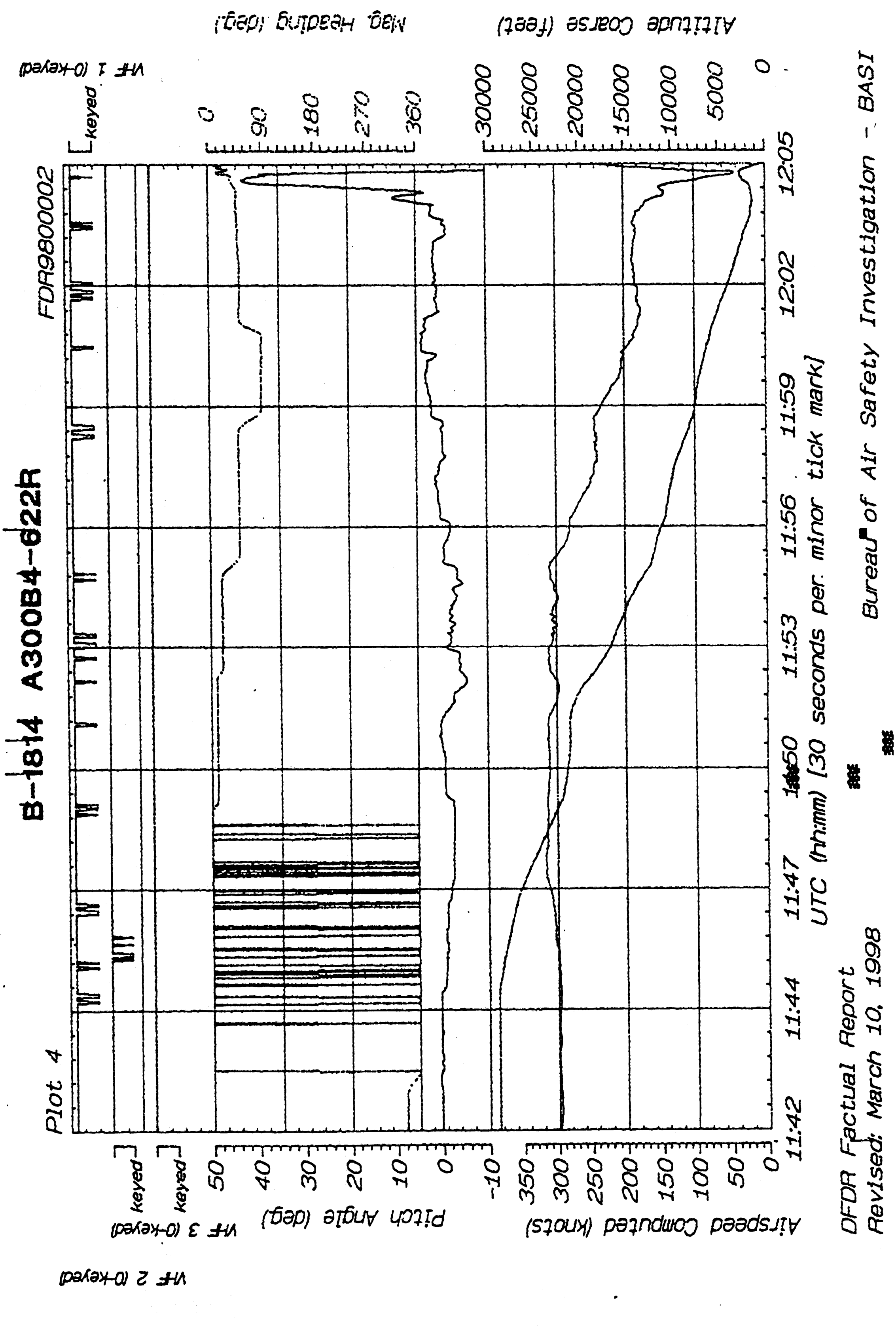
B-1814 A300B4-622R
FDR9800002
Plot 4
VHF 1 (0-keyed)
keyed
VHF 2 (0-keyed)
keyed
VHF 3 (0-keyed)
keyed
Mag. Heading (deg.)
0
90
180
270
360
Pitch Angle (deg.)
50
40
30
20
10
0
-10
Altitude Coarse (feet)
30000
25000
20000
15000
10000
5000
0
Airspeed Computed (knots)
350
300
250
200
150
100
50
0
11:42
11:44
11:47
11:50
11:53
11:56
11:59
12:02
12:05
UTC (hh:mm) [30 seconds per minor tick mark]
DFDR Factual Report
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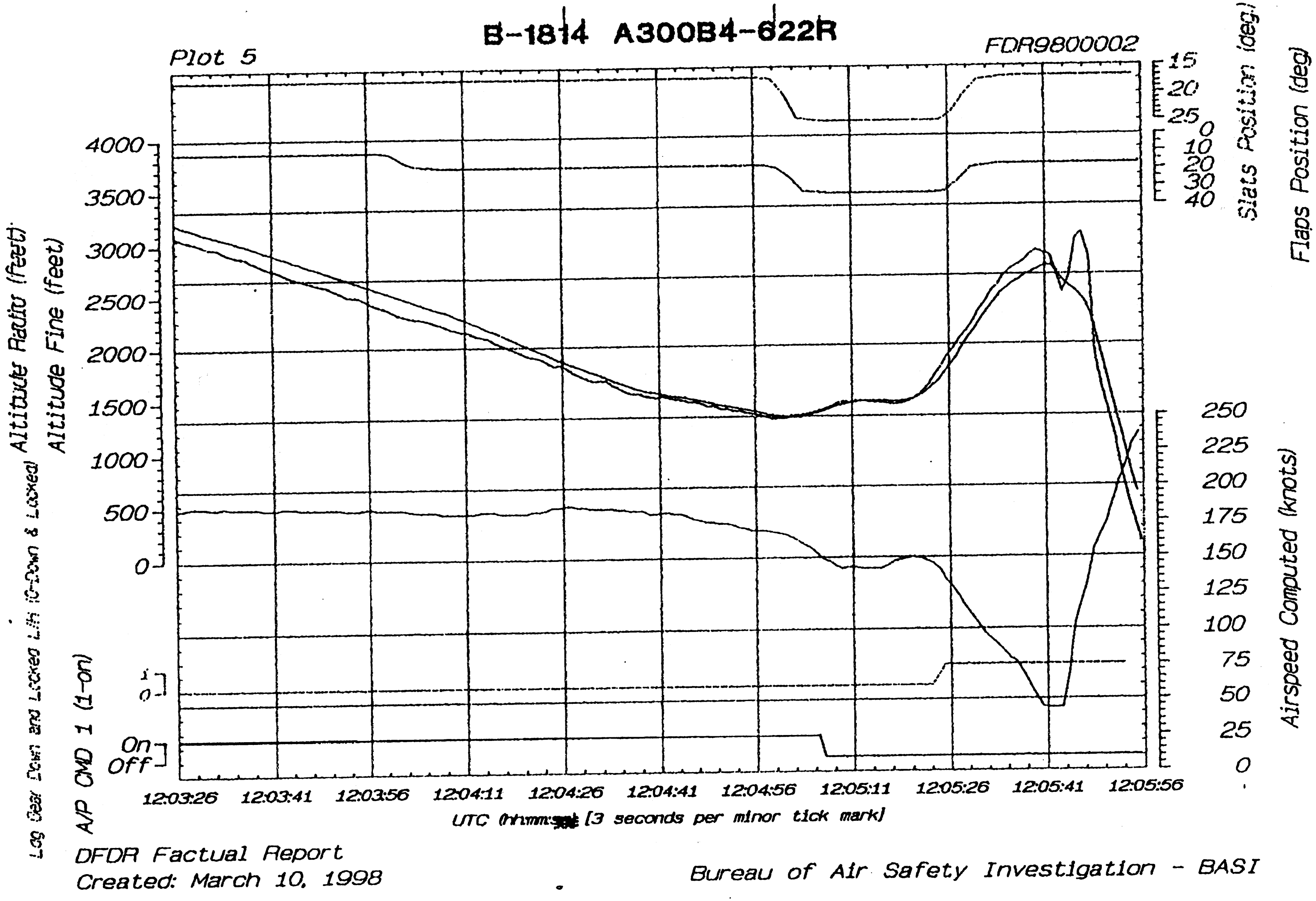
B-1814 A300B4-622R
Plot 5
FDR9800002
Altitude Radio (feet)
Altitude Fine (feet)
4000
3500
3000
2500
2000
1500
1000
500
0
Slats Position (deg)
15
20
25
Flaps Position (deg)
0
10
20
30
40
Airspeed Computed (knots)
250
225
200
175
150
125
100
75
50
25
0
Log Gear Down and Locked L/H (0-Down & Locked)
1
0
A/P CMD 1 (1-on)
On
Off
12:03:26
12:03:41
12:03:56
12:04:11
12:04:26
12:04:41
12:04:56
12:05:11
12:05:26
12:05:41
12:05:56
UTC (hh:mm:ss) [3 seconds per minor tick mark]
DFDR Factual Report
Created: March 10, 1998
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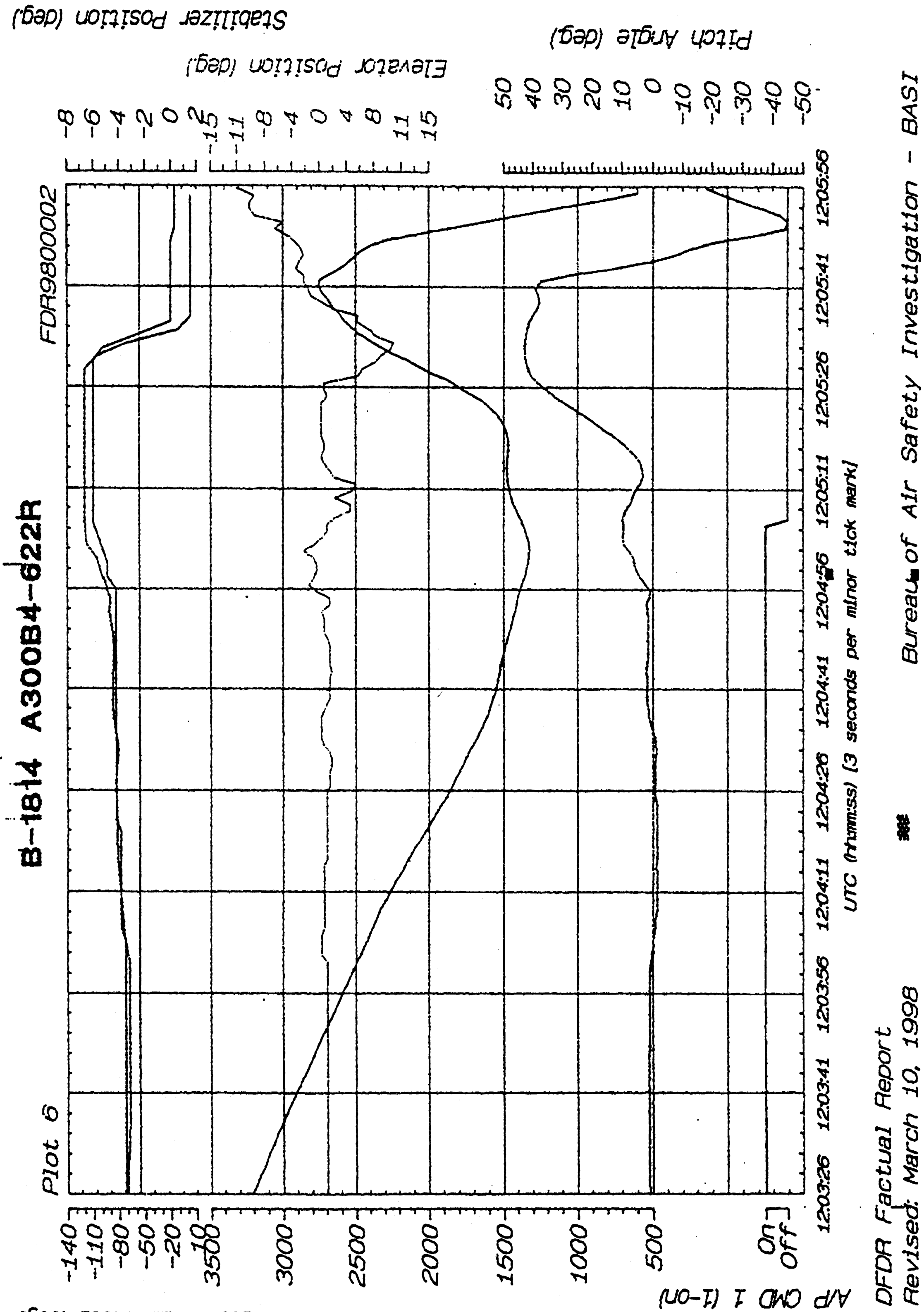
Plot 6
B-1814 A300B4-622R
FDR9800002
Stabilizer Position (deg.)
-8 -6 -4 -2 0 2
Elevator Position (deg.)
-15 -11 -8 -4 0 4 8 11 15
Pitch Angle (deg.)
50 40 30 20 10 0 -10 -20 -30 -40 -50
Pitch Trim Wheel (deg)
-140 -110 -80 -50 -20 10
Altitude Fine (feet)
3500 3000 2500 2000 1500 1000 500
A/P CMD 1 (1-on)
On
Off
12:03:26 12:03:41 12:03:56 12:04:11 12:04:26 12:04:41 12:04:56 12:05:11 12:05:26 12:05:41 12:05:56
UTC (hh:mm:ss) [3 seconds per minor tick mark]
DFDR Factual Report
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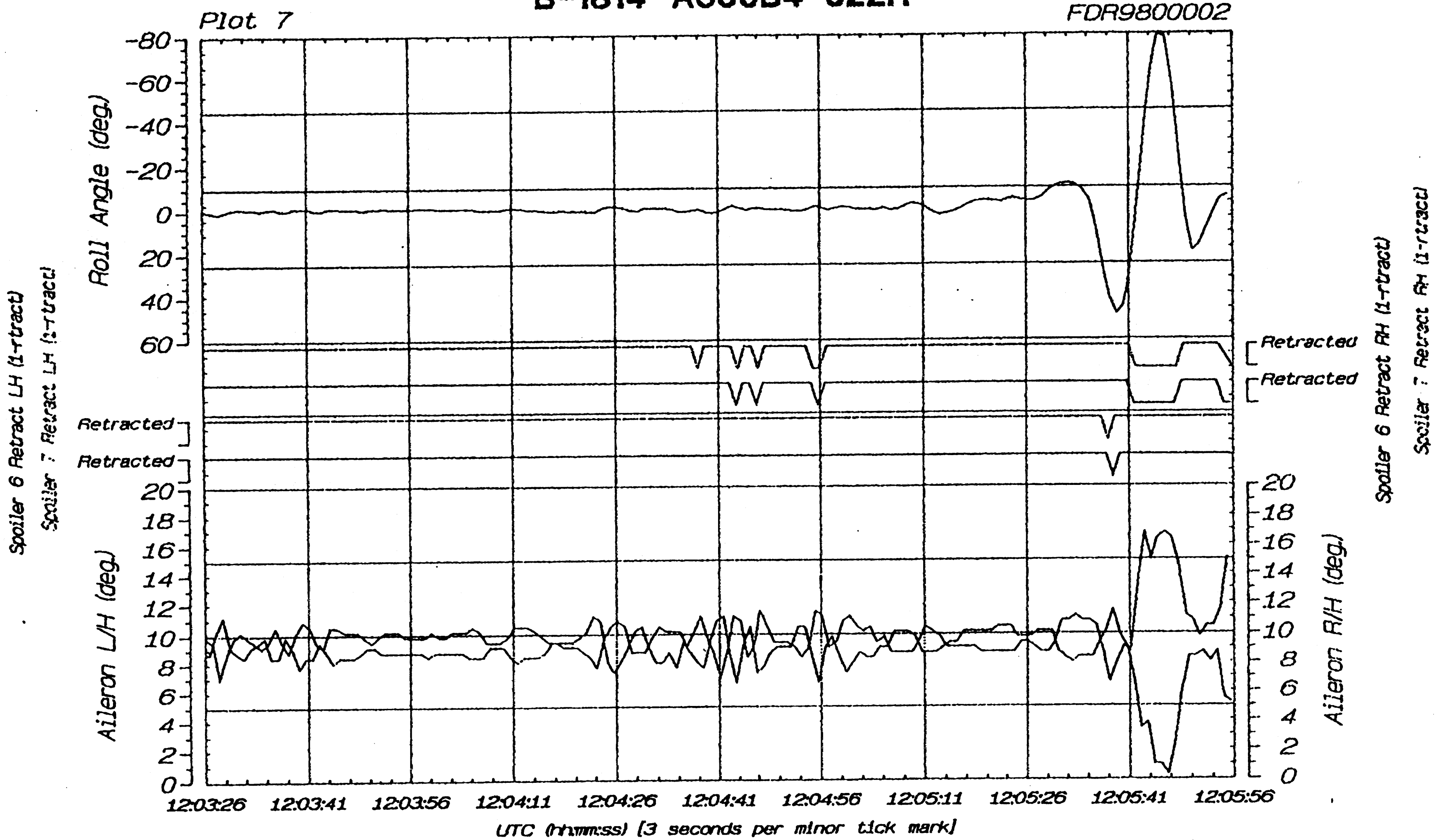
B-1814 A300B4-622R



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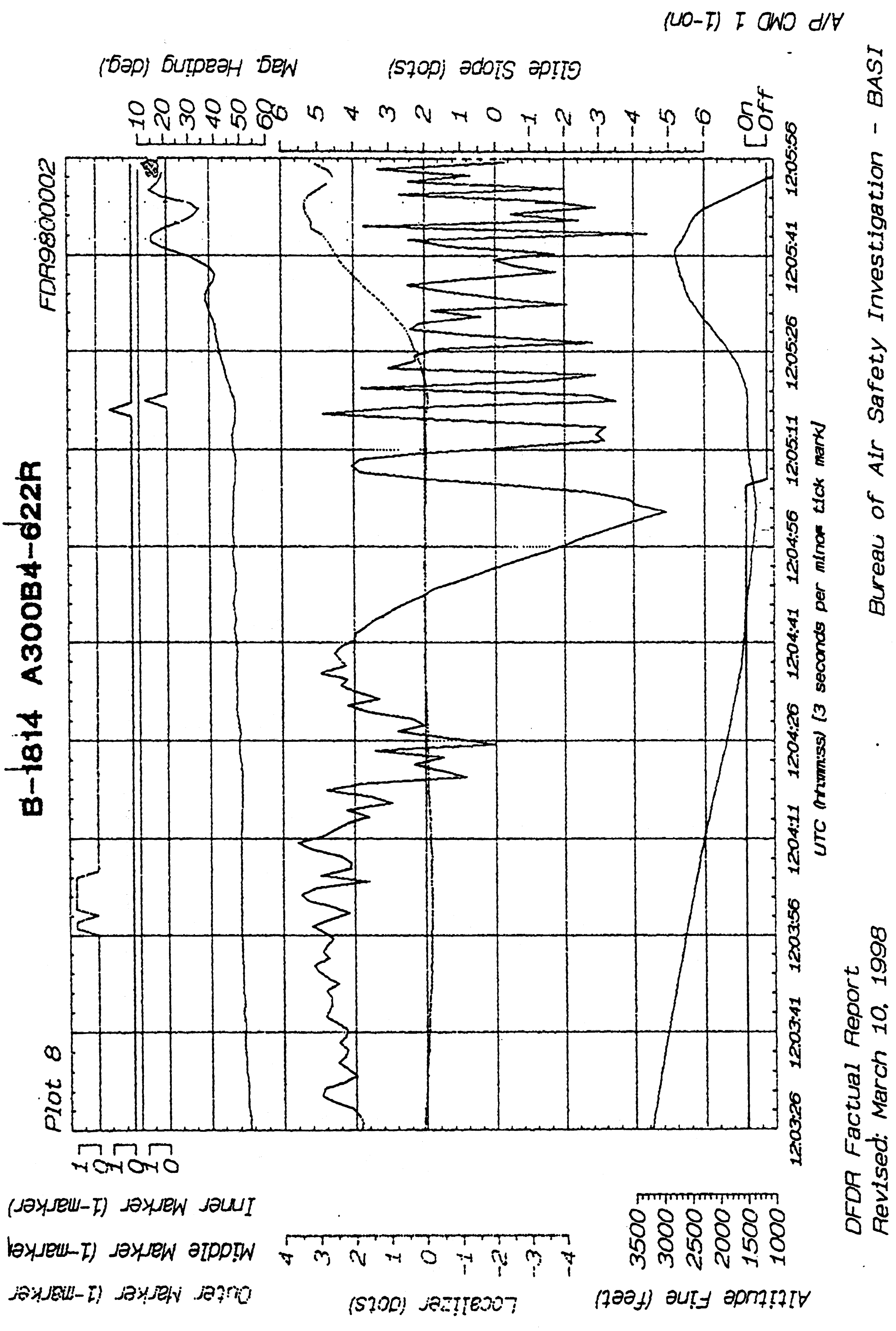
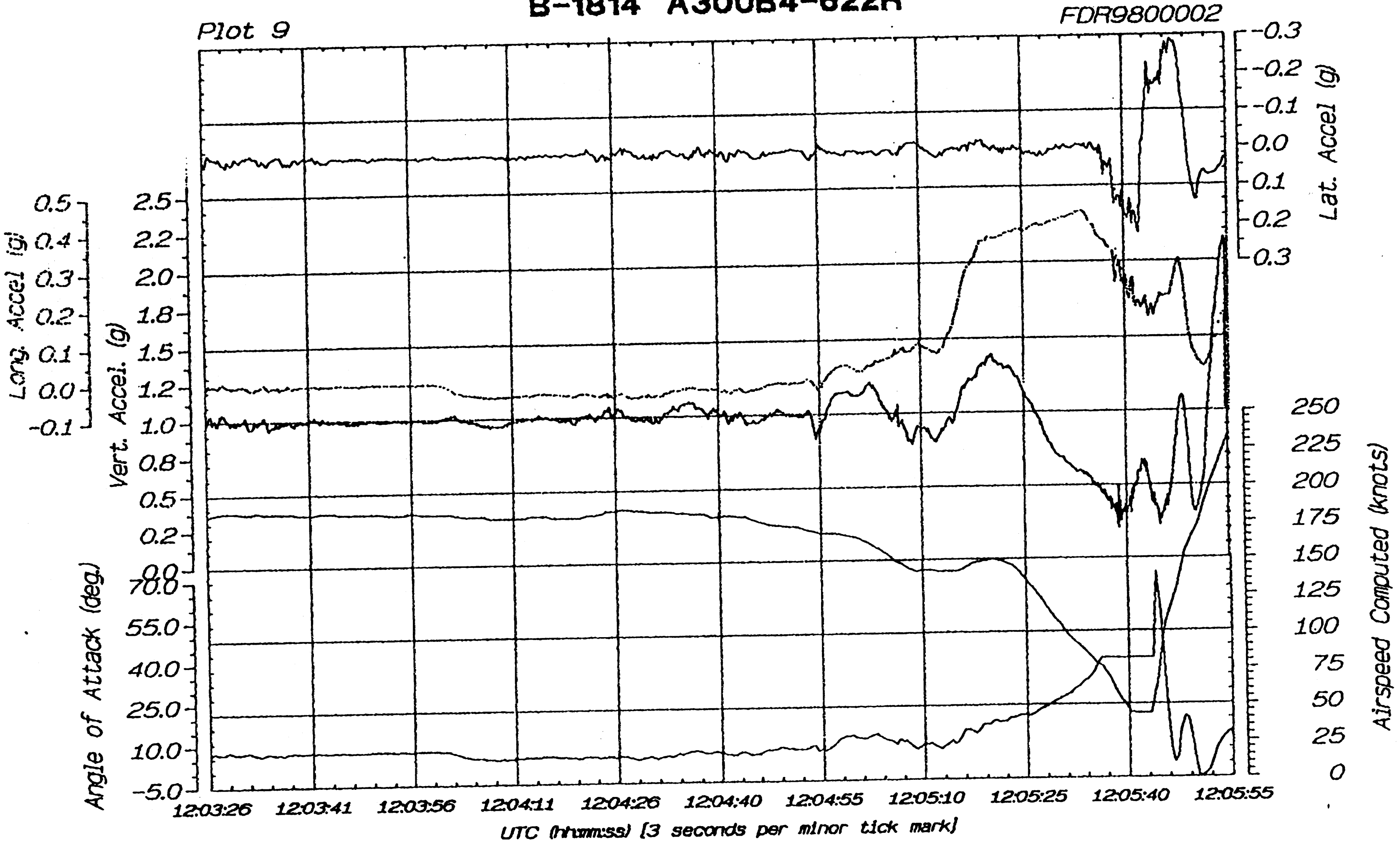

B-1814 A300B4-622R
Plot 8
FDR9800002
Mag. Heading (deg.)
10
20
30
40
50
60
Glide Slope (dots)
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
A/P CMD 1 (1-on)
On
Off
Inner Marker (1-marker)
Middle Marker (1-marker)
Outer Marker (1-marker)
1
0
1
0
1
0
Localizer (dots)
4
3
2
1
0
-1
-2
-3
-4
Altitude Fine (feet)
3500
3000
2500
2000
1500
1000
12:03:26
12:03:41
12:03:56
12:04:11
12:04:26
12:04:41
12:04:56
12:05:11
12:05:26
12:05:41
12:05:56
UTC (hh:mm:ss) [3 seconds per minor tick mark]
DFDR Factual Report
Revised: March 10, 1998
Bureau of Air Safety Investigation - BASI

B-1814 A300B4-622R



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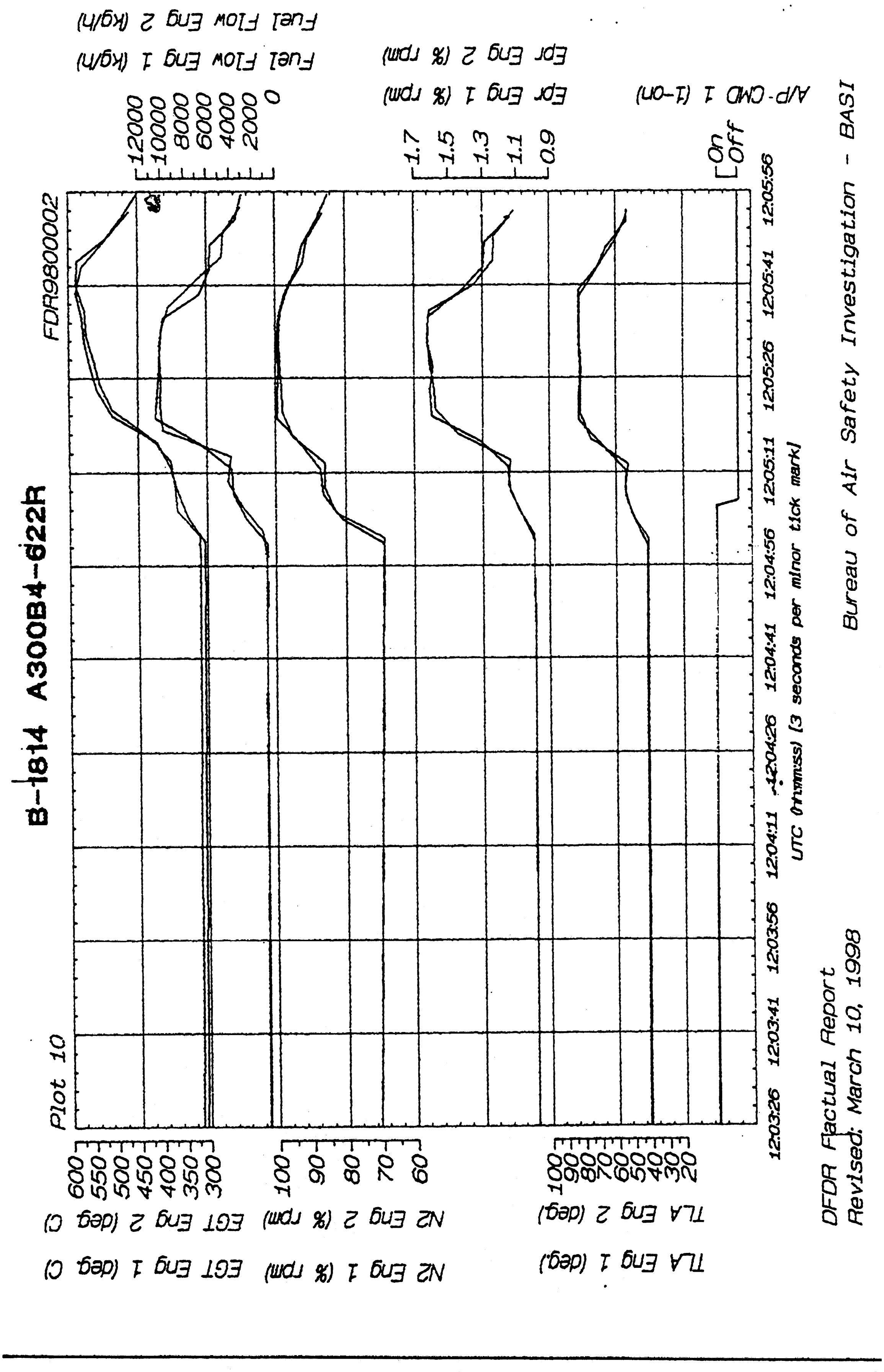
B-1814 A300B4-622R
Plot 10
FDR9800002
EGT Eng 1 (deg. C)
EGT Eng 2 (deg. C)
600
550
500
450
400
350
300
N2 Eng 1 (% rpm)
N2 Eng 2 (% rpm)
100
90
80
70
60
TLA Eng 1 (deg.)
TLA Eng 2 (deg.)
100
90
80
70
60
50
40
30
20
Fuel Flow Eng 1 (kg/h)
Fuel Flow Eng 2 (kg/h)
12000
10000
8000
6000
4000
2000
0
Epr Eng 1 (% rpm)
Epr Eng 2 (% rpm)
1.7
1.5
1.3
1.1
0.9
A/P-CMD 1 (1-on)
On
Off
12:03:26
12:03:41
12:03:56
12:04:11
12:04:26
12:04:41
12:04:56
12:05:11
12:05:26
12:05:41
12:05:56
UTC (hh:mm:ss) [3 seconds per minor tick mark]
DFDR Factual Report
Revised: March 10, 1998
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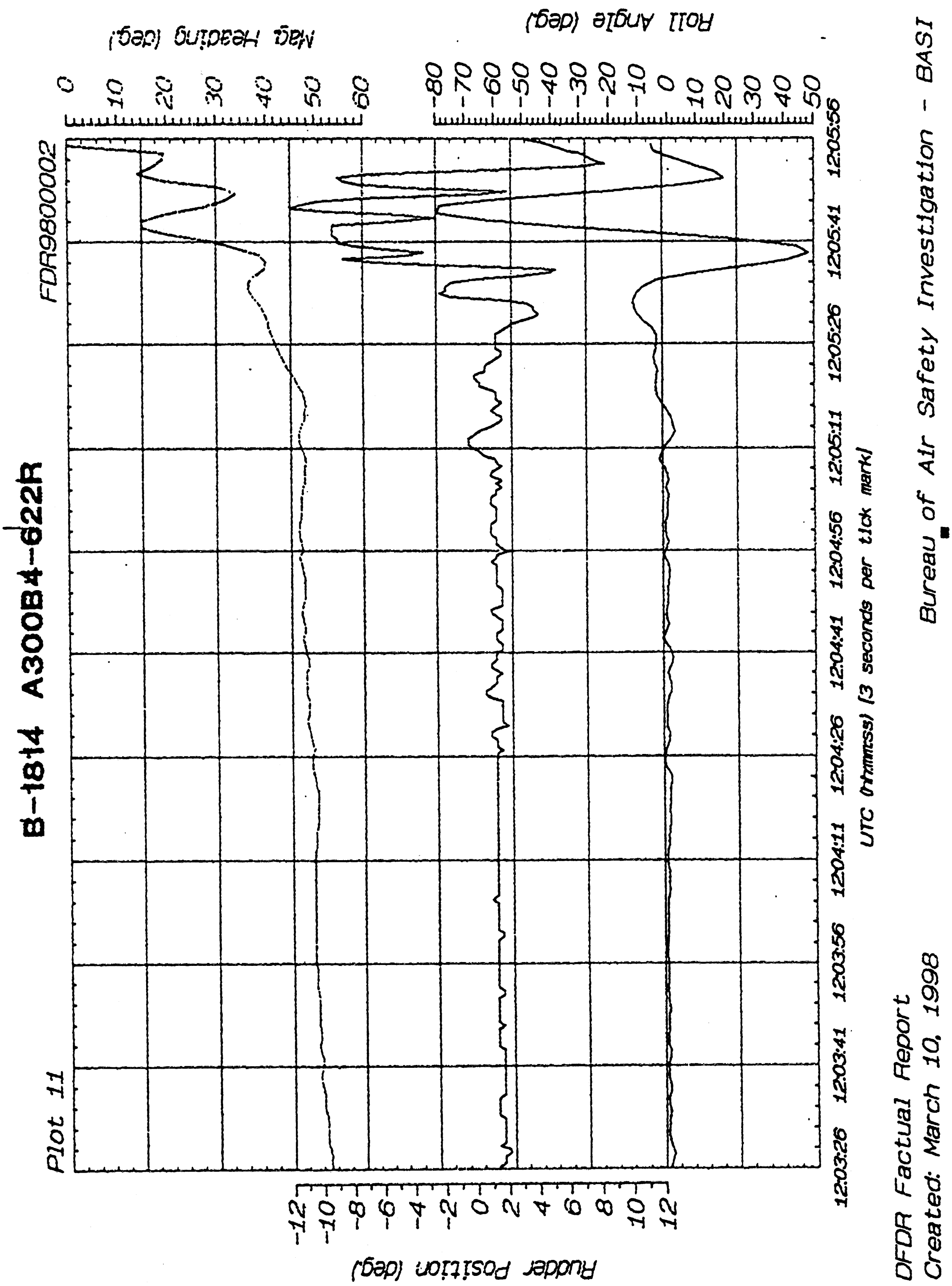
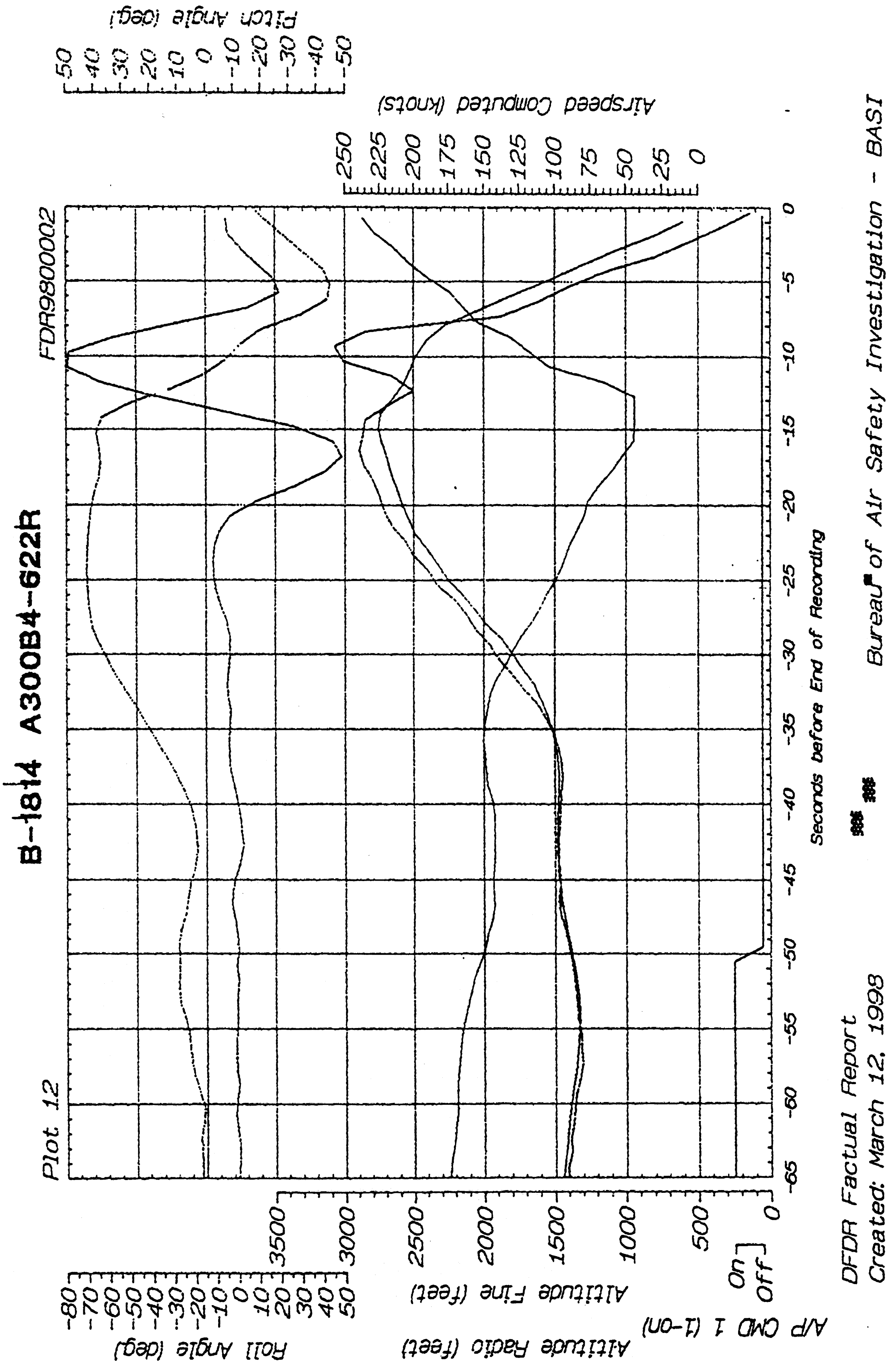
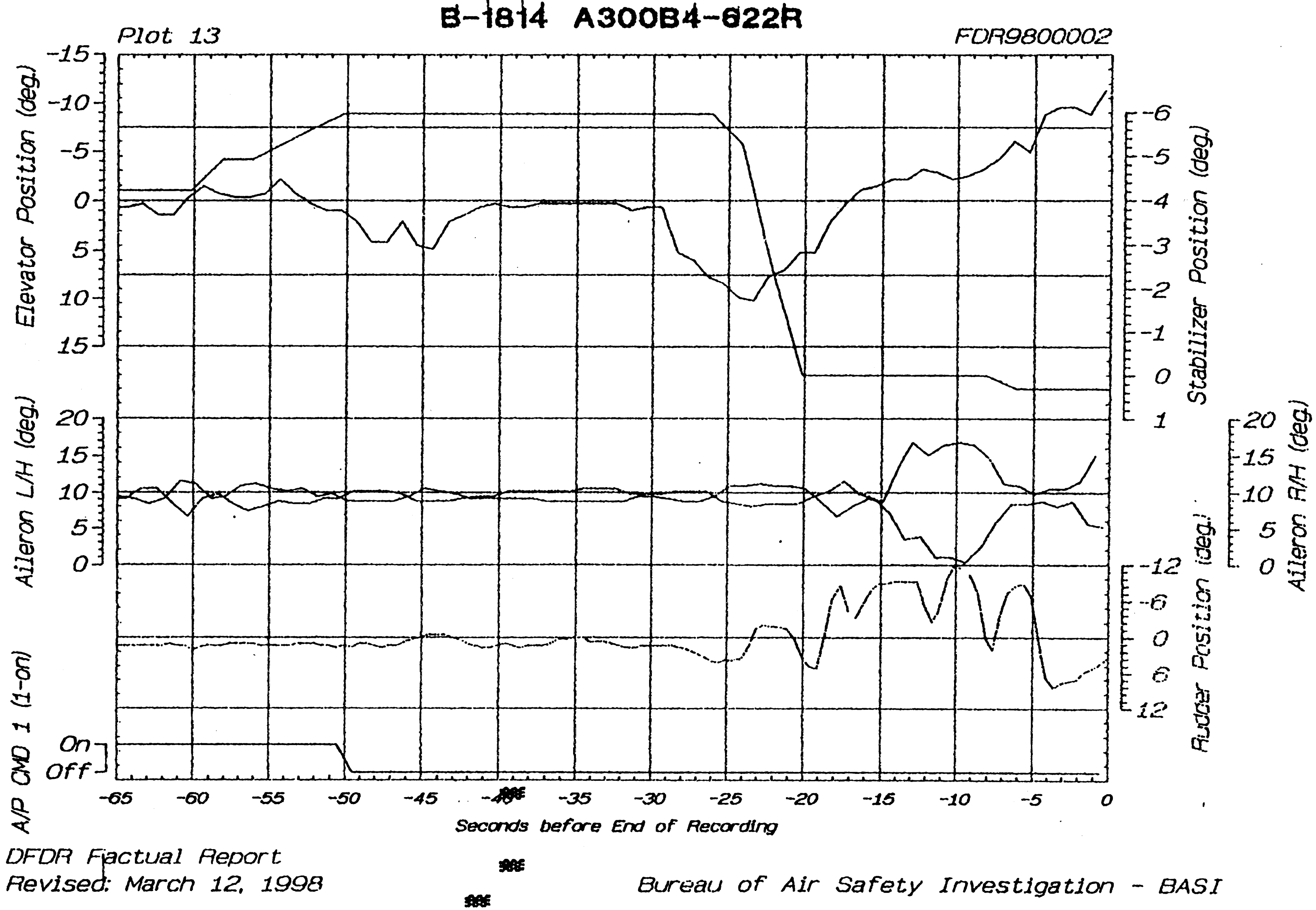

Plot 11
B-1814 A300B4-622R
FDR9800002
Mag. Heading (deg.)
0
10
20
30
40
50
60
Roll Angle (deg)
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
Rudder Position (deg)
-12
-10
-8
-6
-4
-2
0
2
4
6
8
10
12
12:03:26
12:03:41
12:03:56
12:04:11
12:04:26
12:04:41
12:04:56
12:05:11
12:05:26
12:05:41
12:05:56
UTC (hh:mm:ss) (3 seconds per tick mark)
DFDR Factual Report
Created: March 10, 1998
Bureau of Air Safety Investigation - BASI


B-1814 A300B4-622R
Plot 12
FDR9800002
Pitch Angle (deg)
50 40 30 20 10 0 -10 -20 -30 -40 -50
Airspeed Computed (knots)
250 225 200 175 150 125 100 75 50 25 0
Roll Angle (deg)
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50
Altitude Fine (feet)
Altitude Radio (feet)
3500 3000 2500 2000 1500 1000 500 0
A/P CMD 1 (1-on)
On
Off
-65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0
Seconds before End of Recording
DFDR Factual Report
Created: March 12, 1998
Bureau of Air Safety Investigation - BASI


B-1814 A300B4-622R
Plot 13
FDR9800002
Elevator Position (deg.)
-15
-10
-5
0
5
10
15
Stabilizer Position (deg.)
-6
-5
-4
-3
-2
-1
0
1
Aileron L/H (deg.)
20
15
10
5
0
Aileron R/H (deg.)
20
15
10
5
0
Rudder Position (deg.)
-12
-6
0
6
12
A/P CMD 1 (1-on)
On
Off
-65
-60
-55
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
Seconds before End of Recording
DFDR Factual Report
Revised: March 12, 1998
Bureau of Air Safety Investigation - BASI

Appendix 6

DFDR Data for last seconds

MINISTERE DE L'EQUIPEMENT, DES TRANSPORTS ET DU LOGEMENT

INSPECTION GENERALE DE L'AVIATION CIVILE
ET DE LA METEOROLOGIE

BUREAU ENQUÊTES-ACCIDENTS

Le Bourget, le 15/05/1998

RECOVERY WITH GARNET MICROSCOPE OF THE LAST SECONDS FROM THE FLIGHT DATA RECORDER TAPE OF THE A300 REGISTERED B1814

FINAL REPORT

Le Bourget, France, May 1998

Bâtiment 153 - Aéroport du Bourget - 93352 LE BOURGET Cedex
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I. UFDR RECORDING FUNCTIONAL DESCRIPTION

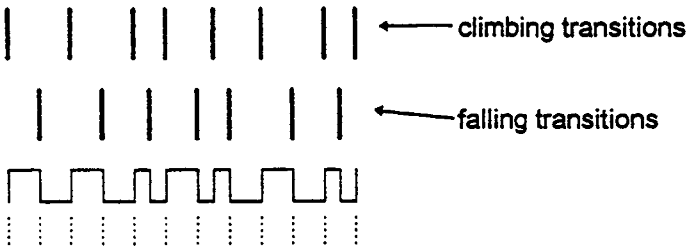
The Flight Data Recorder which fitted the A300 B-1814 was a Sundstrand Universal Flight Data Recorder (UFDR). This tape recorder has a specific functioning mode which it is important to know before any operation with the garnet microscope.

The flight data parameters are recorded on a 8 track magnetic tape sequentially (4 forwards and 4 backwards) for a total capacity of 25 hours.

The UFDR uses 4 heads with 4 tracks each : a backward read/write head, a forward erase head, a backward erase head, and a forward read / write head. (See APPENDIX 1)

The UFDR receives the digitized parameters from the Flight Data Acquisition Unit (FDAU) in Arinc 573 continuous Harvard Biphase format (at a rate of 768 bit/s). However, the recorder does not write the data on the tape continuously but by blocks separated by short inter-record gaps (IRG).

The continuous input data is converted to NRZ format and stored in a buffer of 768 bits. When this first buffer is full, preamble and postamble are added, and the resulting 784 bits are then re-converted to bi-phase signal and recorded on the tape



The garnet microscope recovery method consists of decoding the signal from the images of the transition.

The first step is to make images. As mentioned in part I, data is recorded in blocks of 768 bits (=12*64) plus a preamble and a postamble of about 2*8 bits. Between two blocks there is a long section without any magnetic transition, called the inter-record gap (IRG).

The first image is made just after a gap. Then the tape is moved slightly to the left, and the next image is taken. In order to enable the link between two following images, image number n+1 starts just before the end of picture number n. After 15 to 18 images the new gap appears. A new set of images can be made just after this new gap.

As the data stream between two gaps is about 1 cm length, one image shows about 1/15 of centimeter of the tape.

Once all the images of the area of the tape that needs to be studied have been made, these images are numerized and stored in computers.

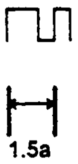
The software then determines the distance between two consecutive transitions. According to what these transitions represent, only three values should be found for such distances : a, 1.5a and 2a.

Let's suppose that we are looking for climbing transition. If the bit value is 1, the signal is :

and the image of the transitions will show :

Let's call "a" the distance between these two transitions. "a" is also the length of one cell.

If the bit value is zero and then one, the signal is :



and the image of the transitions will show :

at a rate of approximately 11200 bit/s. A second buffer alternates with the first one to receive the input data continuously.

As the input data is not interpreted, it is very unlikely that the first bit stored in the current buffer corresponds to the beginning of a subframe, so that each subframe may be recorded on two different blocks.

During this writing phase, the tape velocity is 5 inch / s, which results in a record length of approximately 0.36 inch.

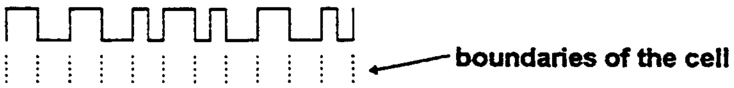
To reduce the length of inter-record gaps, the tape motion is not continuous but consists of a cycle repeated every second (see APPENDIX 1) :

-initial position of the read/write head on the tape: (about 0.23 inch) before the beginning of the previous record. Tape speed is zero.
-sequence 1: tape acceleration to 5 inch / s
-sequence 2: tape speed stabilization during which the head can read the previous record to check that the number of bi-phase transitions written is the same as in the received data.
-sequence 3: inter-record gap (0.06 inch).
-sequence 4: head in write mode, recording the 784 bits of the current buffer on the tape. (record length is 0.354 inch)
-sequence 5: tape deceleration
-sequence 6: tape travel back to initial position + 0.414 inch , so that next data block will be written 0.06 inch after this data block.

II. GARNET RECOVERY THEORETICAL DESCRIPTION

On the Sundstrand UFDR data is coded using Harvard Biphase format. The signal consist of cells of equal length. Each cell corresponds to one bit and ends with a magnetic transition. If there is another transition inside the cell, the value of the bit is 1. If not, the value is 0.

Example of Harvard Biphase Signal :



This example corresponds to the value : 0 0 0 0 1 0 1 0 0 0 1. (no transition in the first cell : 0, no transition in the second cell :0, no transition in the third cell : 0, no transition in the fourth cell : 0, transition in the fifth cell :1...).

The garnet crystal characteristically enables the visualization of the magnetic transition of the recorded signal.

According to the focus of the microscope the operator can either see the climbing transitions or the falling transitions :

The distance between two transitions is « a » (one cell) plus 0.5a (half-cell length).

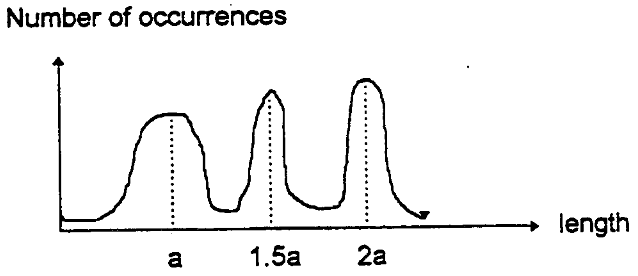
And if the bit value is two consecutive zeros, the signal will be :

and the image of the transitions will show :

The distance between two transitions is 2a because that is the length of two cells.

So, despite the fact that there are only two values (0 and 1), you can observe three different values for the distance between two following transitions.

Practically, the software measures each distance and translates it onto a graph where the abscise is the length and the y-axis shows the number of occurrences. This graph should show graphic peaks :



The software can then attribute the theoretical value to each value (a, 1.5a or 2a) to which it is the closest.

At the end, the software transforms the list of the consecutive distances (a, 1.5a or 2a) into a list of bit values (0 or 1) following to the method described above.

Sometimes if the measured distance is just between two peacks, it may happen that the software reads an « a » as an 1.5a, or an 1.5a as a 2a. This is why at the end of the process the operator has to check all the results given by the computers manually, and to change the value of the bits if it appears that the software was wrong in reading some values.

When the file of 0's and 1's is obtained, one must delete the preamble (the first 7 or 6 zeros followed by one 1) and the postamble (the last 6 or 7 zeros preceded by one 1). After that, one must, at the end of this file, paste on the file obtained by the decoding of the next block (between the gap where the process stopped and the next one).

One obtains a file of three or four seconds of recording, which makes about 2500 bits. The sync words have to be searched, and one must verify that between two consecutive sync words you have 768 bits. If not, the data between these two sync words will probably be wrong.

One must remember that the recording after a gap and a preamble does not begin with a sync word. This sync word can be anywhere in the data stream. The only condition is that between two sync words there are 768 bits.

Once the sync words have been found, and after having checked that they are separated by 768 bits, one must transform the file (which is a text file) into a hexadecimal file, which means transforming from ASCII to raw data.

After that, the raw data can be used as normal.

III. SEQUENCE OF OPERATIONS

All the following operations took place at the BEA technical facilities in Le Bourget. M. MA, Li-Sheng was the Taiwanese representative and the operations, under his control were performed by:

Jérôme BASTIANELLI	:	Head of BEA Engineering Department.
Franck GIRAUD	:	Flight Data Recorder Specialist.
Jean-Claude VITAL	:	Flight Data Recorded Specialist.

M. De Villeneuve, French Accredited Representative, followed the operations.

The garnet data recovery of the last seconds of the Taipeh accident required 6 main operations:

1. Direct replay of the original tape,
2. Physical location on the tape of the data to be retrieved,
3. Videoing of the data with the garnet microscope,
4. Automatic computer decoding of the data,
5. Manual checking and validation of the computer results,
6. Final editing and data presentation.

The first three operations took place between the 14th and the 17th of May (Period of M. MA, Li-Sheng presence at the BEA facilities). Each of the six operations is described in detail below.

III.1. Direct replay of the original tape

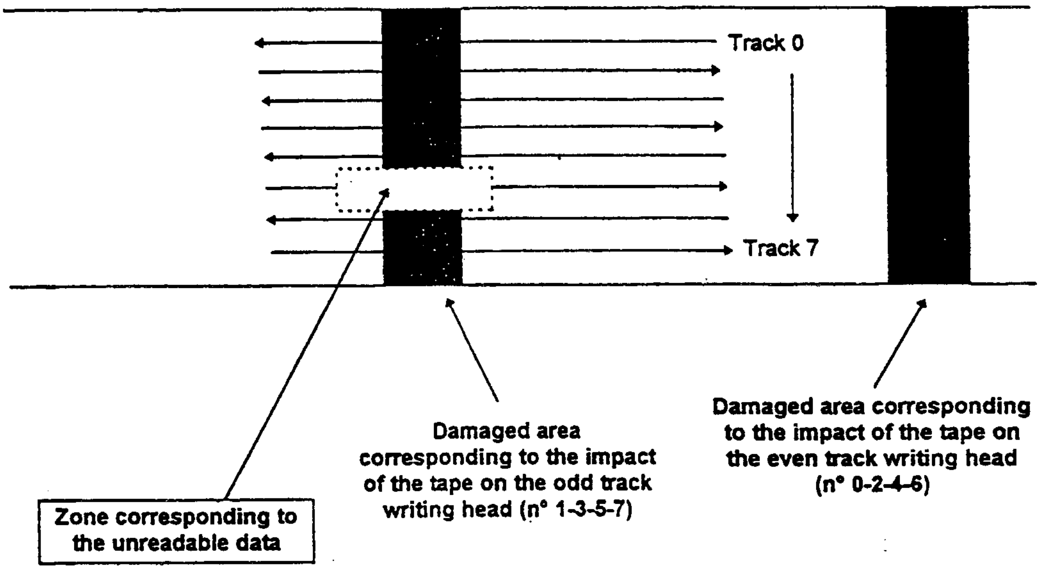
In order to locate the part of the tape that had to be analyzed, a direct replay of the tape was made on the UFDR Copy Recorder (See APPENDIX 2). The replay showed that the event was recorded on <u>track 5</u>.(8 tracks in total from n°0 to n°7).

The analysis of this replay gave, as expected, the same data as the first BASI read-out (Bureau of Air Safety Investigation, Australia).

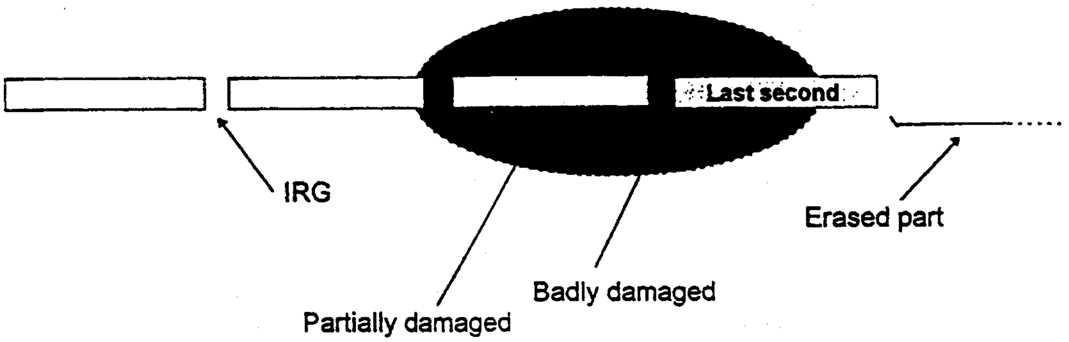
This confirmed that the part of the tape damaged due to the impact was unreadable using the UFDR Copy Recorder and seemed to cover between one and two seconds of data (taking into account the lengh of damaged tape).

III.2. Physical location on the tape of the data to be retrieved

Due to the UFDR data structure on the tape(direction of reading/writing on each track), the part of the tape that had to be analyzed was found as shown in the following diagram:



The UFDR writes blocks of 784 bits of data (corresponding to 1 second). Each block is separated by an IRG (Inter Record Gap). The last second written on the tape is followed by a blank area corresponding to the erasure of the track by the erasure head of the recorder. In consequence, the following diagram shows the structure of the zone to be examined:



In order to completely retrieve the last seconds, and to be able to correlate with the direct playback file, it was decided that the last three seconds corresponding to the last three blocks should be analyzed first, and other previous seconds if necessary, at a later stage.

III.3. Videoing of the data with the microscope

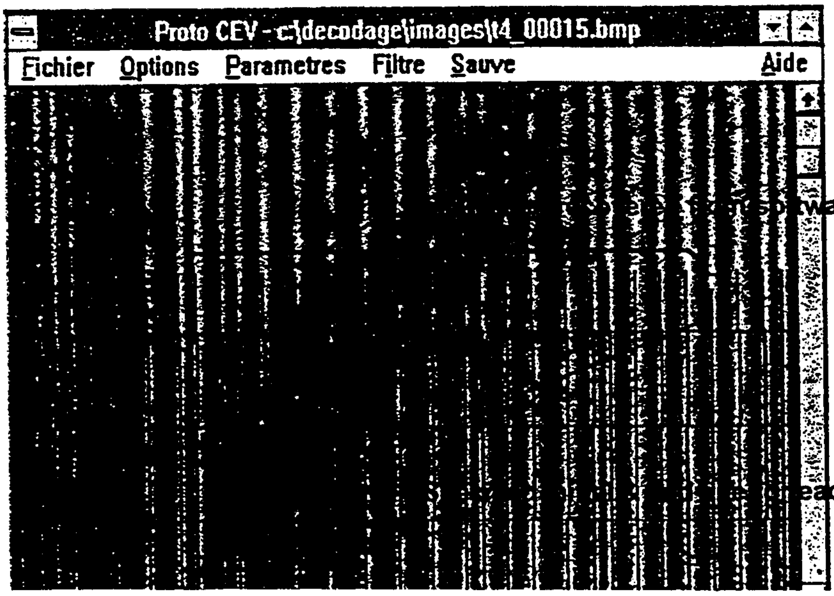
The next step is, for the area selected (i.e. the three last blocks), to make a set of pictures on the microscope, in order to reconstruct the 3 blocks. APPENDIX 2 shows the microscope and the camera: the garnet and the miscroscope reveal the magnetic transitions on the tape, the camera transfers the image to the computer to digitize it.

APPENDIX 3 gives the three series of pictures allowing us to reconstruct the sequence of data. These pictures show the « climbing transitions » as explained in the previous chapter. Each picture corresponds to about 1/15 of a second, and the damaged areas are visible on these pictures, showing the status of degradation of the signal.

III.4. Automatic computer decoding of the data

Once the series of pictures have been taken, the decoding itself can begin. For each picture the software finds the transitions in different parts of the picture (red lines on the next figure), and makes an average to obtain the final green lines.

Since the quality of the picture depends on the quality of the signal written on the tape, there can be some errors during the automatic decoding: some transitions won't be found by the software, some will be found when they don't exist, and some may be wrongly placed. In any case, the checking must be visual, and those errors have to be corrected manually by the operator.



are.

ach picture

For one block of data, corresponding to one second of flight, around 16 pictures are necessary. For each picture, in order to avoid repetitive data, and a incorrect analysis, two specific lines must be declared, corresponding to the initial and end line of the picture. In other words, the end line in picture number N will be the initial line of picture N+1.

This task completed, the last part of the decoding consists of the automatic measurement of all the spaces between each lines, in order to rebuild the square signal. (See previous chapter). The file containing 0's and 1's is the raw results file where the analysis is going to be performed.

III.5. Manual checking and validation of the computer results

Each time there is an uncertainty in the automatic decoding, visual checking is performed by comparing the space measured by the computer between two lines, and the real space seen in the picture itself. The corrections are done manually.

The 3 files corresponding to the three blocks of one second each must have 784 bits. Considering that the UFDR inserts 8 bits at the beginning of the block, and 8 at the end (preamble and postamble, see chapter 1), each file should contain 768 bits. If some bits are missing, it is due to the fact that the quality of the signal is too bad, or in the worst case, the signal has been erased. We found this last case, at the points of impact of the tape on the heads, where the tape itself was damaged.

Moreover, in order to correlate the 3 blocks together, we have to retrieve the synchronization words, which should be placed in the same position in each file, whereas they occur at the beginning of each subcycle of one second.

Last 12 seconds of Recording, Listing 0, MAIN PARAMETERS, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: May 12, 1998, Laboratoires du Bureau Enquetes-Accidents

UTC Time	Altitude Radio (feet)	Airspeed Computed (knots)	Vert. Accel. (g)	Long. Accel (g)	Lat. Accel (g)	Pitch Angle	Roll Angle	PLA Eng 1 (deg.)	PLA Eng 2 (deg.)	Rudder Position	Aileron L/H (deg.)	Aileron R/H (deg.)	Elevator Position (degs.)	Mag. Heading (deg.)
12:05:45	2654	65	0.37 0.44 0.35 0.36 0.36 0.32 0.30 0.22	-0.18 -0.15 -0.17 -0.18	-0.18 -0.17 -0.17 -0.18	0	-64		69	-2.47 -4.59	15.1	1.0	-2.8	15.12
12:05:46	3008	103	0.30 0.26 0.30 0.30 0.33 0.32 0.39 0.35	-0.18 -0.21 -0.20 -0.20	-0.17 -0.20 -0.16 -0.26	-7	-79			-9.53 -12.00	16.5	1.0	-2.1	20.04
12:05:47	3066	117	0.42 0.35 0.39 0.44 0.46 0.52 0.53 0.60	-0.20 -0.20 -0.20 -0.21	-0.25 -0.28 -0.25 -0.28	-12	-79			-11.29 -10.24	16.8	0.3	-2.5	27.07
12:05:48	2844	131	0.64 0.71 0.79 0.83 0.89 0.98 1.03 1.07	-0.23 -0.25 -0.27 -0.29	-0.29 -0.28 -0.28 -0.26	-20	-58	65		-7.41 0.32	16.5	2.4	-3.2	31.64
12:05:49	1878	154	1.09 1.09 1.09 1.09 0.99 0.99 0.89 0.85	-0.30 -0.28 -0.24 -0.20	-0.22 -0.15 -0.12 -0.09	-34	-27		60	2.08 -4.24	14.7	5.9	-4.2	34.10
12:05:50	1604	164	0.79 0.69 0.59 0.51 0.44 0.35 0.35 0.32	-0.15 -0.11 -0.08 -0.07	-0.03 0.04 0.07 0.10	-44	5			-7.41 -8.47	11.2	8.4	-6.0	30.59

Last 12 seconds of Recording, Listing 0, MAIN PARAMETERS, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: May 12, 1998, Laboratoires du Bureau Enquetes-Accidents

UTC Time	Altitude Radio (feet)	Airspeed Computed (knots)	Vert. Accel. (g)	Long. Accel (g)	Lat. Accel (g)	Pitch Angle	Roll Angle	PLA Eng 1 (deg.)	PLA Eng 2 (deg.)	Rudder Position	Aileron L/H (deg.)	Aileron R/H (deg.)	Elevator Position (degs.)	Mag. Heading (deg.)
12:05:51	1394	173	0.32 0.31 0.34 0.35 0.38 0.42 0.43 0.47	-0.06 -0.05 -0.03 -0.03	0.12 0.14 0.14 0.10	-45	20			-8.82 -6.71	10.9	8.4	-4.9	18.98
12:05:52	1136	189	0.50 0.53 0.55 0.62 0.72 0.83 0.91 1.00	-0.03 -0.02 -0.01 -0.02	0.09 0.07 0.07 0.07	-42	17	53		1.02 6.68	9.8	8.7	-8.8	14.41
12:05:53	806	203	1.07 1.17 1.22 1.28 1.33 1.44 1.51 1.59	-0.03 -0.04 -0.05 -0.06	0.07 0.08 0.07 0.07	-37	9		53	8.45 7.74	10.5	8.0	-9.5	17.58
12:05:54	566	214	1.64 1.69 1.73 1.80 1.84 1.92 1.97 2.04	-0.08 -0.09 -0.11 -0.13	0.07 0.07 0.07 0.06	-30	2			7.39 7.03	10.5	8.7	-9.5	19.34
12:05:55	340	228	2.06 2.09 2.11 2.12 2.15 2.14 2.16 5.99	-0.15 -0.16 -0.16 -0.15	0.05 0.05 0.03 -1.00	-24	-5			5.97 7.94	11.6	5.6	-8.8	19.69
12:05:56	136	237	2.12 2.12 2.15 2.22 2.24 2.28 2.33 5.99	-0.15 -0.14 -0.15 -0.17	0.03 0.02 0.04 -1.00	-18	-6	53		4.56 3.50	15.1	5.2	-11.3	19.69

Last 12 seconds of recording, Listing 1, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Long. Accel (g)	Outer Marker	Middle Marker (1-marker)	Mag. Heading (deg.)	Landing Gear RH (discrete)	Vert. Accel. (g)	Altitude Fine (feet)	C of G (%)	Start Valve Eng 1 (1-closed)	Start Valve Eng 2 (1-closed)	VHF 1 (0-keyed)	VHF 2 (0-keyed)	Aileron L/H (deg.)	Localizer Dev. (MA)	Spoiler 1 & 4 Fault
12:05:45	1464	-0.18 -0.15 -0.17 -0.18	no	no	15.12		0.37 0.44 0.35 0.36 0.36 0.32 0.30 0.22	2579	29	Closed	Closed	not	not	15	214	no fault
12:05:46	2631	-0.18 -0.21 -0.20 -0.20	no	no	20.04	not down	0.30 0.26 0.30 0.30 0.33 0.32 0.39 0.35	2527	29	Closed	Closed	not	not	16	237	no fault
12:05:47	3512	-0.20 -0.20 -0.20 -0.21	no	no	27.07		0.42 0.35 0.39 0.44 0.46 0.52 0.53 0.60	2479	29	Closed	Closed	not	not	17	237	no fault
12:05:48	583	-0.23 -0.25 -0.27 -0.29	no	no	31.64	not down	0.64 0.71 0.79 0.83 0.89 0.98 1.03 1.07	2399	29	Closed	Closed	not	not	16	245	no fault
12:05:49	1464	-0.30 -0.28 -0.24 -0.20	no	no	34.10		1.09 1.09 1.09 1.09 0.99 0.99 0.89 0.85	2271	29	Closed	Closed	not	not	15	252	no fault
12:05:50	2631	-0.15 -0.11 -0.08 -0.07	no	no	30.59	not down	0.79 0.69 0.59 0.51 0.44 0.35 0.35 0.32	2035	29	Closed	Closed	not	not	11	251	no fault

Last 12 seconds of recording, Listing 1, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

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Time (seconds)	Sync codes raw count	Long. Accel (g)	Outer Marker	Middle Marker (1-marker)	Mag. Heading (deg.)	Landing Gear RH (discrete)	Vert. Accel. (g)	Altitude Fine (feet)	C of G (%)	Start Valve Eng 1 (1-closed)	Start Valve Eng 2 (1-closed)	VHF 1 (0-keyed)	VHF 2 (0-keyed)	Aileron L/H (deg.)	Localizer Dev. (MA)	Spoiler 1 & 4 Fault
12:05:51	3512	-0.06 -0.05 -0.03 -0.03	no	no	18.98		0.32 0.31 0.34 0.35 0.38 0.42 0.43 0.47	1799	29	Closed	Closed	not	not	11	243	no fault
12:05:52	583	-0.03 -0.02 -0.01 -0.02	no	no	14.41	not down	0.50 0.53 0.55 0.62 0.72 0.83 0.91 1.00	1543	29	Closed	Closed	not	not	10	223	no fault
12:05:53	1464	-0.03 -0.04 -0.05 -0.06	no	no	17.58		1.07 1.17 1.22 1.28 1.33 1.44 1.51 1.59	1319	29	Closed	Closed	not	not	11	203	no fault
12:05:54	2631	-0.08 -0.09 -0.11 -0.13	no	no	19.34	not down	1.64 1.69 1.73 1.80 1.84 1.92 1.97 2.04	1087	29	Closed	Closed	not	not	11	192	no fault
12:05:55	3512	-0.15 -0.16 -0.16 -0.15	no	no	19.69		2.06 2.09 2.11 2.12 2.15 2.14 2.16 5.99	807	29	Closed	Closed	not	not	12	199	no fault
12:05:56	583	-0.15 -0.14 -0.15 -0.17	no	no	19.69	not down	2.12 2.12 2.15 2.22 2.24 2.28 2.33 5.99	599	29	Closed	Closed	not	not	15	229	no fault

Last 12 seconds of Recording, Listing 2, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Event Marker (1-event)	Ldg Squat Switch L/H (1-on ground)	Ldg Squat Switch R/H (1-on ground)	Ldg Squat Switch Nose (1-on ground)	Lat. Accel (g)	Spoiler 1 Retract	Spoiler 1 Retract	EVM Fan Eng 1	Slats Fault	Flaps Fault (1-fault)	Roll Angle	Airspeed Computed (knots)	Spoiler 2 Retract	Spoiler 2 Retract
12:05:45	1464	no event	air	air	air	-0.18 -0.17 -0.17 -0.18	Retracte	Retracte		no fault	no fault	-64.3	65	Retracte	Retracte
12:05:46	2631	no event	air	air	air	-0.17 -0.20 -0.16 -0.26	Retracte	Retracte	0.80	no fault	no fault	-79.0	103	Retracte	Retracte
12:05:47	3512	no event	air	air	air	-0.25 -0.28 -0.25 -0.28	Retracte	Retracte		no fault	no fault	-78.7	117	Retracte	Retracte
12:05:48	583	no event	air	air	air	-0.29 -0.28 -0.28 -0.26	Retracte	Retracte	0.65	no fault	no fault	-57.9	131	Retracte	Retracte
12:05:49	1464	no event	air	air	air	-0.22 -0.15 -0.12 -0.09	Retracte	Retracte		no fault	no fault	-27.0	154	Retracte	Retracte
12:05:50	2631	no event	air	air	air	-0.03 0.04 0.07 0.10	Retracte	Retracte	0.50	no fault	no fault	4.57	164	Retracte	Retracte
12:05:51	3512	no event	air	air	air	0.12 0.14 0.14 0.10	Retracte	Retracte		no fault	no fault	19.69	173	Retracte	Retracte
12:05:52	583	no event	air	air	air	0.09 0.07 0.07 0.07	Retracte	Retracte	0.35	no fault	no fault	16.53	189	Retracte	Retracte
12:05:53	1464	no event	air	air	air	0.07 0.08 0.07 0.07	Retracte	Retracte		no fault	no fault	8.79	203	Retracte	Retracte
12:05:54	2631	no event	air	air	air	0.07 0.07 0.07 0.06	Retracte	Retracte	0.35	no fault	no fault	1.76	214	Retracte	Retracte
12:05:55	3512	no event	air	air	air	0.05 0.05 0.03 $\boxed{-1.00}$	Retracte	Retracte		no fault	no fault	-4.54	228	Retracte	Retracte
12:05:56	583	no event	air	air	air	0.03 0.02 0.04 $\boxed{-1.00}$	Retracte	Retracte	0.40	no fault	no fault	-5.59	237	Retracte	Retracte

▭ : unreadable dat

Last 12 seconds of recording, Listing 5, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Lat. Accel (g)	A/P CMD 2 (1=CMD mode)	A/P CWS 2 (1=CWS mode)	Pitch Angle	Reverser Unlock Eng 1	Reverser Unlock Eng 2	EGT Eng 1 (deg. C)	Tank Quant. Trim (kg)	Stabilizer Position (deg.)	Pack Man Mode Sel. 2	Spoiler 7 Retract	Spoiler 7 Retract	Rudder Position
12:05:46	2631	-0.17	Off	Off	-7.21	normal	normal			0.00		Retracte		-9.53
		-0.20												-12.00
		-0.16												
		-0.26												
12:05:47	3512	-0.25	Off	Off	-12.4	normal	normal					Retracte		-11.29
		-0.28												-10.24
		-0.25												
		-0.28												
12:05:48	583	-0.29	Off	Off	-20.0	normal	normal	525.5	0.00	0.00	normal	Retracte		-7.41
		-0.28												0.32
		-0.28												
		-0.26												
12:05:49	1464	-0.22	Off	Off	-34.1	normal	normal					Retracte	Retracte	2.08
		-0.15												-4.24
		-0.12												
		-0.09												
12:05:50	2631	-0.03	Off	Off	-43.7	normal	normal			0.32		Retracte	Retracte	-7.41
		0.04												-8.47
		0.07												
		0.10												
12:05:51	3512	0.12	Off	Off	-44.6	normal	normal					Retracte	Retracte	-8.82
		0.14												-6.71
		0.14												
		0.10												
12:05:52	583	0.09	Off	Off	-42.3	normal	normal	484.0	0.00	0.32	normal	Retracte	Retracte	1.02
		0.07												6.68
		0.07												
		0.07												
12:05:53	1464	0.07	Off	Off	-36.5	normal	normal					Retracte	Retracte	8.45
		0.08												7.74
		0.07												
		0.07												
12:05:54	2631	0.07	Off	Off	-30.2	normal	normal			0.32		Retracte	Retracte	7.39
		0.07												7.03
		0.07												
		0.06												
12:05:55	3512	0.05	Off	Off	-24.4	normal	normal					Retracte		5.97
		0.05												7.94
		0.03												
		$\boxed{-1.00}$												
12:05:56	583	0.03	Off	Off	-18.1	normal	normal	449.0	0.00	0.32	normal	Retracte		4.56
		0.02												3.50
		0.04												
		$\boxed{-1.00}$												
[redacted]	[redacted]													

☐: unreadable data.

Last 12 seconds of recording, Listing 3, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	VHF 3 (0-keyed)	Inner Marker (1-marker)	Glide Slope Dev. (MA)	Rudder Position	Spoiler 3 Retract	Spoiler 3 Retract	EVM Fan Eng 2	A/P Land Track 1 (1-engage)	A/P Land Track 2 (1-engage)	A/P CWS 1 (1= CWS mode)	A/P CWS 2 (1=CWS mode)	Lat. Accel (g)	Aft CG Warn (1-warn)	N2 Eng 1 (% rpm)
12:05:45	1464	not keyed	no marker	-329	-2.47 -4.59	Retracte			Off	Off	Off	Off	-0.18 -0.17 -0.17 -0.18	0	
12:05:46	2631	not keyed	no marker	277	-9.53 -12.00	Retracte		1.31	Off	Off	Off	Off	-0.17 -0.20 -0.16 -0.26	0	
12:05:47	3512	not keyed	no marker	-181	-11.29 -10.24	Retracte			Off	Off	Off	Off	-0.25 -0.28 -0.25 -0.28	0	
12:05:48	583	not keyed	no marker	-33	-7.41 0.32	Retracte		1.00	Off	Off	Off	Off	-0.29 -0.28 -0.28 -0.26	0	92.25
12:05:49	1464	not keyed	no marker	-218	2.08 -4.24	Retracte	Retracte		Off	Off	Off	Off	-0.22 -0.15 -0.12 -0.09	0	
12:05:50	2631	not keyed	no marker	-114	-7.41 -8.47	Retracte	Retracte	0.70	Off	Off	Off	Off	-0.03 0.04 0.07 0.10	0	
12:05:51	3512	not keyed	no marker	202	-8.82 -6.71	Retracte	Retracte		Off	Off	Off	Off	0.12 0.14 0.14 0.10	0	
12:05:52	583	not keyed	no marker	-147	1.02 6.68	Retracte	Retracte	0.65	Off	Off	Off	Off	0.09 0.07 0.07 0.07	0	88.12
12:05:53	1464	not keyed	no marker	184	8.45 7.74	Retracte	Retracte		Off	Off	Off	Off	0.07 0.08 0.07 0.07	0	
12:05:54	2631	not keyed	no marker	52	7.39 7.03	Retracte	Retracte	0.50	Off	Off	Off	Off	0.07 0.07 0.07 0.06	0	
12:05:55	3512	not keyed	no marker	248	5.97 7.94	Retracte			Off	Off	Off	Off	0.05 0.05 0.03 $\boxed{-1.00}$	0	
12:05:56	583	not keyed	no marker	-20	4.56 3.50	Retracte		0.45	Off	Off	Off	Off	0.03 0.02 0.04 $\boxed{1.00}$	0	84.81

□: unreadable data.

Last 12 seconds of recording, Listing 4, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Spoiler 4 Retract	Spoiler 4 Retract	Inlet Anti-Ice Valve (1-Open)	Inlet Anti-Ice Valve (1-Open)	Flaps Position (deg)	Spoiler 5 Retract	Spoiler 5 Retract	Aileron R/H (deg.)	Elevator Position (degs.)	Spoiler 7 Fault	Spoiler 6 Fault	Oil Quant. Eng 1 (US Quart)	Spoiler 6 Retract	Spoiler 6 Retract	Angle of Attack (deg.)
12:05:45	1464	Retracte					Retracte		1.0	-2.8	no fault	no fault		Retracte		70.0 58.0
12:05:46	2631	Retracte		Open	closed	17	Retracte		1.0	-2.1	no fault	no fault		Retracte		42.7 20.4
12:05:47	3512	Retracte					Retracte		0.3	-2.5	no fault	no fault		Retracte		6.2 0.5
12:05:48	583	Retracte		Open	closed	17	Retracte		2.4	-3.2	no fault	no fault	13	Retracte		2.5 12.5
12:05:49	1464	Retracte	Retracte				Retracte	Retracte	5.9	-4.2	no fault	no fault		Retracte	Retracte	17.2 16.2
12:05:50	2631	Retracte	Retracte	closed	closed	17	Retracte	Retracte	8.4	-6.0	no fault	no fault		Retracte	Retracte	9.5 1.1
12:05:51	3512	Retracte	Retracte				Retracte	Retracte	8.4	-4.9	no fault	no fault		Retracte	Retracte	-4.7 -4.6
12:05:52	583	Retracte	Retracte	Open	closed	17	Retracte	Retracte	8.7	-8.8	no fault	no fault	12	Retracte	Retracte	-3.5 -2.3
12:05:53	1464	Retracte	Retracte				Retracte	Retracte	8.0	-9.5	no fault	no fault		Retracte	Retracte	0.9 5.1
12:05:54	2631			Open	closed	17	Retracte	Retracte	8.7	-9.5	no fault	no fault		Retracte	Retracte	7.2 9.0
12:05:55	3512								5.6	-8.8	no fault	no fault		Retracte		10.7 11.6
12:05:56	583			Open	closed	17			5.2	-11.3	no fault	no fault	12	Retracte		9.8 10.2
[illegible]	[illegible]															

Last 12 seconds of recording, Listing 5, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Lat. Accel (g)	A/P CMD 2 (1=CMD mode)	A/P CWS 2 (1=CWS mode)	Pitch Angle	Reverser Unlock Eng 1	Reverser Unlock Eng 2	EGT Eng 1 (deg. C)	Tank Quant. Trim (kg)	Stabilizer Position (deg.)	Pack Man Mode Sel. 2	Spoiler 7 Retract	Spoiler 7 Retract	Rudder Position
12:05:46	2631	-0.17 -0.20 -0.16 -0.26	Off	Off	-7.21	normal	normal			0.00		Retracte		-9.53 -12.00
12:05:47	3512	-0.25 -0.28 -0.25 -0.28	Off	Off	-12.4	normal	normal					Retracte		-11.29 -10.24
12:05:48	583	-0.29 -0.28 -0.28 -0.26	Off	Off	-20.0	normal	normal	525.5	0.00	0.00	normal	Retracte		-7.41 0.32
12:05:49	1464	-0.22 -0.15 -0.12 -0.09	Off	Off	-34.1	normal	normal					Retracte	Retracte	2.08 -4.24
12:05:50	2631	-0.03 0.04 0.07 0.10	Off	Off	-43.7	normal	normal			0.32		Retracte	Retracte	-7.41 -8.47
12:05:51	3512	0.12 0.14 0.14 0.10	Off	Off	-44.6	normal	normal					Retracte	Retracte	-8.82 -6.71
12:05:52	583	0.09 0.07 0.07 0.07	Off	Off	-42.3	normal	normal	484.0	0.00	0.32	normal	Retracte	Retracte	1.02 6.68
12:05:53	1464	0.07 0.08 0.07 0.07	Off	Off	-36.5	normal	normal					Retracte	Retracte	8.45 7.74
12:05:54	2631	0.07 0.07 0.07 0.06	Off	Off	-30.2	normal	normal			0.32		Retracte	Retracte	7.39 7.03
12:05:55	3512	0.05 0.05 0.03 $\boxed{-1.00}$	Off	Off	-24.4	normal	normal					Retracte		5.97 7.94
12:05:56	583	0.03 0.02 0.04 $\boxed{-1.00}$	Off	Off	-18.1	normal	normal	449.0	0.00	0.32	normal	Retracte		4.56 3.50
[redacted]	[redacted]													

☐ : unreadable data.

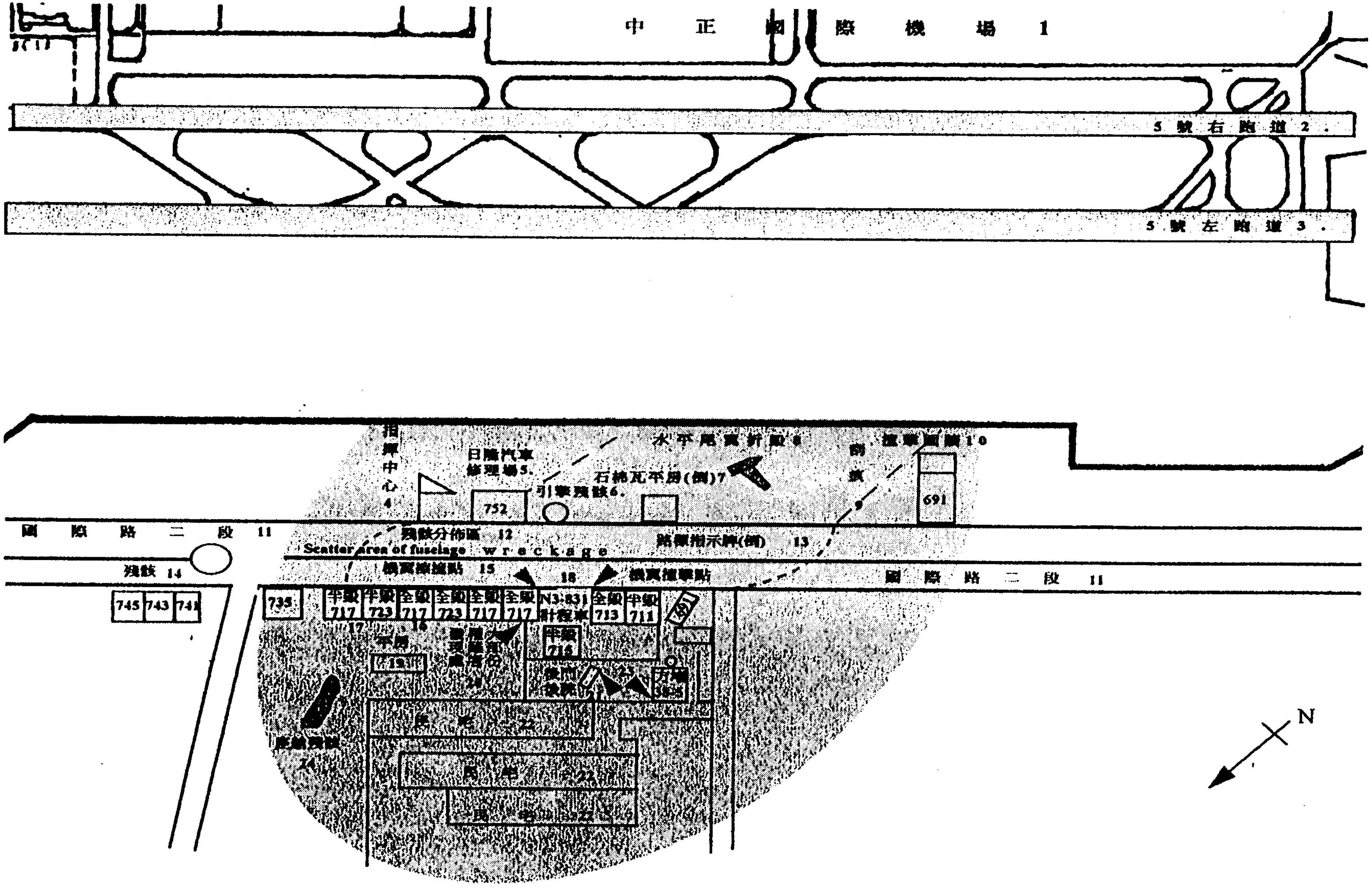
Last 12 seconds of recording, Listing 6, A300 registered B1814
(two last seconds from garnet recovery), Date Printed: April 28, 1998, Laboratoires du Bureau Enquetes-Accidents

Time (seconds)	Sync codes raw count	Landing Gear Nose (discrete)	VMO/MMO (1-warning)	Bleed Valve Eng 2 (1-open)	Start Valve Eng 1 (1-closed)	Start Valve Eng 2 (1-closed)	EVM Turbine Eng 2	Max Allowable Airspeed (knots)	EVM Fan Eng 2	EVM Fan Eng 1	EVM Turbine Eng 1	Pitch Trim Wheel (degs.)	Wing Anti-Ice Valve Norm. L/H (1-not closed)	Slats Position	Total Air Temp. (deg. C)
12:05:45	1464	up	normal		Closed	Closed	0.90	204.75			1.11	3.08		17	30.51
12:05:46	2631				Closed	Closed			1.31	0.80					
12:05:47	3512	up	normal	Closed	Closed	Closed	0.85	204.75			0.95	3.08	Closed	17	33.26
12:05:48	583				Closed	Closed			1.00	0.65					
12:05:49	1464	up	normal		Closed	Closed	0.75	204.75			0.75	3.08		17	29.01
12:05:50	2631				Closed	Closed			0.70	0.50					
12:05:51	3512	up	normal	Closed	Closed	Closed	0.50	204.75			0.45	3.08	Closed	17	22.25
12:05:52	583				Closed	Closed			0.65	0.35					
12:05:53	1464	up	normal		Closed	Closed	0.25	204:75			0.30	3.08		17	19.25
12:05:54	2631				Closed	Closed			0.50	0.35					
12:05:55	3512	up	normal	Closed	Closed	Closed	0.20	204.75			1.41	3.08	Closed	17	20.25
12:05:56	583				Closed	Closed			0.45	0.40					
[redacted]	[redacted]														

Appendix 7

Diagram Map of the Scene

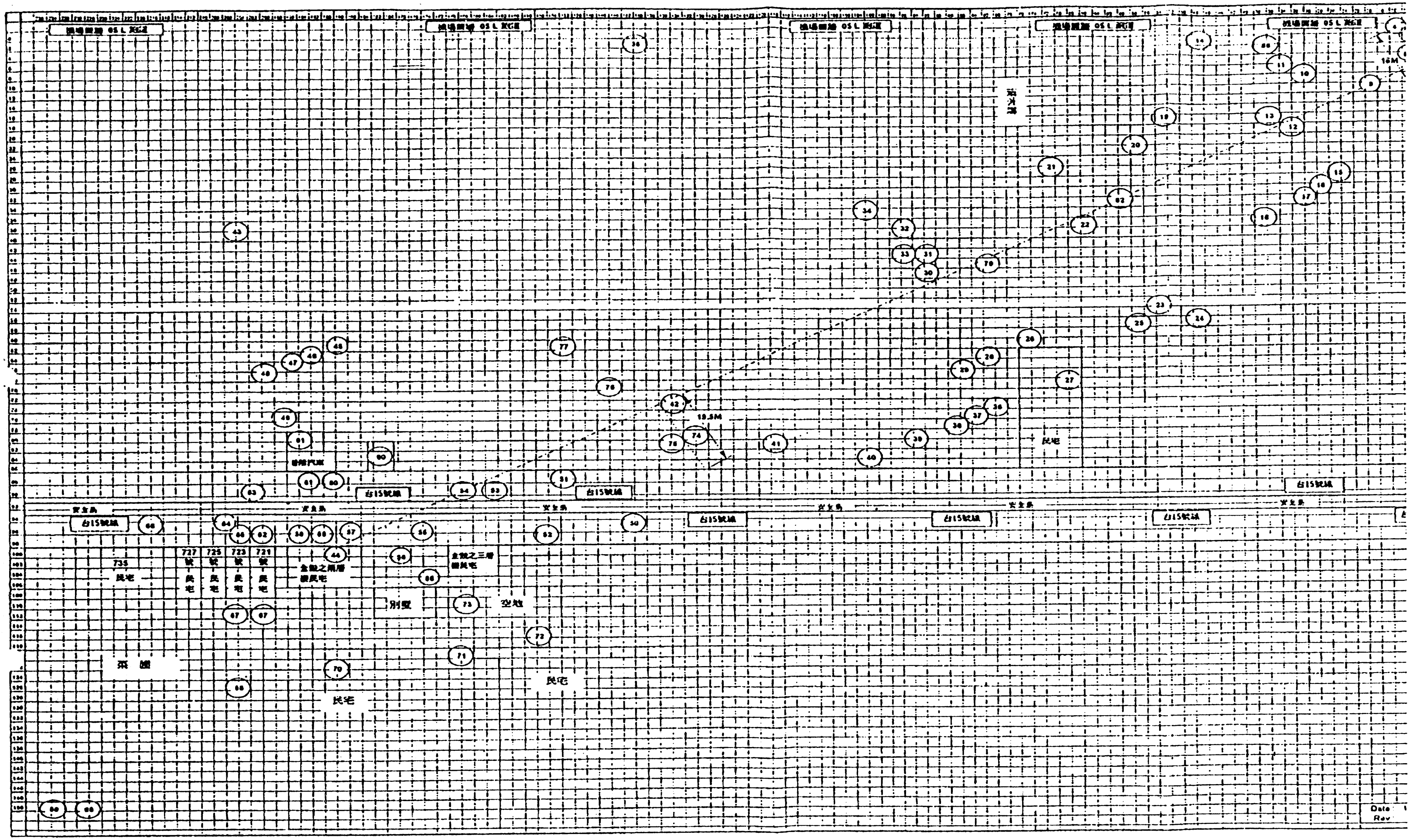
Appendix 7 Diagram Map of the Scene



1. **CKS International Airport**
2. **Runway 05 R**
3. **Runway 05 L**
4. **Command Center**
5. **Jih-Lung Auto Tune-Up Shop**
6. **Engines Wreckage**
7. **Fallen Asbestos Shingle Bungalow**
8. **Broken Tailplane**
9. **Scratch/Gash**
10. **Collided With Fence**
11. **Kuo-Chi Rd., Sec. 2**
12. **Scatter Area of Fuselage Wreckage**
13. **Fallen Road Sign**
14. **Wreckage**
15. **Collision Point of Wing**
16. **Completely Destroyed**
17. **Partly Destroyed**
18. **Taxi**
19. **Bungalow**
20. **Exhibited Location of Most Victims**
21. **Back Door/Back Yard**
22. **Residence**
23. **Residence**
24. **Cabin Frame/Skin Wreckage**

Appendix 8

Wreckage Distribution Map


機場圍牆 05L 跑道
16M
18.5M
安全島
台15號線
735
民宅
727號民宅
725號民宅
723號民宅
721號民宅
金鼎之兩層樓民宅
金鼎之三層樓民宅
別墅
空地
菜園
民宅
Date
Rev

ITEM	DESCRIPTION	DISTANCE TO ITEM #1 (M)	REMARK -
1	TAIL IMPACT POINT	0	DEPTH 1.10M
2	FUSELAGE IMPACT POINT	10	DEPTH 1.0M
3	APU ASSY	12	
4	RH ENG IMPACT POINT	15	DEPTH 1.2M
5	PITCH FEEL ACTUATOR		
6	LH ENG IMPACT POINT		DEPTH 1.2M
7	LH WING JACK SCREW		
8	#1 IDG		
9	APU TAIL CONE	22	
10	RH ENG FAN CASE	30	
11	RH TAIL FUSELAGE	34	
12	APU COMPARTMENT	38	
13	RH ENG TAIL PLUG	39	
14	FLAP JACK SCREW	47	
15	LH FLAP TRACK	38	
16	RUDDER TIP	39	
17	LH WING T/E FLAP & TRACK & JACK SCREW	40	
18	LH ENG LOW PRESSURE SHAFT	56	
19	RH ENG FAN COWL	56	
20	W/W DOOR ACTUATOR	62	
21	FLAP TRACK	76	
22	AUTOPILOT SERVO MOTOR	76	
23	LH ENG LPT 3RD STAGE AIR SEAL		
24	LH T/E FLAP	76	
25	LH FLAP #1 JACKSCREW	81	
26	SPOILER	88	
27	LH L/E SLAT	87	
28	LH ENG TAIL SLEEVE	100	
29	RH HORI STAB	101	

30	RH IB T/E FLAP	101	
31	RH ENG NOSE LIP	100	
32	LWR BELLY & MAIN FUEL PUMP	100	
33	RH ENG TAIL SLEEVE	101	
34	RH WING FLAP TRACK & JACKSCREW NO.5	102	
35	WING RIB 19, 20	141	
36	LH IB T/E FLAP	101	
37	LH ENG EXHAUST SLEEVE	102	
38	LH ENG VSV CASE	102	
39	LH ENG LOW PRESSURE COMPRESSOR	115	
40	LH PYLON	128	
41	GYRO Z-AXIS	140	
42	VERTICAL FIN & TAIL FUSELAGE CROWN	146	
43	SPOILER ACTUATOR & SPOILER	200	
44	FINAL IMPACT POINT	212	
45	RH WING RIB 22-26	205	
46	T/E FLAP JACKSCREW NO.6	206	
47	RH ENG LIP (HALF)		
48	RH CABIN DOOR	210	
49	ENG TAIL PLUG		
50	LH ENG LPT	150	
51	RUDDER LIMITER ACTUATOR	198	
52	LH FUSELAGE #1-L DOOR		
53	LH ENG EXHAUST CASE		
54	RH ENG EXHAUST CASE - S/N:621		
55	COCKPIT		

56	RH WING & CENTER WING BOX		
57	MAIN L/G ACTUATOR		-
58	NOSE L/G		
59	NOSE L/G & E/E COMPARTMENT		
60	LH ENG HPC & DIFFUSER /BURNER /HPT		
61	ENG REVERSE COWL		
62	AUTO PILOT SERVO		
63	RH ENG INTERMEDIATE CASE & MOUNT		
64	RH WING		
65	RH MAIN L/G		
66	RH ENG LPC AND FAN HUB		
67	LH EMERGENCY DOOR		
68	LH MAIN L/G & #6 WHEEL		
69	LH WING		
70	LH WING		
71	RH #1 DOOR		
72	LH WING RIB 18-24		
73	REVERSE COWL		
74	RH HORIZONTAL STABILIZER	146	
75	FLAP TRACK JACK SCREW		
76	RH WING T/E FLAP	148	
77	RH ENG FAN EXIT CASE-724017	148	
78	LH ENG FAN CASE		
79	LPT BLADE		
80	RH HPC DIFFUSER / BURNER / HPT		
81	RH ENG LPT & SHAFT		
82	LOW PART OF THSA BALLSCREW		

83	FRAME 90		
84	ENG DRIVEN PUMP		
85	BATTERY		
86	SLAT SCREW JACK		
87	NO.1 EEC		
88	SPOILER/SERVO		

Appendix 10

B-1814 on Board Computer List

B-1814 On Board Computer List

ITEM	DESCRIPTION	VENDOR	PART NUMBER	SERIAL NUMBER	QTY	NVM
1	TEST PANEL-MAINTENANCE	SFENA	K159AEMO	410	1	NO
2	FLIGHT CONTROL COMPUTER	SFENA	B470AAM2	118 189	2	NO
3	FLIGHT CONTROL UNIT	SFENA	K157ABM6	392	1	NO
4	THRUST CONTROL COMPUTER	SFENA	B415AAM3	150	1	NO
5	FLIGHT AUGMENT COMPUTER	SFENA	B471AAM5	800 299	2	NO
6	TRANSCEIVER-VHF COMMUNICATION	BENDIX	2041237-4413	1873 4249	2	YES
7	TRANSCEIVER-HF COMMUNICATION	COLLINS	622-5272-001	2175 2098	2	YES
8	RECORDER-VOICE COCKPIT	FAIRCHILD	93A100-80	4874	1	YES
9	GENERATOR CONTROL UNIT	SUNDSTRAND	740120B	1296 1515 1626	3	YES
10	GPCU	SUNDSTRAND	735234B	0248	1	YES
11	SLAT/FLAP CONTROL COMPUTER	GEC	49-095-05	513 740	2	NO
12	FEEL LIMITATION COMPUTER	AEROSPATIAL	35-900-2000-201	795 732	2	YES

13	SGU-ECAM	SEXTANT	9612670322	1242 0960	2	YES
14	SDAC	THOMSON	66501-005-1	759	1	NO
15	FLIGHT WARNING COMPUTER	AEROSPATIAL	35-0B5-3004-308	608 TBD	2	YES
16	CGCC	SFENA	B473ABM2	187	1	YES
17	DFDAU	SFIM	36042610060	267	1	YES
18	DFDR	SUNDSTRAND	980-4100-DXUS	7359	1	YES
19	ELEC. UNIT-PROXIMITY SYSTEM	CEM	BDM300-3	361	1	NO
20	AIR DATA COMPUTER	HONEYWELL	4045053-903	91011116 89060846	2	YES
21	IRU	HONEYWELL	HG1050BD02	366 381 315	3	NO
22	FMC	HONEYWELL	4052510-965	90013146 89102995	2	YES
23	TRANSCEIVER-LRRA	TRT	9599-607-14932	3899 4953	2	YES
24	TRANSPONDER-ATC	TRT	9599-614-03904	1211 1037	2	NO
25	DME-INTEROGATOR	TRT	9599-614-03104	1214 1259	2	YES
26	GPWC	SUNDSTRAND	965-0576-002	1232	1	YES

27	SGU-EFIS	THOMSON	9612660314	1680 1219 1272	3	YES
28	RECEIVER-VOR/MKR	BENDIX	2041231-3604	1580 1628	2	YES
29	RECEIVER-ILS	BENDIX	2041230-3504	5053 3094	2	YES
30	RECEIVER-ADF	BENDIX	2041168-7506	2696 2683	2	YES
31	TRANSCEIVER-WX RADAR	BENDIX	2041217-0418	3704 5751	2	YES
32	FUEL QTY	INTERTECHNIQUE	SIC5077-3	587	1	YES
33	PNEUMATIC CONTROLLER	GARRETT	627248-2	111C1066 108C1305	2	NO
34	ENGINE ELECTRONIC CONTROL COMPUTER	HAMILTON	791100-6-095L11 791100-6-090L11	4000-0230 4000-0302	2	YES

Appendix 11

Status of retrieved Computer Components on Board Aircraft B-1814

Status Of Retrieved Computer Wreckage On B-1814

1. Time：Feb. 26 1998
2. Location：CKS Airport
3. Status：

CAUTION：Memory data are usually stored and can be retrieved for dumping and analysis until the corresponding Non Volatile Memory (NVM) is powered by internal battery. Shocks, water ingress, overheat or any other computer damage may have corrupted NVM data or even erased the internal memories.

ITEM	DESCRIPTION	PART NUMBER	SERIAL NR	QTY	VENDOR	CONDITION	NVM
1	GND POWER CONTROL UNIT (GPCU)	735234B	0248	1	SUNDSTRAND	Damage	YES
2	INTERTIAL REFERENCE UNIT (IRU)	HG1050BD02	UNKNOWN	3	HONEYWELL	Damage	NO
3	AIR DATA COMPUTER (ADC)	4045053-903	89080875	1	HONEYWELL	Damage	YES
4	PNEUMATIC CONTROLLER	627248-2	111C-1066	1	GARRETT CAN	Damage	NO
5	ILS RECEIVER	2041230-3504	UNKNOWN	2	BENDIX	Both Damage	YES
6	FLIGHT CONTROL UNIT	K157ABM6	392	1	SEXTANT	Damage	NO
7	TEST PANEL-MAINTENANCE	K159AEMO	410	1	SEXTANT	Not Damage	NO

8	TRANSCEIVER-HF COMM.	622-5272-001	UNKNOWN	1	COLLINS	Damage	YES
9	TRANSCEIVER-LRRA	9599-607-14932	4593	1	TRT	Not Damage	YES
10	GPWC (疑似)	965-0576-002	UNKNOWN	1	ALLIEDSIGNAL	Damage	YES
11	ELEC. ENGINE CONTROLLER	791100-6-095L11 791100-6-090L11	4000-0230 4000-0302	2	HAMILTON	Not Damage	YES

Appendix 12

Shipment of Retrieved Computer Components B-1814

Appendix 13 Shipment Of Retrieved Computer Wreckage On B-1814

CAUTION： Memory data are usually stored and can be retrieved for dumping and analysis until the corresponding Non Volatile Memory (NVM) is powered by internal battery. Shocks, water ingress, overheat or any other computer damage may have corrupted NVM data or even erased the internal memories.

ITEM	DESCRIPTION	PART NR	SERIAL NR	QTY	VENDOR ADDRESS
1	AIR DATA COMPUTER (ADC)	4045053-903	89080875	1	MFR：HONEYWELL AEROSPACE PTE LTD. 21111 NORTH 19TH AVENUE PHONEIX, ARIZONA 85036-1111 U.S.A. CONTACT：DAVE GLACOMEILL FAX：1-602436-2252 TEL：1-602-436-6695
2	TRANSCEIVER-LRRA	9599-607-14932	4593	1	MFR：SEXTANT AVIONIQUE FRANCE RUE MARCEL DASSAULT, B.P.140 86101 CHATELLERAULT CEDEX FRANCE CONTACT：MS MARIE FRANCEOLSE DUFOUR FAX：33.(0)549021090 TEL：33.(0)549021000
3	ENGINE ELEC..CONTROLLER	791100-6-095L11 791100-6-090L11	4000-0230 4000-0302	2	MFR：HAMILTON STANDARD 400 MAIN STREET, M/S 162-24 EAST HARTFORD, CT 06108 U.S.A. CONTACT：MR. MICHEAL L. YOUNG FAX：1-860-565-1568 TEL：1-860-565-9904

Appendix 13

Honeywell's Report

Honeywell

Honeywell, Inc.
P.O. Box 21111
Phoenix, Arizona 85036-1111

602-436-2311

Aircraft Accident Investigation

Honeywell Inc.
June 2, 1998

Accident: China Airlines A300-600

Participants:

Ding-Hwa Lee
China Airlines
Taoyuan, Taiwan, R.O.C.

Hal Thomas
Honeywell Inc.
Phoenix, AZ

Hau Nguyen
Honeywell Inc.
Phoenix, AZ

Ira McNear
Honeywell Inc.
Phoenix, AZ

Summary:

On Monday, June 1, 1998 the Honeywell Digital Air Data Computer Part Number 4045053-903, Serial Number 89080875 was received at Honeywell. The unit was severely damaged, in tact but substantially crushed, and it was not possible to read out the contents of the non volatile memory (NVM). The unit was cut open and the circuit card containing this memory, Part Number 4040817-906 Rev C, Serial Number 9052938 was removed. An Air Data Computer containing circuit card, Part Number 4040817-906 Rev D, Serial Number 7081629, was put on a test fixture to make sure that it was operational. The NVM was then removed from this card and replaced with the NVM from the accident air data computer. This card was reinserted in the Air Data Computer and put on the test fixture. A failure code, 020032 was logged. This indicated a failure during flight 2 (a prior flight) setting bit 32 that indicates "Alternate Vmo Discrete."

Photographs were taken during the entire process to document what was done.

It was noted that the connectors had covers that appeared to have been installed prior to the time of the accident. This indicates that the unit tested was probably a spare unit that was not operating at the time of the crash.

Appendix 14

Thomson's Report

THOMSON-CSF
COMMUNICATIONS

6, rue du Lieutenant Colonel Laporte B.P. 428
19311 Brive Cedex
France
Fax : (33) 05 55 92 89 70
Tél. : (33) 05 55 92 89 89

CIVIL AVIATION ADMINISTRATION
Ministry of transportation and communication
SUNG SHAN AIRPORT
TAIPEI, TAIWAN 105

REPUBLIC OF CHINA

To the attention of Mr LEE WAN-LEE

June 8th, 1998

Quality Assurance Department
QAD/85-98/FS/pr

SUBJECT : LRRA TRANSCEIVER 9599- 607-14932 expertise

Dear Mr LEE WAN-LEE

The expertise on the LRRA TRANSCEIVER 9599-607-14932, S/N 4953, coming from the China Airlines A300-600 Crash Aircraft was held at THOMSON CSF COMMUNICATIONS, at the Brive Industrial Center, on June 2nd and 3rd, 1998.

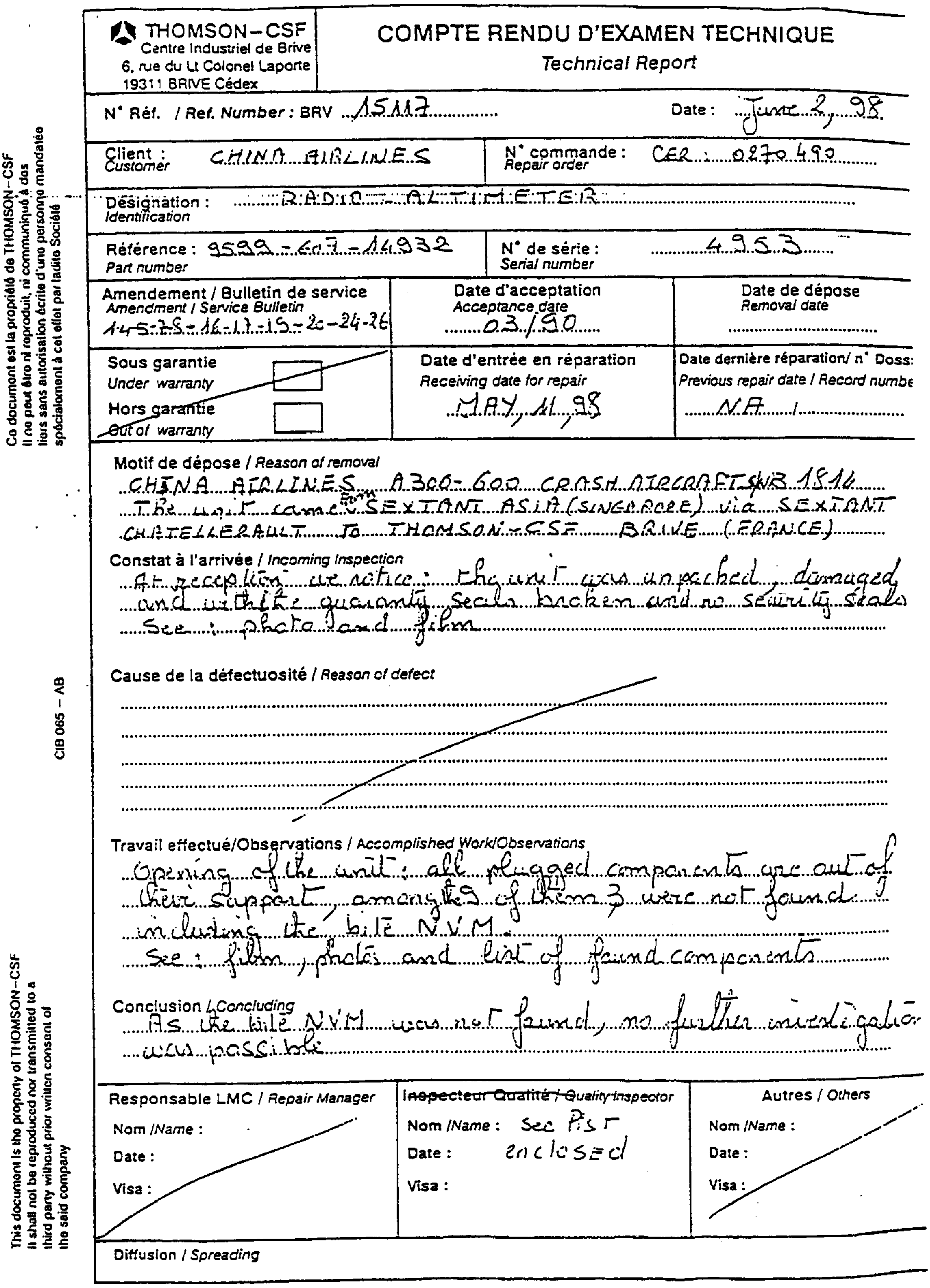
You will find herewith enclosed :
- 1/ a copy of the expertise report
- 2/ 4 pictures
- 3/ a cartridge with two movies

Best regards.

Ms Fabienne SIMON
Quality Assurance Manager

Copies : Mr J.C. SEGUINEAU - Mr M. MARRE : THOMSON Brive (without enclosures)
Mr M. KWARTNIK : THOMSON Colombes (without enclosures)
Mr D. BACHELIER : SEXTANT Chatellerault (with encl. 1 and 2)
Mr LAWRENCE CHEW : SEXTANT Asia (with encl.1)

THOMSON-CSF COMMUNICATIONS : Filiale de Thomson-CSF, Branche Communication et Commandement
S.A. au capital de 900 250 000 F - Siège Social : 160, bd de Valmy - Colombes - Hauts-de-Seine - RCS Nanterre B 383 470 937



CIB 065 – AB

THOMSON–CSF
Centre Industriel de Brive
6, rue du Lt Colonel Laporte
19311 BRIVE Cédex

COMPTE RENDU D'EXAMEN TECHNIQUE
Technical Report

N° Réf. / *Ref. Number* : BRV 15117 Date : June 2, 98

Client : / *Customer* CHINA AIRLINES N° commande : / *Repair order* CER : 0270490

Désignation : / *Identification* RADIO – ALTIMETER

Référence : / *Part number* 9599 – 607 – 14932 N° de série : / *Serial number* 4953

Amendement / Bulletin de service *Amendment / Service Bulletin*	Date d'acceptation *Acceptance date*	Date de dépose *Removal date*
1-4-5-7-8-16-17-19-20-24-26	03/90	

	Date d'entrée en réparation *Receiving date for repair*	Date dernière réparation/ n° Doss: *Previous repair date / Record numbe*
Sous garantie *Under warranty* ☐ Hors garantie *Out of warranty* ☐	MAY, 11, 98	N.A. /

Motif de dépose / *Reason of removal*
CHINA AIRLINES A300-600 CRASH AIRCRAFT SN B 1814
The unit came from SEXTANT ASIA (SINGAPORE) via SEXTANT
CHATELLERAULT to THOMSON-CSF BRIVE (FRANCE)

Constat à l'arrivée / *Incoming Inspection*
At reception we notice : the unit was unpacked, damaged
and with the guaranty seals broken and no security seals
See : photo and film

Cause de la défectuosité / *Reason of defect*

Travail effectué/Observations / *Accomplished Work/Observations*
Opening of the unit : all plugged components are out of
their support, amongst of them 3 were not found
including the bite NVM.
See : film, photos and list of found components

Conclusion / *Concluding*
As the bite NVM was not found, no further investigation
was possible

Responsable LMC / *Repair Manager*	~~Inspecteur Qualité / Quality inspector~~	Autres / *Others*
Nom /*Name* :	Nom /*Name* : See Pis T	Nom /*Name* :
Date :	Date : enclosed	Date :
Visa :	Visa :	Visa :

Diffusion / *Spreading*

PARTICIPANTS TO THE EXPERTISE
OF THE RADIOALTIMETER S/N 4353
THE 2nd OF JUNE AT THOMSON CSF
FACILITIES IN BRIVE.FRANCE.

INSPECTION GÉNÉRALE DE L'AVIATION CIVILE ET DE LA MÉTÉOROLOGIE
BUREAU ENQUÊTES ACCIDENTS

Yann PIHAN
Ingénieur Electronicien / Division Technique

Tél. : (33) 01 49 92 72 36
Fax : (33) 01 49 92 72 03
Télex : 230070 F / RSFTA (AFTN) LFPSYLYX

Bâtiment 153
Aéroport du Bourget
93352 Le Bourget Cedex

中華航空公司
CHINA AIRLINES

Lin Jiin-Chyuan 林錦銓
Avionics Shop
Engineering & Maint. Division
修技工廠

桃園中正國際機場
C.K.S. INTERNATIONAL AIRPORT, TAOYUAN
TAIWAN, REPUBLIC OF CHINA
TEL: 03-3834251 EXT. 7602 (H): 02-9141228
FAX: 03-3987214

AEROSPATIALE
AERONAUTIQUE

Gilles TATHAM
Radio Navigation Systems Manager
Systems Department
Design Office

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Phone : (33) 61 93 00 53

Telex : AISPA 531 546 F
Telefax : (33) 61 93 80 90
X400: C=FR, A=ATLAS, P=ASATO, S=Tatham, G=Gilles
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Marian KWARTNIK
Product Program Manager
COMMUNICATIONS, NAVIGATION, IDENTIFICATION DIVISION

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THOMSON-CSF

Parc d'activités Kleber / 160, boulevard de Valmy / BP 82 / [illegible]
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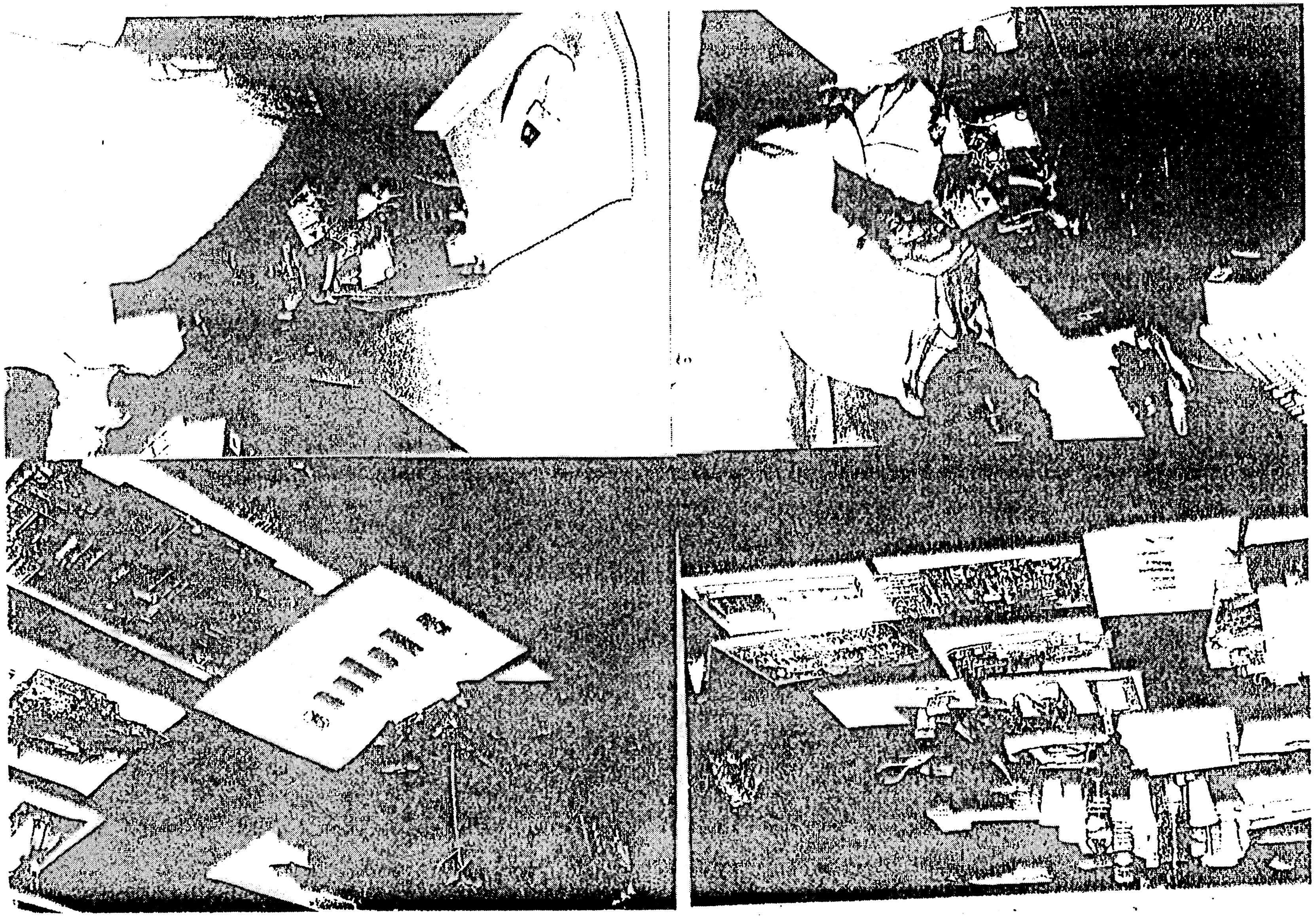


Appendix 15

Hamilton Standard and Pratt & Whitney's Report

Hamilton Standard
A United Technologies Company

One Hamilton Road
Windsor Locks, Connecticut
06096-1010
860/654-6000
Mail Stop: 6-B12

May 15, 1998
Our Reference: 8-TRB-8087

Pratt & Whitney
400 Main Street
East Hartford, CT 06108
U.S.A.
Attention: Mr. Michael C. Romanowski
Office of Flight Safety

Summary of Findings Report - FADEC Fault Data Extraction

Overview:
This findings report provides a summary of the activities of the investigation team assembled to support the fault data extraction process on the FADECs associated with the China Airlines A300 Crash event in Taipei, Taiwan on Feb. 16, 1998, Flight #676. The team of investigators arrived at the Hamilton Standard Overhaul and Repair facility in East Windsor, CT, USA on April 28, 1998. The purpose of the visit was to document the condition of the FADECs involved in the event, and to extract fault data stored in the non-volatile memory within the FADECs.

Photographs were taken to document the condition of the FADECs. The FADECs were assigned unit identifiers to simplify the investigation process. Table 1 provides the unit identifiers that were assigned to the FADECs for the investigation. Table 2 and Table 3 provide a summary of the photographs taken during the investigation. The fault data extraction process was completed in one business day. Fault data was extracted from the Ch A and Ch B halves of the FADECs, and was provided to Pratt & Whitney for a system level analysis.

Table 1: FADEC Identification

Unit Identifier	FADEC Serial Number	FADEC Part Number	Engine Position
EEC#1	4000-0230	791100-6-095	Position #1
EEC#2	4000-0302	791100-6-090	Position #2

Photographs:
Photographs were taken to document the condition of the FADECs. Table 2 provides a summary of the photographs taken to document the condition of EEC #1. Table 3 provides a summary of the photographs taken to document the condition of EEC #2.

The following photographs document the condition of EEC #1:

Table 2: Photographs of EEC#1

Photo Number:	Description:
ECA32339D	Unit condition as-received - View #1
ECA32340D	Ch B housing damage and missing vibration isolator
ECA32341D	Missing vibration isolator
ECA32342D	Unit condition as-received - View #2
ECA32343D	Damaged cooling fins - Ch A
ECA32344D	Unit separated into Ch A and Ch B halves
ECA32346D	Condition of Ch A half
ECA32345D	Condition of Ch B half
ECA32347D	Ch A EEPROM devices - solder side
ECA32348D	Ch B EEPROM devices - solder side
ECA32349D	Ch A half - disassembled
ECA32350D	Ch A processor board assembly
ECA32351D	Ch A EEPROM devices - component side
ECA32352D	Ch B half - disassembled
ECA32353D	Ch B processor board assembly
ECA32354D	Ch B EEPROM devices - component side

The following photographs document the condition of EEC #2:

Table 3: Photographs of EEC #2

Photo Number:	Description:
ECA32355D	Unit condition as-received - View #1
ECA32356D	Unit condition as-received - View #2
ECA32357D	Unit separated into Ch A and Ch B halves
ECA32358D	Ch A half - disassembled
ECA32359D	Contamination in Ch A housing
ECA32360D	Ch A EEPROM devices - component side
ECA32361D	Ch B half - disassembled
ECA32362D	Ch B EEPROM devices - component side

Observations:
The investigation team assembled in the breakout room to discuss the activities to be performed on the FADECs. The 'List of Attendees' is attached as Appendix A. A synopsis of the FADEC was provided to the team. The synopsis provided details of the internal construction of the FADEC. It highlighted major subassemblies of the FADEC and the location of the fault memory devices on the Processor board assembly. The synopsis also provided an overview of the FADECs fault storage capabilities, and a summary of the types of faults the FADEC can identify. The 'FADEC Synopsis Presentation' is attached as Appendix B.

A test plan for the FADEC fault data extraction process was presented to the team for their review and concurrence. The test plan was updated to reflect the fault data extraction process that was agreed to by the team. The 'Fault Data Extraction Test Plan' is attached as Appendix C.

The FADECs arrived at Hamilton Standard on April 28, 1998. They were received in a cardboard shipping container with a shipping weight of approximately 73 pounds. The FADECs remained in the unopened shipping container until the entire team was present to witness their removal. The FADECs were double-wrapped in clear plastic bags. Each FADEC was labeled with the unit part number and serial number. Packing material was placed around and between the FADECs. The FADECs were processed through receiving inspection, and were delivered by the team to the investigation area.

The data extraction process was performed on EEC#1. Photos ECA32339D, and ECA32342D were taken to document the as-received condition of the FADEC. The team agreed that the unit appeared to be in good condition with only minor impact damage. Photos ECA32340D, ECA32341D, and ECA32343D were taken to document the impact damage to the FADEC. EEC#1 was then disassembled to gain access to the fault memory chips. The FADEC was separated into the Ch A and Ch B halves. Photos ECA32344D, ECA32345D, and ECA32346D were taken to document the condition of the unit. Photos ECA32347D, and ECA32348D were taken to document the condition of the solder joints associated with the fault memory chips. The team agreed that the fault memory chips appeared to be in good condition as viewed from the solder side of the board assembly, and that there did not appear to be any damage to the components.

Observations: (continued)
The Ch A half of the FADEC was disassembled. Photos ECA32349D, ECA32350D, and ECA32351D were taken to document the condition of the sub-assemblies. The team agreed that the Ch A Processor board assembly was in good condition, that it may be functional, and that it would be possible to install it into a test bed unit to extract the fault data. An ohm meter was used to verify the condition of the Ch A Processor board power supplies to ensure the power rails were not shorted. The Ch A Processor board assembly was then installed into the test bed unit, the laptop computer containing the fault data extraction software program was connected, and +28VDC ground test power was applied. The Ch A Processor board assembly successfully powered-up, and the fault data was uploaded to the laptop and stored on a floppy disk. The 'EEC#1 - Channel A Extracted Fault Information' is attached as Appendix D.

The Ch B half of the FADEC was disassembled. Photos ECA32352D, ECA32353D, and ECA32354D were taken to document the condition of the sub-assemblies. The team agreed that the Ch B Processor board assembly was in good condition, that it may be functional, and that it would be possible to install it into a test bed unit to extract the fault data. An ohm meter was used to verify the condition of the Ch B Processor board power supplies to ensure the power rails were not shorted. The Ch B Processor board assembly was then installed into the test bed unit, the laptop computer containing the fault data extraction software program was connected, and +28VDC ground test power was applied. The Ch B Processor board assembly successfully powered-up, and the fault data was uploaded to the laptop and stored on a floppy disk. The 'EEC#1 - Channel B Extracted Fault Information' is attached as Appendix E.

The data extraction process was then performed on EEC #2. Photos ECA32355D, and ECA32356D were taken to document the as-received condition of the FADEC. The team agreed that the unit appeared to be in good condition with only minor impact damage. EEC#2 was then disassembled to gain access to the fault memory chips. The FADEC was separated into the Ch A and Ch B halves. Photo ECA32357D was taken to document the condition of the unit. The team agreed that the memory chip appeared to be in good condition as viewed from the solder side of the board assembly, and that there did not appear to be any damage to the components.

Observations: (continued)
The Ch A half of the FADEC was disassembled. Photo ECA32358D was taken to document the condition of the sub-assemblies. The Ch A half of the unit contained some contamination. Photo ECA32359D was taken to document the contamination. The team inferred that the contamination was soil from the crash site, and that it had entered the Ch A housing through the damaged area near the J9 (DEP) connector. Photo ECA32360D was taken to document the condition of the Ch A fault memory chips. The team agreed that the Ch A Processor board assembly was in good condition, that it may be functional, and that it would be possible to install it into a test bed unit to extract the fault data. An ohm meter was used to verify the condition of the Ch A Processor board power supplies to ensure the power rails were not shorted. The Ch A Processor board assembly was then installed into the test bed unit, the laptop computer containing the fault data extraction software program was connected, and +28VDC ground test power was applied to the test bed. The Ch A Processor board assembly did not successfully power-up.

The team agreed that the fault memory chips would be removed from the Ch A Processor board assembly and installed into sockets on the Processor board assembly from the test bed unit. The test bed Processor board assembly was then installed into the test bed unit, the laptop computer containing the fault data extraction software program was connected, and +28VDC ground test power was applied. The test bed unit powered-up, however, it was determined that the microprocessor was in a state of continuous Power-On-Reset. The team agreed that the fault data could not be extracted with the microprocessor in this operational state, and to connect the test bed unit to the Hamilton Standard functional test rig to attempt to power-up the unit and print a hard copy of the fault information from the Ch A fault memory chips. This process was successful. The team agreed that another attempt would be made to connect the test bed unit to the laptop computer to extract the fault data in an electronic format. The test bed unit successfully powered-up, and the fault data was uploaded to the laptop and stored on a floppy disk. The 'EEC#2 - Channel A Extracted Fault Information' is attached as Appendix F.

The Ch B half of the FADEC was disassembled. Photos ECA32361D, and ECA32362D were taken to document the condition of the sub-assemblies. The team agreed that the Ch B Processor board assembly was in good condition, that it may be functional, and that it would be possible to install it into a test bed unit to extract the fault data. An ohm meter was used to verify the condition of the Ch B Processor board power supplies to ensure the power rails were not shorted. The Ch B Processor board assembly was then installed into the test bed unit, the laptop computer containing the fault data extraction software program was connected, and +28VDC ground test power was applied.

Page 6
8-TRB-8087

Observations: (continued)
The Ch B Processor board assembly successfully powered-up, and the fault data was uploaded to the laptop and stored on a floppy disk. The 'EEC#2 - Channel B Extracted Fault Information' is attached as Appendix G.

Follow-Up Activities:
When the fault data extraction process was completed, the investigation team assembled in the breakout room to conclude the investigation. Fault data was extracted from the Ch A and Ch B halves of EEC#1 and EEC#2. The extracted fault data files were provided to Pratt & Whitney for a system level analysis. A meeting to review the FADEC fault data was arranged for Wednesday, April 29, 1998 at the Pratt & Whitney facility in East Hartford, CT, U.S.A. The FADECs remained at the Hamilton Standard facility in East Windsor , CT in a disassembled condition. The final disposition of the FADECs will be coordinated with the Taiwan CAA, and China Airlines.

Timothy R. Bowman

Timothy R. Bowman
Sr. Service Engineer
Hamilton Standard - Customer Support

Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Pratt & Whitney
A United Technologies Company

4 June 1998

Mr. Lee Wan Lee
Deputy Director
Flight Standards Division
Civil Aeronautic Administration
Taipei Sungshan Airport (10592)
Taiwan, Republic of China

Subject: China Airlines Flight 676 Accident - Electronic Engine Control Memory Analysis

Dear Mr. Lee;

Attached is a combined summary report documenting the results of the investigation into the contents of the non-volatile memories (NVM) of the Full Authority Digital Engine Controls (FADEC's) from the engines on the China Airlines flight 676 accident airplane. The report combines two separate documents; one generated by Pratt & Whitney and the other by Hamilton Standard, into one package. The Pratt & Whitney generated portion provides a description NVM contents recorded on the accident flight. The NVM data is then analyzed with reference to the available DFDR data and Sequence of Events summary provided by the CAA. The Hamilton Standard portion includes a summary, general observations, and conclusions of the April 28 group investigation activity at Hamilton Standard's East Windsor, Connecticut facility. Attachments include a list of attendees, the test plan, and the extracted data. Photographs taken during the investigation are also provided.

Sincerely,

for M. L. Young

Dr. Michael C. Romanowski
Pratt & Whitney
Office of Flight Safety
860-565-3295 / -1568

cc: Mr. C. Keng, CAL
Mr. J. de Villeneuve, BEA
Mr. J. Guzzetti, NTSB
Mr. H. Donner, FAA
Mr. J. Daney, Airbus
Mr. T. Bowman, HSD

Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Pratt & Whitney
A United Technologies Company

CHINA AIRLINES FLIGHT 676 ACCIDENT INVESTIGATION
EEC131-1 FAULT DATA EXTRACTION AND ANALYSIS
SUMMARY OF ACTIVITY

April 28-29, 1998

An investigative team met on April 28, 1998 at the Hamilton Standard facility in East Windsor, Connecticut to extract data stored in the non-volatile memories of the engine FADEC's from the accident airplane. Representatives from China Airlines (accredited representative from the Taiwan CAA), Pratt & Whitney, Hamilton Standard, the United States FAA and NTSB were present. Members of the team also met on April 29, 1998 at the Pratt & Whitney facility in East Hartford, Connecticut to review and provide preliminary analysis of the extracted data. Names and affiliation of the team members are given on attachment 1. Data was successfully extracted from each channel of both FADEC's. The raw data is given on attachment 2. Electronic copies of the data were also given to the CAA accredited representative and Pratt & Whitney.

A Summary of Findings report for the FADEC's is expected to be generated by Hamilton Standard on or before May 15, 1998. This report is expected to contain a summary of the April 28 activity, general observations, and conclusions. Attachments will include photographs with explanations, a list of attendees, the test plan, and the extracted data.

A Pratt & Whitney report is expected to be completed on or before May 15, 1998.
It is expected to provide a description of the faults recorded on the accident flight. The report is also expected to relate the extracted FADEC data to the available DFDR data and Sequence of Events summary provided by the CAA.

The Hamilton Standard Summary of Findings report will be attached to the Pratt & Whitney report. This combined report is expected to be submitted to the Taiwan CAA on or before May 22, 1998. Pratt & Whitney will also forward copies to all parties.

Michael C. Romanowski
Pratt & Whitney
Office of Flight Safety

April 29, 1998

At approximately 23,000 Feet Pressure Altitude and .74 Mach Number the following Maintenance Messages were recorded:

Message Acronym	Cell Number	Channel Time
ST350X	109	13518
FIXME	110	13518
T5L	111	13518
T5XCF	112	13518

At approximately 3,000 Feet Pressure Altitude and .12 Mach Number the following Maintenance Message was recorded:

Message Acronym	Cell Number	Channel Time
SURGE	113	13523

<u>Channel B</u>

On the Ground prior to dispatch the following Maintenance Messages were recorded:

Message Acronym	Cell Number	Channel Time
T3L	153	13519
T3XCF	154	13519
ST350X	155	13519

At approximately 29,000 Feet Pressure Altitude and .78 Mach Number the following Maintenance Messages were recorded:

Message Acronym	Cell Number	Channel Time
FIXME	156	13519
T5XCF	157	13519

At approximately 2,900 Feet Pressure Altitude and .04 Mach Number the following Maintenance Message was recorded:

Message Acronym	Cell Number	Channel Time
SURGE	158	13523

The Contents of FADEC Serial Number 4000-0320, which was mounted on Engine serial Number 724017 in position 2 of Aircraft 676 is as follows:

Channel A

At approximately 3,200 Feet Pressure Altitude and .13 Mach Number the following Maintenance Message was recorded:

Message Acronym	Cell Number	Channel Time
PBSTL	184	14560

Channel B

At approximately 2,700 Feet Pressure Altitude and .15 Mach Number the following Maintenance Message was recorded:

Message Acronym	Cell Number	Channel Time
PBSTL	126	14560

The following describes the interpretation of the above maintenance messages.

ST350X - The definition of this Maintenance Message is that the Opposite Channel has stored a Maintenance Message which will be made available to the Aircraft Maintenance System during "Maintenance Playback". The purpose of this message is to synchronize The "Flight Legs" within the FADEC to insure the integrity of the Playback function. This Message is not communicated to the Aircraft.

FIXME - The definition of this Maintenance Message is that the Control System is in a "Long" Time Limited Dispatch (TLD) condition (Fault Level C in the Engine Type Certificate). Currently, the time limit on this condition is 1,000 operating hours. This maintenance Message is communicated to the Aircraft on the ARINC data bus via Octal Label 350 Bit 18.

PBSTL - The definition of this Maintenance Message is that the FADEC has detected a rapid drop in Burner Pressure and activated the "Stall Recovery Logic" . This Message is communicated to the Aircraft on the ARINC data bus via Octal Label 272 Bit 25.

SURGE - The definition of this Maintenance Message is identical to PBSTL above.

T3L - The definition of this Maintenance Message is that the FADEC has detected that the Tt3 measurement for that channel has gone out of the allowable range of values. This range is -80 °C to 1,000°C. This Maintenance Message is communicated to the Aircraft on the ARINC data bus via Octal Label 352 Bit 22.

T3XCF - The definition of this Maintenance Message is that the FADEC has detected that the value of Tt3 measured by the Local Channel is different for the Tt3 value measured by the opposite Channel. The tolerance on this disagreement is 50 °C. This Maintenance Message is communicated to the Aircraft on the ARINC data bus via Octal Label 353 Bit 22.

T5L - The definition of this Maintenance Message is that the FADEC has detected that the Tt5 (EGT) measurement for that channel has gone out of the allowable range of values. This range is -80 °C to 1,000°C. This Maintenance Message is communicated to the Aircraft on the ARINC data bus via Octal Label 352 Bit 19.

T5XCF - The definition of this Maintenance Message is that the FADEC has detected that the value of Tt5 (EGT) measured by the Local Channel is different for the Tt5 value measured by the opposite Channel. The tolerance on this disagreement is 100 °C. This Maintenance Message is communicated to the Aircraft on the ARINC data bus via Octal Label 353 Bit 19.

DESCRIPTION OF DFDR ENGINE DATA

The DFDR data of primary engine parameters was updated every four seconds with a one second stagger between the data for engine #1 and #2. The data was available to Pratt & Whitney for the last two and one-half minutes of the flight for times between 12:03:28 and 12:05:56 Universal Time Code (UTC). Time history plots of this DFDR data are attached in Appendix H.

At the beginning of this time period, both engines were stabilized at a typical approach power condition as the airplane was descending during the approach to the Taipei airport. Engine parameters for both engines show good agreement with no unusual behavior.

Just after 12:05:01 UTC, the throttles for both engines smoothly increased from about 41 degrees to 54 degrees throttle resolver angle. EPR, N2, fuel flow, and EGT for both engines began to increase uniformly in response to the throttle input. This addition in thrust slowed the rate of descent of the airplane, then allowed the airplane to climb. During this time period, altitude reached a minimum of 1323 feet before increasing to about 1470 feet.

Just after 12:05:13 UTC, both throttles increased from approximately 54 degrees to the maximum (takeoff/go-around) throttle position of 82 degrees throttle resolver angle. Engine #2 was initially about 1 degree throttle resolver angle short of the maximum throttle position, but soon after was fully advanced. Engine parameters for both engines increased uniformly in response to the throttle input for go-around power. After about seven seconds at 12:05:20 UTC, altitude began to slowly then rapidly increase.

Approximately sixteen seconds after reaching go-around power, just past 12:05:36 UTC with the airplane climbing through 2535 feet altitude, EPR for both engines suddenly dropped even though both throttles remained at the go-around position. Pratt & Whitney believes that the sudden drop in EPR before the throttles were retarded was a high power surge on both engines. This conclusion is supported by the drop in N2 and fuel flow and the corresponding upward inflection in EGT just after 12:05:36 UTC. For both engines to have surged nearly simultaneously, there likely was some large, common, external destabilizing influence.

Approximately four seconds later, just past 12:05:40 UTC, as the altitude of the airplane approached 2700 feet, the throttles for both engines were retarded smoothly and nearly linearly to end approximately 12 seconds later at 12:05:52 UTC at 53 degrees throttle resolver angle. During this time period as the throttles were retarded, the altitude of the airplane dropped rapidly from a peak of 2751 feet to 1543 feet and was continuing to rapidly decrease. Both engines recovered from surge by 12:05:44 UTC as evidenced not only by the small overall increase in EGT (under 20 degrees C), but also by the inflections in EPR, N2, and fuel flow and by the decrease in EGT as the throttles were retarded.

Following surge recovery, both engines exhibited normal deceleration characteristics as the throttles continued to be retarded to 53 degrees throttle resolver angle position. Both engines were continuing to decelerate toward their new commanded power level based on throttle position at the end of the recording.

RELATIONSHIP OF DFDR TO FADEC MAINTENANCE MESSAGES AND SEQUENCE OF EVENTS SUMMARY FROM CAA

The Sequence of Events summary, attached in Appendix I, indicated that go-around power was selected at 12:05:14 UTC and that the airplane began to pitch up. This is consistent with the DFDR which indicated that just after 12:05:13 UTC, both throttles increased to go-around throttle position.

The Sequence of Events summary indicated that at 12:05:27 UTC airplane pitch attitude increased above 37 degrees nose up and that at 12:05:32 UTC calibrated airspeed (CAS) decreased below 100 knots. Furthermore, at times between 12:05:33 and 12:05:40 UTC, significant left and right roll of the airplane suggest controllability problems such as might be expected if the wings of the airplane stalled and lost lift. Under these conditions of very high airplane pitch angle and slow airspeed beyond levels demonstrated in engine-airframe compatibility testing, the airflow into the engine inlets becomes severely distorted and this significant pressure distortion can cause engine surge.

The engines appear to have surged just past 12:05:36 UTC when the airplane pitch attitude was above 37 degrees, airspeed was below 100 knots, and airplane controllability problems occurred as indicated by the left and right airplane roll. When the airplane pitch attitude decreased, as was occurring at 12:05:42 UTC, inlet distortion would have diminished. The decreased engine power request associated with the retarding of the throttles beginning at 12:05:40 UTC would have further reduced the inlet distortion, and both engines then recovered from surge as the destabilizing inlet distortion was reduced. Both engines then continued to decelerate normally as they followed the retarding throttle input.

Based on the surge characteristics observed for each engine in the DFDR, P&W expected to find a surge flag in the contents of the FADEC maintenance memory for each engine during this flight. That was, in fact, what was found. For engine position #1, the surge flag was recorded at 9728 N2 at an altitude between 2890 feet (Channel B) and 3162 feet (Channel A) and between a Mach Number of 0.04 (Channel B) and 0.12 (Channel A). For engine position #2, the surge flag was recorded at 9600 N2 and at an altitude between 2768 feet (Channel B) and 3201 feet (Channel A) and between a Mach Number of 0.13 (Channel A) and 0.15 (Channel B). The conditions present when the surge flags were stored support the very slow airspeed documented in the Sequence of Events summary at nearly 3000 feet altitude as indicated in both the DFDR and the Sequence of Events summary. No other related maintenance messages were present.

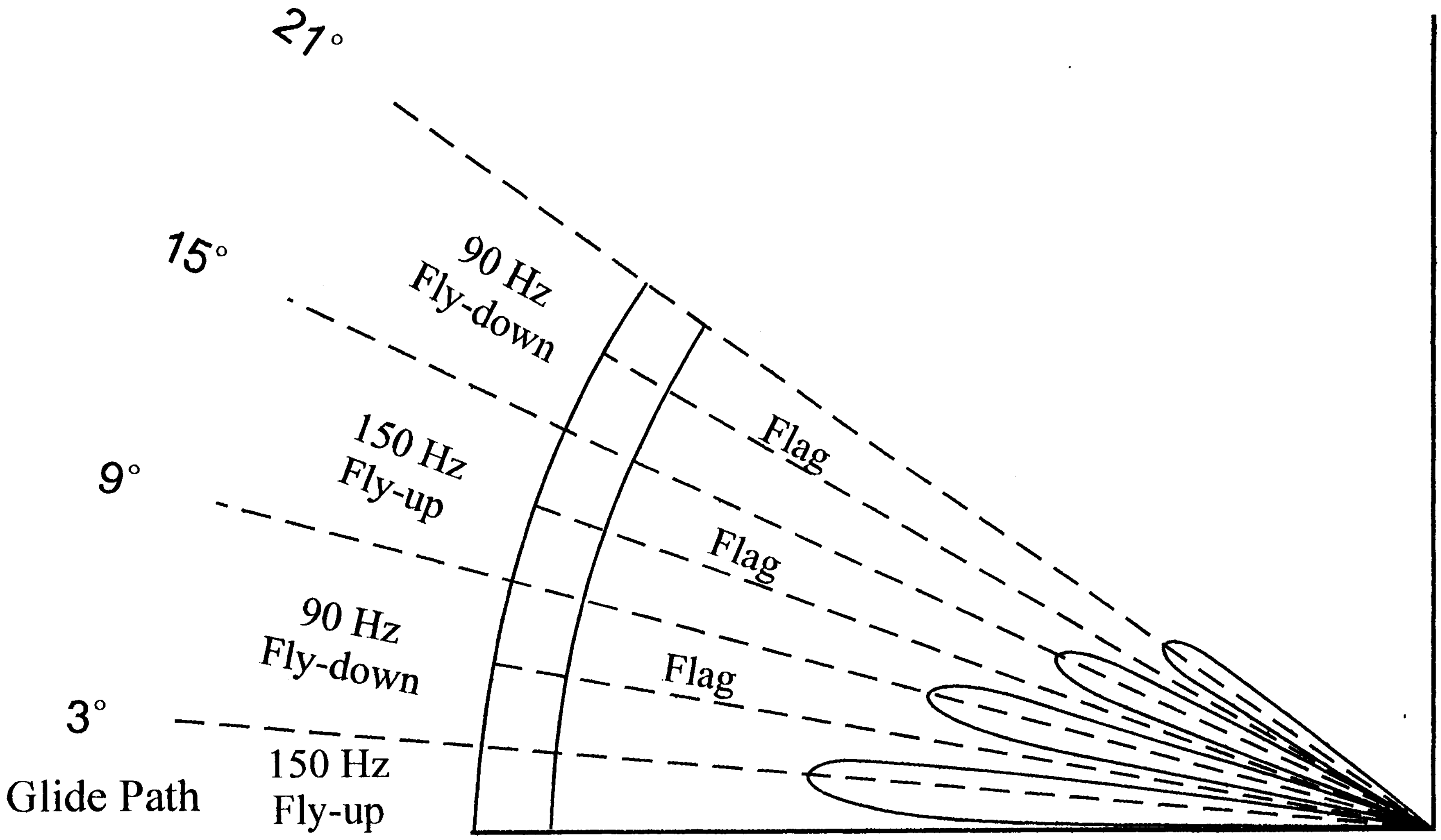
SUMMARY

The DFDR engine data, recorded FADEC maintenance messages, and the CAA's Sequence of Events summary are all consistent in describing the time history of events. Throughout the final two and one-half minutes, the engines responded normally to the throttle input except for the surge which occurred on each engine with the significant inlet distortion caused by too high an airplane pitch angle at too low an airspeed.

5/15/98

Appendix 16

B-1814 Approach Diagram Relevant to the Glide Slope

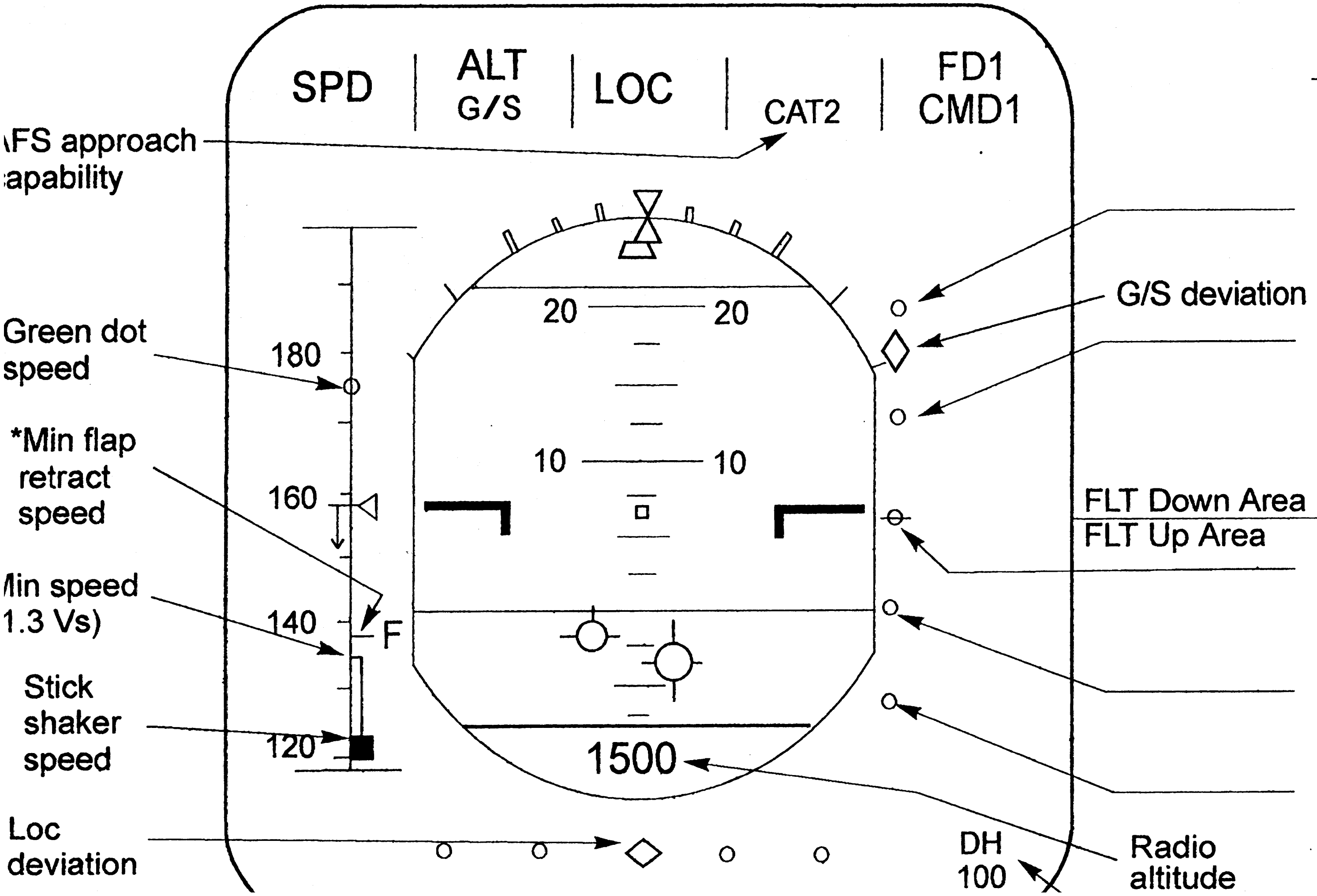


Signal Structure Diagram (NOT SCALE)

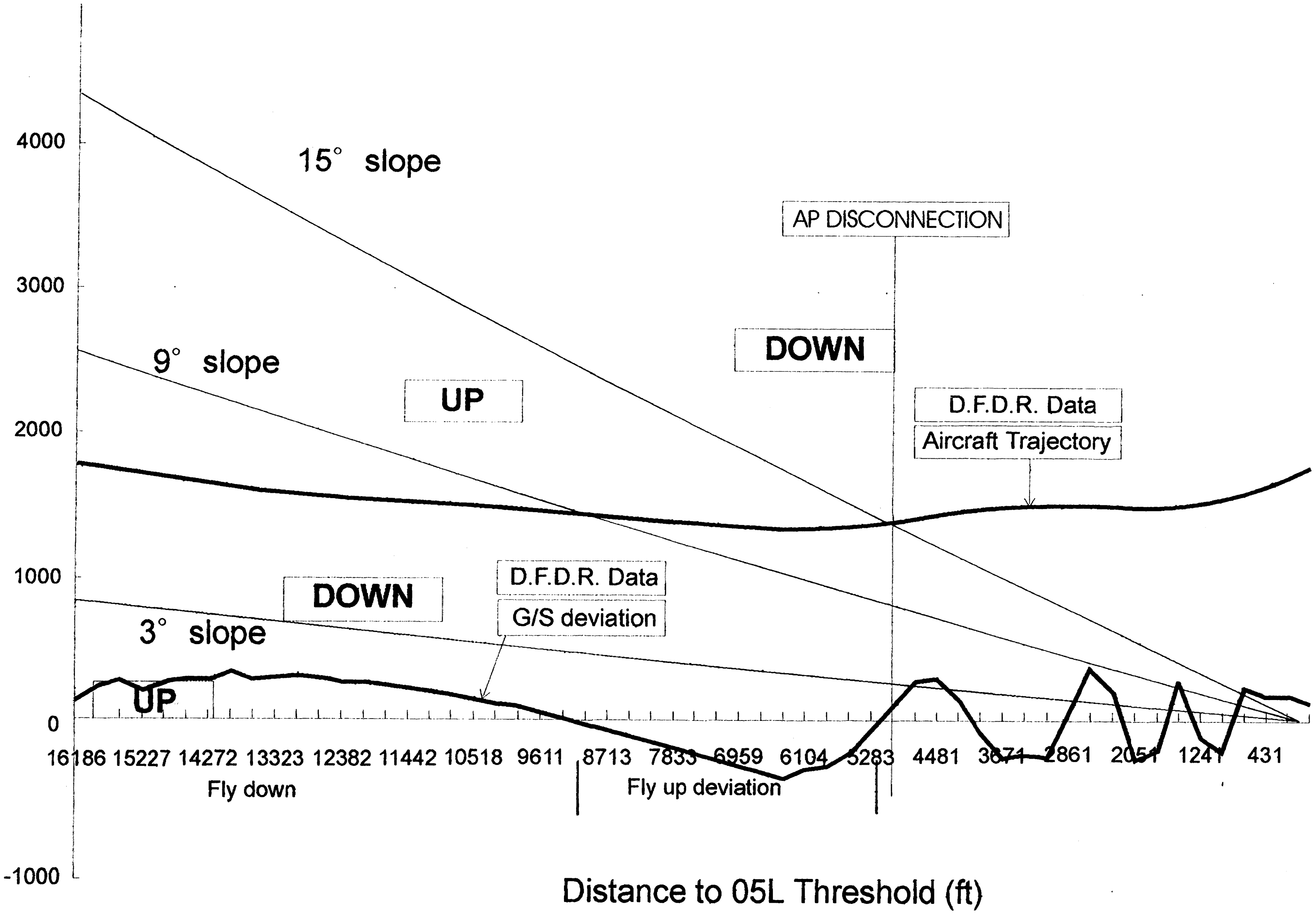
Appendix 16 B-1814 Approach Diagram relevant to the Glide Slope

A300-600R EFIS primary flight display

PFD Approach before glide capture
AP 1 engaged in CMD



PFD Indication	Normal A/P - ON Mode→captured
2 dot high	This Area Aircraft Pitch up Intercept glide slope
1 dot high	
ON Glide Slope	
1 dot low	This Area Aircraft Pitch down Intercept glide slope
2 dot low	



4000
3000
2000
1000
0
-1000
15° slope
9° slope
3° slope
UP
DOWN
DOWN
UP
AP DISCONNECTION
D.F.D.R. Data
Aircraft Trajectory
D.F.D.R. Data
G/S deviation
16186 15227 14272 13323 12382 11442 10518 9611 8713 7833 6959 6104 5283 4481 3671 2861 2051 1241 431
Fly down
Fly up deviation
Distance to 05L Threshold (ft)

Appendix 19

BEA's Comments

MINISTERE DE L'EQUIPEMENT, DES TRANSPORTS ET DU LOGEMENT

INSPECTION GENERALE DE L'AVIATION CIVILE
ET DE LA METEOROLOGIE

BUREAU ENQUÊTES-ACCIDENTS

Le Bourget, le 4 February 1999

N°000156 IGACEM/BEA/I

Objet : Accident of B1814 at CKS airport (Taiwan)
on 16 February 1998

V/réf : your letter dated January 15, 1999

Mr. Lee, Wan-Lee
Investigator In Charge
Civil Aeronautics Administration
Sung Shan Airport
340 TUN HUA North Road
TAIPEI, TAIWAN 105

Dear Mr Lee

Thank you for having given us the opportunity to review the draft final report on the accident of the A300-622R registered B1814.

This report shows well the extensive work performed during the investigation, and accurately represents the circumstances of the accident and the underlying reasons.

The BEA concurs with the content of the report and with its conclusions and recommendations.

Consequently, we have no specific comment to make on this draft report and we look forward receiving the final report upon its publication.

I take this opportunity to thank you for associating our team in all stages of your investigation, and for the spirit of cooperation that prevailed between all participants.

Sincerely

J.P. de VILLENEUVE

Appendix 20

NTSB's Comments

National Transportation Safety Board
Washington, D.C. 20594

29 December 1998

Mr. Lee, Wan-Lee
Senior Investigator
Flight Standards Division
Civil Aeronautics Administration
Ministry of Transportation and Communications
Sung Shan Airport
Taipei, Taiwan 105
Republic of China

Dear Mr. Lee:

Thank you for the opportunity to meet with you and your staff to discuss the Civil Aeronautics Administration's draft report on accident involving a China Airlines Airbus A300B4-622R, B-1814, that crashed on February 16, 1998. During the meeting, the Safety Board's technical specialists went through the report in detail and provided their comments. These comments were discussed at length during the meeting.

Based on the results of the meeting, the Safety Board staff does not have any further comments regarding the draft report. We found the report to be thorough and addressed the important issues of the investigation in a direct manner. The Safety Board looks forward to receiving a copy of the final report on the accident.

Thank you for the opportunity to meet with you and provide our comments to the draft report.

Sincerely,

Thomas E. Haueter
Chief, Major Investigations Division

Appendix 21

BASI's Comments

COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

BASI
Bureau of Air Safety Investigation

21 December 1998

Lee, Wan-Lee
Senior Investigator
Flight Standards Division
Civil Aeronautics Administration
Taiwan

Dear Captain Lee

In response to your letter of 30 October 1998 concerning the BASI comments on the draft report of the accident involving China Airlines Airbus A300 on 16 Feb 1998, firstly, let me thank you for the invitation for BASI to assist the CAA in this investigation.

After the CAA draft report was received at BASI, a team of experienced investigators and analysts was formed to read the draft report and make comment internally. The team then identified the areas that needed to be addressed when the CAA team arrived in Canberra. You will remember that during the week following the arrival of the CAA team, the two teams had extensive discussions regarding the content of the draft report and some aspects associated with the translation of the report into English. These discussions covered all of the points that the BASI team had previously identified as needing to be addressed.

At the end of the CAA visit, the BASI team was satisfied that the draft report presented the facts and analysis according to the CAA requirements and also was readable in the ICAO international language.

The Bureau was pleased to be able to help the CAA in this way and enjoyed the informal, professional working relationship that existed between the two organisations during this process. All involved also have fond memories of the out-of-session activities the two teams participated in.

Best regards

Dr Rob Lee
Director