AIRCRAFT ACCIDENT REPORT 1/97

ACCIDENTS INVESTIGATION DIVISION

Civil Aviation Department
Hong Kong

Report on the Incident to
Airbus A320-231 VR-HYU
at Hong Kong International Airport
on 6 June 1994

民航處 Civil Aviation Department

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The Right Honourable Christopher Patten
Governor of Hong Kong
Government House
Hong Kong

Sir,

In accordance with regulation 10(6) of the Hong Kong Civil Aviation (Investigation of Accidents) Regulations I have the honour to submit the report by Mr Jeffrey TO, an Inspector of Accidents, on the circumstances of the incident to Airbus A320-231 aircraft, Registration VR-HYU, which occurred in Hong Kong on 6 June 1994.

Yours faithfully,

R.A. Siegel
Director of Civil Aviation

Contents | Page

5. APPENDICES

GLOSSARY

Abbreviation Explanation

AFC	Airport Fire Contingent
AFM	Aircraft Flight Manual
AP	Auto-Pilot
ATC	Air Traffic Control
BSCU	Brake System Control Unit
CAD	Civil Aviation Department (Hong Kong)
CFDS	Centralized Fault Display System
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
ECAM	Electronic Centralized Aircraft Monitoring System
EFCS	Electronic Flight Control System
ELAC	Elevator Aileron Computer
FA	Flight Attendant
FAC	Flight Augmentation Computer
FCDC	Flight Control Data Concentrator
FCOM	Flight Crew Operations Manual
FCU	Flight Control Unit
FFS	Full Flight Simulator
FMGC	Flight Management Guidance Computer
FP	Flight Purser
FWC	Flight Warning Computer
GPWS	Ground Proximity Warning System
HAECO	Hong Kong Aircraft Engineering Company
HKIA	Hong Kong International Airport
IGS	Instrument Guidance System
ILS	Instrument Landing System
LOFT	Line Oriented Flight Training
MAP	Missed Approach Procedure
NWS	Nose Wheel Steering
OEB	Operational Engineering Bulletins
OM	Outer Marker
PA	Public Address
PAR	Precision Approach Radar
PCU	Power Control Unit
PIO	Pilot Induced Oscillation
POB	Pressure Off Brake
QAR	Quick Access Recorder
QRH	Quick Reference Handbook
RTF	Radiotelephone
SEC	Secondary Spoiler Elevator Computer
SFCC	Slat/Flap Control Computer
SP	Senior Purser
TOGA	Take-Off Go Around
WOG	Wheels-on-ground

ACCIDENTS INVESTIGATION DIVISION

CIVIL AVIATION DEPARTMENT

Aircraft Accident Report No. 1/97

Owner and Operator	:	Hong Kong Dragon Airlines Limited (HDA)
Aircraft Type	:	A320-231
Registration	:	VR-HYU
Place of Incident	:	Hong Kong
Date and time	:	6 June 1994 at 0917 hr (daylight)

All times in this report are UTC

SYNOPSIS

At 0834 hr on 6 June 1994, an A320 aircraft registration VR-HYU was at 800 ft on an Instrument Guidance System (IGS) approach to Runway 13 at Hong Kong International Airport (HKIA) when it encountered a severe gust. The gust caused the trailing edge flaps to lock in the fully down position and for a "FLAPS LOCKED" caption to be displayed on the cockpit Electronic Centralized Aircraft Monitoring System (ECAM). The Captain decided to go around.

A second approach to Runway 13 was carried out with the FLAPS lever at Config 3 as directed by the Flight Crew Operating Manual (FCOM) procedure which was also displayed on the relevant ECAM system page. This approach was abandoned due to transient but pronounced lateral oscillations of the aircraft.

The Captain then decided to attempt to land on Runway 31. Some 30 minutes later with the flaps still locked fully down and the slats now at 18° a manual approach to runway 31 was commenced. When the aircraft was below 1200 feet lateral oscillations again occurred

with roll angles of up to ±30° recorded on the Digital Flight Data Recorder (DFDR). Again the Captain carried out a missed approach procedure.

By this stage the aircraft's fuel state was critical and a fourth approach was attempted with slats at 22° and the Flaps locked at 40° (FLAPS lever at Config 3). Again, roll oscillations of up to ±30° occurred at about 1200 ft and continued throughout the approach. Because of the low fuel state, the Captain decided to continue the approach and land. The aircraft touched down within the normal landing area and on the runway centreline. Within 5 seconds of touchdown the aircraft departed the paved runway to the right at a constant track of 324°T and after traversing the runway strip came to rest on the paved parallel taxiway B1. The Captain ordered an evacuation and an orderly evacuation took place using the port-side doors and the over-wing exits.

The report concludes that the aircraft, on its first approach, encountered a gust of sufficient intensity to produce asymmetric movement of the flaps. The asymmetric movement caused the flaps to lock and generated a "FLAPS LOCKED" message on the ECAM. By selecting the FLAPS lever to Config 3 as directed to by the ECAM the lateral control law became sensitive when the flaps were locked in the Config FULL position (40°) and hence rendered the aircraft difficult to control in roll in turbulent conditions.

The performance of the crew degraded as the degree of anxiety and level of stress on them increased. Approach briefings were omitted, the landing check list was not properly performed and routine crew co-ordination on the flight deck broke down completely towards the end of the flight.

The departure of the aircraft from the runway after touchdown was caused by the apparent delay by the Captain to exercise effective directional control.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 General

Dragonair Flight 323 (HDA 323) was a regular charter passenger flight from Nanjing to Hong Kong. It departed Nanjing at 0625 hr on 6 June 1994 with two pilots, five cabin attendants and 141 passengers on board.

Departure and en-route phases of the flight were uneventful and the aircraft was then cleared for an IGS approach to Runway 13 at HKIA. The IGS approach is a non-precision instrument approach which provides instrument guidance signals in azimuth and glide-slope until approximately 1.7 nm from touchdown at which point a visual right turn of 47° is required to continue the approach (Appendix 1). At about 9 nm from touchdown, auto-pilot was disengaged and the Captain continued the approach manually. At that time, there was no precipitation, the main cloud base was about 2500 ft, visibility was good and the wind was easterly at 15-20 kt gusting to 30 kt.

1.1.2 First Approach

When HDA 323 was approaching the IGS Outer Marker (OM), the landing gear was extended followed shortly by the selection of landing flaps (Config FULL). On passing 1700 ft, the aircraft was fully configured for landing with the FLAPS lever set at Config FULL (i.e. Flaps at 40° and slats at 27°) and the landing gears extended and locked.

At 0834 hr, when the Captain was about to commence the visual right turn at 800 ft to line up with the runway, the aircraft encountered a severe gust which caused the flap to lock in the fully extended position (40°). This event was

displayed, through the ECAM, on the Engine/Warning display unit at the centre of the pilots instrument panel (Appendix 2). The Captain immediately initiated a go-around and carried out the IGS missed approach procedure (MAP). As the FLAPS lever was raised one stage up (Config 3), roll oscillations began but were soon corrected and the Captain continued the MAP without difficulty and levelled off at 4500 ft.

1.1.3 Second Approach

At 0848 hr, after being radar vectored by Hong Kong Approach, the aircraft established on the localizer for a second IGS approach to Runway 13. The Auto-pilot was engaged and the slats were set at 22° with the flaps locked at 40° (FLAPS lever at Config 3). On passing 3000 ft at about 10 nm from touchdown, landing gear was extended. Almost immediately the gear was lowered, the aircraft experienced diverging roll oscillations. The Captain called for gear up and carried out the IGS MAP again. The auto-pilot was disengaged and the oscillations continued to a maximum of 20° of roll. Air Traffic Control (ATC) radar plots showed that the aircraft was on the correct IGS missed approach track during the initial climb out but shortly after passing the IGS OM the aircraft started to turn right onto a south-easterly heading and climbed through 4500 ft. The crew reported to ATC that they had a serious problem with the flight controls and the aircraft was uncontrollable. They requested Runway 31 and radar assistance. The aircraft climbed through the 4500 ft MAP altitude to 5000 ft and was instructed to maintain that altitude and track direct to the Charlie Hotel (CH) VOR/DME beacon.

1.1.4 Third Approach

HDA 323 contacted Hong Kong Approach and was given radar vectors for an approach to Runway 31. At 0901, the landing gear was extended and the

aircraft established on the ILS localizer for Runway 31 for the third attempt to land. At about 5 nm from touchdown, the auto-pilot was disengaged and the Captain continued the ILS approach which was monitored by Precision Approach Radar (PAR). The FLAPS lever was set at Config 1 with flap locked at 40° and slats at 18°. The aircraft was slightly above the glide path but otherwise the approach was relatively smooth. At about 3 nm from touchdown, large roll and pitch movements were recorded on the DFDR. The aircraft started to experience diverging roll oscillations. At about 1 nm from touchdown, the Ground Proximity Warning System (GPWS) detected an excessive sink rate and triggered a synthetic verbal warning "SINK RATE SINK RATE". Thrust was increased promptly but at the same time roll oscillations increased significantly in magnitude to a maximum of ±30°. The approach was continued for a few more seconds and the Captain then initiated the MAP at about 0.5 nm from touchdown. At that time, surface wind was 100°/22 kt. The approach procedure for Runway 31 is shown at Appendix 3.

1.1.5 Fourth Approach

After the aircraft was stabilized in the missed approach, the Captain, due to the low fuel state, declared an emergency and requested a landing on Runway 31 as soon as possible. Full emergency stand-by was initiated by ATC at 0904 and radar assistance was given again for a further approach. At 0913 the Captain reported 'visual' when the aircraft was on left base about 4 nm south of the Runway 31 OM. HDA 323 was then cleared for a visual approach. At about 7 nm from touchdown, the flight was cleared to land and advised that the surface wind was 090°/19 kt. The approach was carried out with the FLAPS lever set at Config 3 (with flaps locked at 40° and slats at 22°) and with the auto-pilot engaged. At about 1200 ft auto-pilot was disengaged but was re-engaged after a few seconds. Landing gear was extended on passing 1000 ft and the auto-pilot was disengaged again at 800 ft. The aircraft experienced significant roll oscillation from 1200 ft on the approach all the way until touchdown. At that time, surface wind was 090°/13 kt.

1.1.6 Landing

At 0917 hr, the aircraft landed within the normal touchdown zone close to the runway centre-line at a ground speed of 161 kt and tracking 319°T (Runway direction is 314°T). DFDR data showed that the aircraft changed track to 324°T within 5 seconds of touchdown. The aircraft then departed the runway paved surface to the right on to the grass area and headed towards the northern edge of the runway promontory. However, towards the end of the landing roll, the Captain managed to steer the aircraft on to taxiway B1. The outer tyre of the left main gear was punctured and smoke was observed coming from the main landing gear by the Airport Fire Contingent (AFC) who signalled the Captain to initiate an emergency evacuation on the port side. Seven passengers received minor injuries or suffered from shock and were taken to hospital for observation and treatment. A plot showing the events of the aircraft after landing is at Appendix 4.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	0	0	-
Serious	0	0	-
Minor	0	3	-
None	7	138	-

1.3 Damage to aircraft

Apart from a burst tyre, a few score marks on the oleo of a main-undercarriage and cracks at the edge margin of wing root support brackets, the aircraft was not damaged.

1.4 Other damage

The aircraft damaged two runway edge lights when it departed the runway paved surface on to the adjacent grass area.

1.5 Personnel information

1.5.1 Flight crew

Commander	:	Male, aged 39 years
Licence	:	ATPL (A) valid until June 1999
Aircraft rating	:	A320 on 28 February 1993
Instrument rating	:	Renewed on 17 January 1994
Medical certificate	:	Valid with no limitations
Date of last line check	:	30 March 1994
Last CRM training	:	February 1993

Flying experience

Total all types	:	8500 hr
Total on type	:	822 hr
Total in last 28 days	:	55 hr
Total in last 7 days	:	8 hr 20 min

Duty time	:	Off duty at 1300 hr 5 June until 0200 hr 6 June 1994 (13 hr)
		On duty at 0200 hr 6 June 1994 (7 hr 17 min up to the time the aircraft came to a stop)

Co-pilot	:	Male, aged 39 years
Licence	:	CPL (A) valid until July 1998

Aircraft rating	:	A320 on 9 March 1993
Instrument rating	:	Renewed on 10 July 1993
Medical Certificate	:	Valid with requirement to wear glasses
Date of last line check	:	26 April 1994
Last CRM training	:	February 1993

Flying experience

Total all types	:	4190 hr
Total on type	:	616 hr
Total in last 28 days	:	43 hr
Total in last 7 days	:	11 hr 41 min

Duty time	:	Off duty on the previous day (5 June 1994) On duty 0200 hr 6 June 1994 (7 hr 17 min up to the time the aircraft came to a stop)

1.5.2 Cabin Crew

The Cabin crew comprised one senior purser (SP), one flight purser (FP) and three flight attendants (FA). All were qualified in accordance with regulatory requirements to carry out their duties and were medically fit. All of them had satisfactorily completed emergency procedures and safety/survival equipment training within the 12-month period prior to the occurrence.

1.6 Aircraft Information

1.6.1 Particulars

Manufacturer	:	Airbus Industrie
Type/Model	:	A320 - 231

Serial No.	:	447
Date of Manufacture	:	December 1993
Certificate of Airworthiness	:	Issued 3 December 1993
		Valid to 2 December 1994
Certificate of Maintenance	:	Valid to 30 July 1994
Total airframe hours	:	807
Maximum take off weight	:	75500 kg
Maximum landing weight	:	64500 kg
Weight at time of incident	:	when flap lock occurred 59500 kg
		on landing 56700 kg
Centre of Gravity	:	within limits
Fuel on board on departure	:	8700 kg
Fuel on board after landing	:	480 kg

1.6.2 **General description**

The A320-231 is a short to medium range, twin-engined single aisle, subsonic commercial transport aircraft. It has been designed and manufactured using both conventional concepts together with optimum use of up-to-date technology.

This includes the use of a combination of conventional mechanically commanded powered flying controls together with digital "fly by wire" Computerized Electronic Flight Control Systems (EFCS).

Two main characteristics distinguish a fly-by-wire control system:

(i) The commands given by the crew are transmitted in electrical form to the computers and are not directly transmitted to the servo control actuator by mechanical means.

(ii) The flight control computers also receive, as input data, the information delivered by the Auto Flight System to onboard sensors and can, from this, generate the optimized flight control deflection commands for each flight phase.

This second point permits an improvement in the flying qualities by providing extensive flight envelope protection and reduces the pilots' workload as the system can automatically compensate for external disturbances such as turbulence. If the system detects a movement of the aircraft when the pilot has not given the command, it will itself through the auto trimming system, compensate for this movement. It can also incorporate automatic limitations preventing the aircraft from going beyond predetermined values stored in memory such as load factors, high angles of attack or roll rates.

The result is that, unlike aircraft with conventional mechanical flight controls, there is no one-to-one relationship between the position of the pilots controls (side-stick controllers) and the position of the control surfaces while the aircraft is in Flight mode.

The Airbus Industrie A320 aircraft type was certified under Airworthiness Requirements JAR 25 at Change 11 plus Special Conditions. The Direction Generale de l'Aviation Civile (DGAC) of France is the airworthiness authority responsible for Export Certificate of Airworthiness issue and continued airworthiness. At the time of the incident there were approximately 450 Airbus Industrie A320 aircraft in service world wide, operated by some 47 airlines, of which 131 were the A320-231 variant, similar to those operated by Hong Kong Dragon Airlines.

VR-HYU was one of a fleet of seven A320-231 aircraft operated by Hong Kong Dragon Airlines. This aircraft was configured to carry 166 passengers in a single class configuration. The aircraft was equipped with two V2500-A1

engines manufactured by the International Aero Engines consortium (AG IAE). The two power plants fitted to the aircraft at the time of the incident were installed at aircraft manufacture.

1.6.3 Flight Controls

The flight controls of A320 aircraft are divided into primary and secondary systems.

The primary controls comprise ailerons, roll spoilers, elevators, trimmable horizontal stabilizer (THS) and rudder to control the aircraft about the longitudinal, lateral and normal axes.

There are five spoilers and one wing tip aileron on each wing. All five spoilers are used on the ground for lift dump. In flight, roll control is achieved through the aileron and four spoilers (Spoiler 2 to 5). The maximum deflection is 25° for the ailerons and 35° for the spoilers. The ailerons are manually controlled by lateral deflections of the side-stick controllers or automatically by autopilot and load alleviation commands. There is no provision for flight crew roll trim adjustment.

Yaw control is provided by a single rudder actuated by three mechanically commanded servo control actuators operating in parallel, each of which are normally powered by different hydraulic systems. The servo control actuator inputs are provided by two interconnected pairs of flight deck operated pedals in the manual mode using a conventional single load path mechanical linkage control system to the middle servo control actuator.

The primary system architecture is such that pilot demands are signalled to the flight control computers by conventional rudder pedals and pedestal mounted trim controls, whereas the control columns are replaced by two independent

but electrically interconnected side-stick controllers. The side-sticks include roll and pitch position transducers together with artificial feel mechanisms. As the side-stick controllers are not slaved to the Auto-Pilot (AP) a solenoid-operated detent holds the side-stick controller in the neutral position when the AP is engaged. The crew can override this solenoid to gain manual control, this action also disengages the AP.

The secondary flight control systems consisting of five sections of leading edge slats and two sections of trailing edge Fowler flaps per wing. These provide optimized aircraft flight handling at low speeds. Additionally each wing is fitted with five independent panels which operate as airbrakes for decelerating at all flight speeds and ground spoilers for landing deceleration. These systems are electrically controlled and hydraulically actuated.

Slats and flap flight deck demands are made through a conventional single lever to a command sensor unit where physical movements are converted into electrical signals. The signals are in turn received and processed by the two Slat and Flap Control Computers (SFCC) each of which is capable of independent monitoring and control of the slats and flaps.

Each SFCC has the same functions and includes one slat and one flap channel. The flap channels each control one of the two valve blocks on the flap Power Control Unit (PCU). SFCC 1 controls the supply of green hydraulic pressure to the related PCU motor while SFCC 2 controls yellow system. Each channel has two electrical lanes that utilise different hardware and software.

The slats and flaps can be selected to the configurations shown in Appendix 5. There are two lever baulks between Config 1 & 2 and between 3 & FULL. The baulks prevent a one movement change of the FLAPS lever from 0 to Full.

Flap surface actuation is by a hydraulically operated PCU. The PCU comprises a differential gear box driven by two hydraulic motors. Movement of each motor is controlled by dedicated valve blocks in conjunction with the associated Pressure Off Brake (POB). If a POB engages and holds its motor the remaining motor moves the transmission at half speed but full torque. A separate but similar PCU is provided to actuate the slat system.

The gear box drives a series of mechanical transverse shafts and rotary actuators to move both inner and outer flaps simultaneously on each wing.

The inner and outer sections of flap are independent but connected by a dual sensor interconnecting strut. The interconnecting strut will monitor excessive relative movement between the inner and outer flaps, of which, because of the geometry of the two sections there is an approximate normal movement of 7mm during a flap extension or retraction cycle. Should movement exceed 15mm this will be sensed as an alignment fault by the SFCC through a discrete signal from the interconnecting strut and both POB will engage preventing further movement of the flap system. Simultaneously the SFCC will initiate the flight deck master caution and aural warning together with an upper amber ECAM fault message F/CTL FLAPS LOCKED and a brief description of actions required on the lower display. The flight crew are also advised of the maximum aircraft speed in blue on the upper ECAM. Along with these text messages, the slat/flap system synoptic on the upper ECAM display, described as FLAP, now shows the actual position of the FLAPS in amber while the selected position is indicated by a triangle and a numerical value in blue. The synoptic title FLAP will also be presented in amber. A description of the ECAM flaps and slats indication on the upper display is at Appendix 6. Photographs showing the display of normal full flap and flap locked at FULL with FLAPS lever in Configs FULL, 3 and 2 are at Appendices 6A, 6B, 6C and 6D respectively. A photograph of the ECAM indication on the lower display showing the system page for the flap Config to be used in the case of a flap lock in FULL is at Appendix 7.

For the POB to be reset, it requires that the interconnecting strut senses normal conditions and a power interruption greater than 40 milliseconds. The POB cannot therefore normally be reset in flight.

With flaps locked, movement of the slats is available by normal selection subject to system serviceability. Slat position information is displayed on the left portion of the upper ECAM Flap display area, independent of any FLAP fault conditions.

Slat system control and actuation is identical to the flap system, incorporating a dedicated PCU driven by two hydraulic motors on selection via the combined Flaps/Slats selector (FLAPS lever). The PCU drives a series of transverse torque shafts and rotary actuators and the system includes monitoring and fault protections similar to those provided in the flap system without the need for surface interconnections monitoring and protection.

1.6.4 Auto-pilot and flight computers

In manual flight the pilot's control inputs are accomplished using a side-stick. The side-stick movements are routed directly to the flight control computers, ELAC and/or SEC. Auto-pilot is engaged using the Flight Control Unit (FCU). The Flight Management and Guidance Computer (FMGC) compares information obtained from various sensors to reference data and sends the appropriate command signals to the flight control computers.

The A320 flight control computers comprise the following: 2 Elevator and Aileron Computers (ELAC), 3 Spoilers and Elevator Computers (SEC) and 2 Flight Augmentation Computers (FAC). The elevators and stabiliser are controlled by ELAC2 and ELAC1 acting as backup. If neither ELAC is available then pitch control is transferred to SEC1 or 2. The SEC provide spoiler control and standby elevator and stabiliser control. The FAC are used

for rudder control. The system is completed by two Flight Control Data Concentrators (FCDC), these acquire data from the ELAC and SEC and route this to the ECAM and the Centralized Fault Display System (CFDS).

Pitch control laws

There are three pitch control laws:

(i) PITCH NORMAL LAW,
(ii) PITCH ALTERNATE LAW and
(iii) PITCH DIRECT LAW.

Pitch normal law and pitch alternate law have modes which optimise control inputs for ground, flight and landing (flare) operation. Changes in mode are automatic. Pitch normal law provides protection against excessive load factor, pitch attitude, angle of attack and speed. These protections are degraded when pitch alternate law is in use. Pitch direct law is a direct stick to elevator relationship.

Roll control laws

There are two roll control laws:

(i) ROLL NORMAL LAW and
(ii) ROLL DIRECT LAW.

In roll normal law the roll rate demanded is proportional to the side-stick deflection. Maximum roll demand is 15° per second. From the side-stick demands, the ELAC (normally ELAC1 with ELAC2 acting as backup) compute and demand the aileron deflection required, the SEC compute and

demand the spoiler deflection required, the FAC compute and demand the rudder deflection required. It achieves the control and the limitation of the roll rate, bank angle protection, turn co-ordination and dutch roll damping. In roll direct law there is a direct relationship between the position of the side-stick and the control surface position. The gains and kinematics are automatically set according to actual slats and flaps position.

1.6.5 Landing gears and brakes

The A320 landing gear is of conventional retractable tricyle type with direct action shock absorbers. The main landing gears are located under the wings and retract sideways towards the fuselage centreline, with the nose landing gear retracting forward into the fuselage.

There are two main wheels on each main landing gear, these are equipped with carbon disc brakes each operated by two independently hydraulically supplied sets of pistons. One set is supplied by the green hydraulic system and the other by the yellow system assisted by a brake accumulator. Brake temperature is indicated on ECAM. The A320 incorporates four braking modes, besides an anti-skid and an automatic braking system (Autobrake).

The normal braking mode is supplied by the green hydraulic system. The command is electrically achieved through the brake pedals or autobrake system and the anti-skid function. The control computation is carried out by a fully digital Brake System Control Unit (BSCU) that signals a servo valve for each wheel. For redundancy the BSCU has two identical channels with two separate electrical power supplies. The monitoring part of each channel ensures selection of a working channel and when required indication of a faulty channel. The autobrake system, which is available in this mode, has three different preset deceleration rates. Automatic braking is initiated by a

ground spoiler extension command. Arming of the system is by pressing one of the three push buttons designated LO (low), MED (medium) and MAX (maximum).

The 'MAX' mode is normally selected for take off, in this mode maximum brake pressure will be applied simultaneously with a ground spoiler deployment command.

Selection of the 'MED' or 'LO' modes progressively applies pressure to the brakes 2 or 4 seconds respectively, following the ground spoiler deployment order. The 'MED' selection provides a 3 metres per second per second (m/s/s) deceleration rate, whereas the 'LO' selection provides a 1.7m/s/s deceleration rate.

The auto-brake system is disengaged by manual release of the 'armed' button or by measured deflection of the foot actuators after the aircraft is on the ground.

To disengage the auto-brake system using the foot actuators, the following applies to the individual deceleration mode selected.

Maximum - Both pedals require pedal deflections greater than 50% of travel range.

Medium - One pedal deflected by greater than 16.5% of travel range.

Low - One pedal deflected by greater than 10.5% of travel range.

The nose wheel steering is a hydraulic servo system, electrically controlled from the flight deck via the BSCU. Hydraulic pressure is provided by the green system. In the case of loss of green hydraulic pressure steering can be

achieved by differential braking or by differential engine thrust. Hydraulic power to the steering system is shut off, when the aircraft is being towed, the engines are not running, the aircraft speed is higher than 130kts or the main landing gear is not compressed.

Steering is controlled from the flight deck by two hand wheels and the rudder pedals or automatically on landing through the FMGC system. Where steering commands are made simultaneously from more than one source their signals are added algebraically. The maximum steering angle that could be achieved is 75°.

1.6.6 Maintenance Records

Following the incident, a maintenance records examination was conducted. The records showed that the aircraft was delivered from Airbus Industrie to Hong Kong Dragon Airlines Limited on 3rd December 1993 and it entered revenue service on 8th December 1993.

At the time of the accident the aircraft had accumulated some 807 total flying hours and 501 landings. The Certificate of Maintenance had been issued on 21 March 1994 and was valid until 30th July 1994.

The Hong Kong Civil Aviation Department (CAD) approved maintenance schedule, in addition to the usual departure, daily and weekly checks called for an 'A' check each 400 airframe hours with each alternate 'A' check being more comprehensive classified as a 2A check. The last 2A was accomplished on 21 March 1994 at 367.7 hours and was scheduled to be repeated after a further 800 hours.

The records audit for the aircraft indicated that all scheduled maintenance required by the approved maintenance schedule and applicable airworthiness directives had been complied with.

The Technical Log and the Base Deferred Defect system were examined with particular regard to defects which related to the Flying Control, Nose Wheel Steering and Braking systems. At the time of the incident there was no recorded carried forward defect or Base Deferred Defect relevant to this investigation.

1.7 Meteorological information

On the day of the incident, HKIA was affected by a tropical cyclone centred some 320 km south-southeast of Hong Kong. There was a strong gusty wind from the east and the Stand-by Signal Number 1 was hoisted at 0210 hr on 5 June. This signal conveys a general expectation of strong winds due to the existence of a tropical cyclone centred within 800 km of Hong Kong.

Close to the time of the incident the weather may be summarised as follows:-

Surface Wind	:	030° - 090°/20 kt maximum 30 kt
Visibility	:	10 km
Cloud	:	scattered cloud base at 2500 feet
Temperature	:	29°C
QNH	:	1003 hectopascals

Departures and arrivals were warned to expect significant windshear and moderate turbulence on approach and departure. Owing to the local terrain situation, significant low level wind shear and turbulence are usually encountered at HKIA when winds off the hills are around 15 kt or more. The

approach area to Runway 13 is particularly affected when wind is strong and blowing from between NW and ENE in association with a tropical cyclone.

Relevant weather information was passed to HDA 323 on the appropriate ATC frequencies throughout the incident. The crew were in possession of the current surface wind information at the time of their approaches.

1.8 Aids to navigation

Post incident checks revealed that all relevant navigational aids were serviceable. Navigational aids are not considered to have been a factor in this incident.

1.8.1 Approach aids

The approach aid in use on the day of the incident was the Instrument Guidance System (IGS) to runway 13. However, the Captain of HDA 323 requested an Instrument Landing System (ILS) approach for Runway 31 for the last two approaches.

The IGS localiser centre-line is aligned to 088°M and the glidepath is set at 3.1°. The Runway 13 OM is located at 5.3 nm from the threshold and the Obstacle Clearance Limit (OCL) is 660 ft. The instrument flight segment of the approach terminates at the middle marker (1.7 nm from touchdown). If visual flight is not achieved by this point, missed approach action must be taken. The missed approach procedure involves a right turn to establish on TH VOR radial 315 and a climb to 4500 ft amsl. A copy of the IGS approach chart is at Appendix 1.

The ILS runway 31 localiser centre-line is aligned to 315°M and the glidepath is set at 3°. Normally, Hong Kong Approach will provide direct radar feed-in

to arriving aircraft for the ILS approach. The Runway 31 OM is located at 5.66 nm from the threshold. The Obstacle Clearance Limit (OCL) is 390 ft being governed by the height of terrain at Lei Yue Mun Gap. The missed approach procedure involves a left turn via 'RW' and 'SC' NDBs to establish on CH VOR radial 031 and a climb to 4500 ft amsl. A copy of the ILS approach chart is at Appendix 3.

1.9 Communications

At 0806 hr HDA 323 contacted Hong Kong Approach on 119.1 MHZ. Subsequently the aircraft changed frequencies to other ATC units at various phases of the flight.

Apart from communication with ATC, the crew contacted the ground maintenance office of Hong Kong Aircraft Engineering Company (HAECO) on 131.75 MHZ to report the problem.

All RTF communication recordings were available. Tape recordings showed that RTF communications were satisfactory except that there was a cross transmission for a few seconds at 0905 on the APP frequency 119.1 MHZ when the Captain was declaring an emergency due to shortage of fuel. This transmission, though not recorded on ATC tapes, was recorded by the Cockpit Voice Recorder (CVR). As a whole, no difficulty of transmission or reception was evident and communication quality is not considered to have been a factor in this incident. However, because of the volume of traffic handled, RTF communications on the approach and aerodrome control frequencies were rather congested. Relevant transcriptions of RTF communications and CVR conversations which address different aspects of this incident are categorised in Appendices 8, 9 & 9A.

1.10 Aerodrome Information

The single runway 13/31 at HKIA (a plan of which is at Appendix 10) is situated on a promontory of reclaimed land which is 242.3 metres wide and protrudes into Kowloon Bay. The elevation of the runway is 15 ft amsl and it has no slope. A full length parallel taxiway runs along the eastern edge of the promontory and is separated from the runway by a grass area approximately 69 metres wide. The distance between the centre-lines of the runway and taxiway is 111 metres. Operational services at the airport, together with fire fighting and rescue services, are provided by departments of the Hong Kong Government.

HDA 323 landed on Runway 31 which has the following characteristics:

Direction	:	315° (magnetic)
Strip Length	:	3,302.5 metres
Width	:	61 metres
Landing distance available	:	3,030.5 metres
Take-off run available	:	2,892.5 metres
Take-off distance available	:	3,032.5 metres
Surface	:	The first 152 metres are concrete; the remainder is asphalt. The full length of the runway is grooved.
Runway markings	:	The displaced threshold marking, runway designation numbers, thresholds, touchdown zones, centre-line, fixed distance markers, side stripe and runway exits were marked by white paint.

1.11 Flight recorders

The aircraft was equipped, as required, with two mandatory crash protected flight recorders - a Cockpit Voice Recorder and a 25 hour duration Digital Flight Data Recorder. In addition the aircraft was equipped with a Quick Access Recorder: a data recorder used by the operator for maintenance purposes. The mandatory flight recorders were removed from the aircraft undamaged and sent to the flight recorder laboratories of the UK Air Accidents Investigation Branch (AAIB) for replay and analysis.

The CVR and DFDR were found to be fully serviceable and replayed without difficulty. The QAR was replayed at the operator's maintenance facilities in Hong Kong. On this aircraft the DFDR and the QAR were presented with identical data for recording.

1.11.1 Cockpit voice recorder (CVR)

The CVR fitted was a Sundstrand AV577-C. This recorder had a duration of 30 minutes and recorded audio information on 4 channels, (tracks). The channel allocation was as follows:

Channel 1: PA
Channel 2: P2 live microphone and R/T
Channel 3: P1 live microphone and R/T
Channel 4: cockpit area microphone

As a result of the 30 minute recording duration the gust encounter was not recorded on the CVR. The recording began 13 minutes later at 0844, at which time the crew were talking to Hong Kong Approach. A full transcript of the recording was prepared and time correlated with the ATC and DFDR recordings. Relevant excerpts of the CVR recording are reproduced at Appendices 9 and 9A.

1.11.2 Digital flight data recorder (DFDR)

The DFDR was Sundstrand Universal Flight Data Recorder. In excess of 360 parameters were recorded. The entire 25 hours of recorded data were replayed and data for the incident flight were reduced to engineering values. Appendix 11 shows a time history of relevant recorded data covering the period of the incident. It should be noted that the DFDR records a time history of the magnitude of selected parameters using a sampling process. In dynamic situations, e.g. the roll oscillations experienced by VR-HYU, the rate at which the data is sampled may be insufficient to enable the maximum roll attitude, and consequently the roll rate, to be accurately recorded. In such situations it is only possible to say with certainty that the recorded data represents the magnitude of the parameter at the time of sampling.

1.12 Wreckage and impact information

There was no collision involved in this incident. The aircraft landed on the runway, it then departed the runway paved surface to the right, transversed the grass area and eventually stopped on the parallel taxiway. As the outboard tyre of the left main gear contacted the taxiway lip, it was punctured by the pavement edge. The other minor damage occurred during the ground run included a few score marks on the oleo of a main undercarriage and cracks at the edge margin of the wing root support brackets.

Post incident examination of the aircraft including rigging and functional tests of the flight control system indicated that there was nothing wrong with the aircraft except that the right wing strut was 2mm from the datum rigging length. This out-of-rig would make the strut more sensitive to movement between inner and outer flap sections.

1.13 Medical and pathological information

The seven crew members on board HDA 323 were not injured in the incident. Both pilots were well rested the day before and they did not exhibit any sign of being under stress prior to the incident. A medical examination was given to both pilots about 3 hours after the incident and there was no evidence that any pre-existing medical or the physical condition of either pilot contributed to the incident.

Seven of the 141 passengers on board were reported to have received minor injuries or discomfort after the evacuation and were sent to hospital. After medical examination and treatment, six passengers were released on the same day; one passenger was released the next day. Three out of these seven passengers suffered minor physical injuries.

1.14 Fire

There was no evidence of fire throughout the incident. Smoke was seen coming from the main landing gear due to heavy braking.

1.15 Survival aspects

1.15.1 General

The aircraft touched down on the runway, overran the grass area and stopped on the parallel taxiway. There was no impact or fire and the aircraft was relatively undamaged. Although the deceleration forces present during the landing roll were higher than usual they were well within human tolerance and no injury was caused to persons on board. It was only during the evacuation that a few passengers received minor injuries.

1.15.2 Evacuation, rescue and fire-fighting

The Airport Fire Contingent (AFC) was initially alerted by ATC of the incident at 0844 and was notified to up-grade the incident to a full emergency stand-by at 0904 hr. Near-by fire stations and ambulance depots outside the airport were subsequently informed of the details of the emergency traffic. Fire engines and ambulances stationed outside the airport responded to the emergency promptly and some of them had arrived at the airport before HDA 323 landed on Runway 31 at 0917 hr.

When the Tower Controller saw that the aircraft had departed the runway paved surface on to the grass area, he activated the crash alarm. AFC was given clearance to attend the incident aircraft which was at that time still on its landing roll. The first AFC vehicle arrived on scene within 1 minute from the time the aircraft came to a complete stop on taxiway B1.

After engine shut down, both pilots opened their side windows to confirm visually for possible fire at the back of the aircraft. They noted that there was no fire but they could see smoke coming from the landing gear area. At the same time, the AFC personnel signalled the Captain to evacuate the aircraft from the port side where there was a grass area. The Captain made a PA but the instruction was not clear. The SP, after confirmation with the Captain, repeated the evacuation command to other cabin crew members. All port side emergency slides were deployed. The free ends of the front and rear slides were blown off the ground by the strong easterly wind.

Cabin crews shouted to the rescue personnel on scene for assistance and the slides were held firmly on the ground by the AFC personnel. After the evacuation, the brakes were cooled by ground maintenance staff from HAECO. AFC provided fire-fighting cover throughout the evacuation and brake cooling period.

Fire and rescue personnel and appliances (including those from outside) attending the incident included:

Fire and Rescue personnel	:	130
Appliance	:	18
Rescue launch	:	1
Fire boat	:	2
Ambulance	:	11

1.16 Tests and research

1.16.1 Flight handling test

Two flight handling tests were conducted by the investigation team subsequent to the incident to assess the performance of the aircraft within its normal flight envelope and nothing unusual was found.

1.16.2 Simulator test

Although not possible to fully recreate the conditions that led to the incident either on the ground or by use of a simulator, the aircraft manufacturer conducted simulator tests to demonstrate aircraft response with flaps and slats in both normal and abnormal configurations using the following criteria:

Half side-stick control commanded roll input.
20kts constant cross wind gust side-sticks free.
Full range sinusoidal side-stick input (0.4Hz)

It was found that as far as handling qualities were concerned, in an abnormal flap/slat configuration of 18°/40° or 22°/40° in turbulent conditions the aircraft became sensitive to pilot induced oscillations. However, if flown stick

free, the aircraft would stabilize as a result of the EFCS automatic gains applied. Although not the optimised configurations, they did achieve positive dynamic stability.

The manufacturer confirmed that the failure case "flaps locked in full configuration with procedure of application of landing in Config 3", was not evaluated in flight nor in a simulator during Type Certification or during aircraft development. The only demonstration made was the abnormal configuration 22°/35° tested in flight for CL max in direct law. Landing tests were however carried out in the abnormal configurations of 0°/22° with the System Safety Assessment of such failures classifying them as minor.

1.17 Additional Information

1.17.1 Operational Engineering Bulletins

Operational Engineering Bulletins (OEB) were issued by the aircraft manufacturer to transmit advance operational information of technical and procedural nature before the next normal revision to the Flight Crew Operating Manual (FCOM). They were distributed to all FCOM holders through airline operators who instituted their own procedures for disseminating OEB information to individual FCOM holders. The OEB were incorporated in a stand alone section of volume 3 of the FCOM, filed in numerical order. There was no system for prioritizing safety related OEB.

Each OEB carried a warning that the information contained therein may not be approved by the Airworthiness Authorities and in the case of conflict, the certified Aircraft Flight Manual (AFM) would apply. It was not required that a simultaneous amendment to the AFM was issued to prevent conflicts.

It should be noted that Dragonair were required to carry the AFM on all flights, this allowed for in service verification of OEB procedures with the AFM.

The AFM, FCOM Chapter 3 and ECAM procedures stated that for a F/CTL FLAP LOCKED alignment fault condition the FLAPS lever is not to be placed in the "configuration full" position.

The FCOM contained OEB 117/1 published to modify this procedure for instances where the F/CTL FLAP LOCKED - alignment fault, condition occurred at settings greater than "Config 3". In such cases the procedure to be followed required the FLAPS lever to be maintained in the "Config FULL" position. OEB 117/1 is reproduced at Appendix 12. The OEB also explained that the aircraft would be more sensitive to lateral control commands if this modified procedure was not followed.

1.17.2 Other similar occurrences

Control difficulties with the flaps locked had been reported by one operator of the A320 aircraft type. On the 26th November 1993 an Indian Airlines A320-231 aircraft encountered control difficulties on approach with the flaps locked.

The analysis of the event by Airbus Industrie shows that the flaps had locked in "configuration full". The flight crew then applied the FCOM procedure to select the flaps to "configuration 3".

The approach was made with slats at 22° and flaps at 40°. At 800 feet with the auto-pilot engaged, lateral oscillations (+8° - 15°) occurred. The crew disconnected the auto-pilot at which time the aircraft stabilized and continued the approach. The lateral oscillations (+8° -6°) then reappeared on flare at around 75 feet.

As a result of this incident Airbus Industrie produced OEB 117/1. Additionally, work commenced on producing a revised software standard (L69) for the ELAC which, together with the D2 standard of FWC, provide a revised procedure requiring that the FLAPS lever remains at "configuration full" for F/CTL FLAPS LOCKED warnings at positions greater than "configuration 3".

British Airways had also experienced lateral control oscillations but none in combination with a flap lock situation. A detailed study by the airline was carried out of A320-110 aircraft handling characteristics, following an incident where in gusty conditions a British Airways operated A320-110 aircraft encountered considerable turbulence at about 50ft AGL.

The study looked at some 64 events from their data base where a roll rate $> 10°$ per second was encountered. The report concludes that although their data was not definitive, it indicated that the original BA incident was at least partly pilot induced. Of the 64 events analysed nearly half took place with the auto-pilot engaged and over 60% of the approach and landing events were also with auto-pilot engaged.

1.17.3 Safety measures taken after the incident at Hong Kong

As a result of the Hong Kong incident, immediate action was taken by the aircraft manufacturer to issue a Temporary Revision to the AFM, approved by the aircraft type certification authority, to require the FLAPS lever to be maintained in the "configuration full" position in case of flaps locked in configuration full. An Airworthiness Directive was also issued by the Direction General de I'Aviation France for mandatory insertion of the AFM Temporary Revision.

Subsequent actions were taken to modify the Flight Warning Computer (FWC) Standard D2 which enables the ECAM memo page to be amended in line with the OEB and AFM and an Airworthiness Directive was issued to require installation of the improved FWC. The Elevator Aileron Computer Standard L69 was also modified to optimize control laws for all possible slats/flaps configurations which improves the roll sensitivity of the aircraft in turbulence. The most critical abnormal slats/flaps configurations were flight tested for the certification of these two modifications and confirmed their correct behaviour. An Airworthiness Directive was issued for mandatory application of the ELAC modification for a complete fleet retrofit by October 1997.

2. ANALYSIS

2.1 General

The initiating event was the severe gust the aircraft encountered at 800 feet on the approach to Runway 13. It caused the flaps to lock at 40° (full deflection) and a "FLAPS LOCKED" caption to be displayed on the ECAM. The Captain decided to go-around. After the go-around the crew applied the FCOM procedure which was also displayed on the ECAM and selected the FLAPS lever to Config 3. Selecting Config 3 caused the slats to retract from 27° to 22°. The flaps remained at 40°.

If the crew had not followed the ECAM and instead applied the procedure contained in OEB then, in all probability, the aircraft would have landed uneventfully after the second approach. The roll control mechanism, performance of the crew and oscillation of the aircraft are therefore discussed in this report.

Another question addressed is why, after touching down within the normal touchdown zone and close to the runway centre-line, the aircraft departed the runway paved surface 5 seconds after landing.

2.2 Flap lock

Examination of the DFDR data showed that when the aircraft was at 800 feet on its first approach to Runway 13 a normal acceleration of -0.4G was recorded. The crew described this as sudden sinking windshear. Calculations based on DFDR data, confirmed by Airbus, showed that the 'g' loading on the aircraft during this encounter would have resulted in a differential movement between the right inboard and outboard flaps. This movement was sufficient, after allowing for the small out-of-rig, to deflect the right wing flap

interconnecting strut and signal the Slat and Flap Control Computer (SFCC) to apply the Pressure Off Brakes (POB) and lock the flaps. The POB cannot be released in flight. The DFDR recording shows that the flaps remained in this position (40°) for the remainder of the flight.

2.3 A320 flap system and lateral stability

The response of the aircraft to roll demands both from side-stick inputs and via auto-pilot inputs was examined using DFDR data from the incident flight, from previous flights and from other A320 aircraft. From this work it was possible to be confident that the behaviour of the lateral controls on VR-HYU was typical of the A320 type and that the lateral control problems experienced by this crew were not associated with any defect or anomaly in the lateral controls specific to this aircraft.

The deflections of the ailerons and spoilers was examined in detail for the 5 preset configurations of flaps and slats using input data on the control laws supplied by Airbus and DFDR data from the incident flight. Data from previous incidents where lateral control difficulties had been identified was also used. Appendix 13 shows how the gains and kinematics of the control laws vary with actual slats and flaps position. It can be seen that the control gains produce greater deflections of the ailerons and spoilers when Config 1+F, 2 & 3 are selected than they do when Config FULL is selected. The gains in Config 0&1 are not relevant to this investigation as the Flaps are not deployed in these configurations.

The Kinematics figure shows that a 5°/sec side-stick demand in Config Full results in aileron and spoiler deflection of approximately 11.5° and 3° respectively. The same side-stick demand in Config 3 results in deflections of 18° and 8° respectively. Clearly the aircraft is more sensitive to control inputs in Config 3 than in Config FULL. This sensitivity is born out by a

number of reports, extracted from the UK CAA data base, of probable PIO whilst landing in Config 3. This can be explained because the slope of the gain law is much steeper for small side-stick demands in Config 3 than it is in Config FULL.

It should be born in mind that the available information on the control law gains is restricted to the gains appropriate to one of the designated Config states. VR-HYU was not in one of the designated states because the flaps were at full (Config FULL) and the slats were at Config 3. The sampling rate and resolution of the recorded data was not adequate to enable a control law to be determined for this state. Furthermore data on the control law gains for this configuration are unavailable from the manufacturer as no flight testing was undertaken during the certification programme with the aircraft in the incident configuration.

2.4 Flight crew performance

The incident was triggered by the flap lock and the actions taken by the flight crew subsequent to the flap lock indicated that they were confused by the control problem they faced and uncertain of the actions that they should take to resolve it. The following areas of crew performance were therefore examined.

2.4.1 Decision to carry out go-around

The flap lock occurred during the final stage of the visual segment of the IGS approach when the aircraft was fully configured and properly positioned for landing. Apart from the gust encounter and the flap lock indication, there was no reason for the crew to consider a missed approach unless they had doubts about the consequences of the flap lock upon landing performance; their company procedures required it; or there were other factors requiring it.

Interviews with the cabin crew revealed that the gust encounter was so severe that magazines and loose articles were tossed into the air and passengers lifted from their seats to the extent of their seat belts.

Immediately following the gust encounter, the master caution triggered an audio warning together with the ECAM F/CTL FLAPS LOCKED warning as shown at Appendix 6B. Something unusual had obviously occurred and the Captain had to make an immediate decision to land or go around. The primary concern was whether the approach could be continued to a safe landing and to evaluate this required an appreciation of the nature of the problem which caused the warnings. As the aircraft was on short final and was being flown visually, the crew had very limited spare capacity to evaluate the situation. An immediate evaluation of the ECAM indication required the crew to be totally familiar with the ECAM display. Instead of continuing the approach to land with the flap lock, the Captain decided to carry out a go around and resolve the problem later. The decision was probably affected by the violence of the gust encounter immediately preceding the ECAM warning, which could have engendered the expectation of a serious problem. In addition, unfamiliarity with the fault displayed may have predisposed the crew towards a "safe" decision, i.e. one that allowed time for analysis.

2.4.2 Action taken during the go-around

The DFDR showed that during the go around after the gust encounter, the FLAPS lever was moved, as indicated by the movement of the slats, from 27° (FULL) to 22° (Positions 3 or 2), 18° (Position 1), 0° (Position 0) and then back to 18° and 22° for the second approach (see Appendix 5 for relationship of the FLAPS lever and the flap/slat surface positions). The normal procedure for a go around shown in the Quick Reference Handbook (QRH) carried on the aircraft requires the pilot flying to call for go-around-flap after advancing the thrust levers to TOGA power and the pilot non-flying to retract the flaps

one step, and later to further retract flaps to a speed schedule. The movement of the slats shown on the DFDR indicated that the crew had raised the FLAPS lever as required by the normal go around procedures. The slats retracted to 0° before the aircraft reached 4500 ft.

Config 1 was selected shortly after the aircraft levelled off at 4500 ft followed by Config 2. The aircraft flew around at this level for about 10 minutes before establishing on the localizer for a second IGS approach. During this period attempts were made by the crew to find out what the problem was. The CVR indicated (Appendix 9) that due to misinterpretation of the ECAM indication the crew believed that the flaps were locked at Config 2.

2.4.3 Confusion about the flap lock position

The ECAM indication of the slats/flaps positions in normal 'FULL' configuration is shown at Appendix 6A. The indication of a flap lock at 'FULL' is shown at Appendix 6B. The symbol "FLAP" and the flap position line have changed to an amber colour. The indications on flap locked at full while the FLAPS lever is moved to Config 3 and 2 are shown at Appendices 6C and 6D respectively. It should be noted that the amber "flap" symbol and position line do not change but the selected positions (indicated by the green slats position line, a blue small triangular flap symbol and a blue position figure) do. It appears that the crew repeatedly ignored the amber indications and mistook the selected position indications as the flap lock position.

The display was rather complex. Although the information provided was adequate to specify the problem the crew faced, the coding conventions could not be immediately apprehended. Some training or experience with the various possible failure modes would be necessary to ensure that details were attended to or ignored as appropriate in order to arrive at an accurate and timely interpretation.

From the Captain's description of the flap lock position and the co-pilot's reply at 0855 hr (Appendix 9) it is apparent that both pilots were not familiar with the ECAM indication of flaps/slats abnormal configurations.

Apart from the flaps/slats position indications, the ECAM display would also show a speed limit of 177 kt as at Appendix 6B. This is the speed limit for Config FULL. The CVR shows that the limiting speed of 177 kt was mentioned several times throughout the incident but neither pilot co-related the limiting speed with the flap lock position. The DFDR data also shows that this speed was exceeded on a number of occasions.

2.4.4 A320 conversion training

The investigation looked at the company A320 type conversion training requirements. On initial type conversion, in Fixed Base Simulator exercise No.5 - Flight Controls, the syllabus demonstrates the various faults that can occur. Among these faults is one which shows the indication on the ECAM when the flaps are locked; the indication changes colour.

Full Flight Simulator (FFS) training, exercise No 6 is a flown exercise with the wing tip brakes in the locked position for both FLAPS and SLATS. This lock occurs with the surfaces in the retracted position (i.e. a clean wing) and the subsequent handling exercise is flown in this condition.

A flapless, slatless approach is also included in the Line Oriented Flight Training (LOFT) exercise and, in FFS exercise No.10 , pilots are required to carry out an approach with SLATS but no FLAPS.

2.4.5 Technical examination for an A320 type endorsement

To obtain an A320 aircraft type rating, it was necessary, among other requirements, to pass the Type Technical Examination set by the Civil Aviation Department (CAD) Hong Kong. There were several sets of A320 type technical examination papers and each paper consisted of 100 questions, of which about 10% were on the Flight Control System. There were some questions concerning the ECAM Display in relation to a particular fault or problem of a system or control but there was no question on flap lock problems.

2.4.6 Action taken during the second approach

Shortly after the aircraft established on the localizer for the second IGS approach the Captain, in discussion with the co-pilot, mentioned that "FLAPS INOPERATIVE SYSTEM SLATS FOR LANDING USE FLAPS THREE WE DID APPROACH SPEED Vref + TEN" and "I TRIED TO RECYCLE NOTHING HAPPENED BECAUSE THAT'S WHAT THE BOOK SAYS SO." During interview, the crew said that they referred to the Flight Crew Operations Manuals (FCOM) and the Quick Reference Handbook (QRH) before the second approach. The FCOM procedure for flaps fault/locked (Appendix 14) called for

"FLAPS LEVER (if flaps not locked).....RECYCLE" and

"APPR PROC
FOR LDG .....USE FLAP 3
Do not select CONF FULL so as not to degrade handling qualities."

Upon selection of the system page the lower ECAM display unit should also show

"APPR PROC:

FOR LDG .....USE FLAP 3

APPR SPD : VREF + 10 KT" (Appendix 7)

The DFDR data showed that the slats moved to 22° shortly after the aircraft started turning towards the north to intersect the IGS localizer and stayed at that setting until the go around. This indicated that the crew had moved the FLAPS lever to Config 3, or in stages from 2 to 3 for the approach. They were not aware of the need to lower the FLAPS lever to Config FULL as advised in the OEB 117/1 (para 1.17.1).

Apart from the flap and speed settings, normal approach checks were actioned on this approach and the DFDR data showed that almost immediately after the landing gear was extended, significant roll oscillations began. These were accompanied by side-stick inputs from the Captain. The oscillations became so severe that the Captain later described the aircraft to be uncontrollable and he immediately ordered the gear up and carried out a second go around, requesting radar vectors to Runway 31. The aircraft climbed without ATC clearance through 4500 ft to 5000 ft, and although subsequently cleared by ATC to maintain that altitude climbed uncleared to 5500 ft. These "height busts" were probably due to the crew being preoccupied with controlling the roll oscillation which occurred for some 50 seconds during the go-around. During the climb, the FLAPS lever was raised to Config 1. The crew then reported their control problems to Hong Kong Aircraft Engineering Company (HAECO) who responded but did not offer any advice. HAECO was Dragonair's ground maintenance contractor and their Maintenance Control staff were not trained or expected to provide detailed technical information to operating flight crew. However, it is understandable that flight crew may contact a familiar maintenance organization for help.

The initial experience of roll oscillations would undoubtedly have been

alarming to the crew, and the imminent prospect of a repetition would have increased their anxiety. It is likely that the first major effect of increasing anxiety would be to degrade their ability to understand and cope with complex situations. Although well established procedural and handling skills could prove relatively resistant, the diagnosis and resolution of a novel problem would be hampered by increasing disorganisation, failure to attend to all the relevant information, a tendency to jump to conclusions, and decreased flexibility.

2.4.7 Action taken during the third and fourth approach

The unusual performance of the aircraft took the crew by surprise and there were exchanges of opinion between the pilot and the co-pilot on what the cause of the oscillation could be.

Although uncertain of the reason, the crew formed the opinion that the oscillation was related to the extension of the landing gear. The Captain told HAECO and ATC that the aircraft became uncontrollable with the landing gear down. He therefore decided to delay the lowering of the gear to minimize the duration of the roll oscillations. The other concern was the lowering fuel state which added to the pressure on the crew. It could be seen from the CVR transcript at Appendix 9A that the cockpit conversation centred on these two points. The anxiety induced by apparently undemanded perturbations on the approach, difficulty in understanding the ECAM warning, and the threat implied by a deteriorating fuel state is likely to have caused further disorganisation in the crew's behaviour. By this stage any thought of understanding the cause of their problems may have been abandoned as attention became focused on the immediate aim of achieving a landing. Disruption of routines and procedures, and even of handling skills, would not have been unlikely. Preparations for the third and fourth approaches and the possible landing were hurried and no approach briefing was conducted.

On the third approach, the FLAPS lever remained at Config 1, the position set during the previous go around. Approach checks were performed but the landing check list was not called for by the Captain. The approach was abandoned at about 0.5 nm from touchdown, again due to roll oscillations. The aircraft was cleared for a standard missed approach. Because of the critical fuel state, the Captain declared an emergency and asked for the shortest route for another ILS approach. It was apparent from the CVR that the crew were operating under stress. They had a control problem; they did not know the cause nor the solution and they were critically short of fuel. No approach or landing checks were carried out during the fourth approach but the Captain did prepare the cabin crew for a crash landing and review ditching checks. The FLAPS lever was set at Config 3 and except for a momentary disengagement at about 1200 ft, the auto-pilot remained engaged until the landing gear was extended at 1000 ft. Again significant roll oscillations were experienced but the pilot managed to land the aircraft on the runway within the touchdown zone and close to the runway centreline. An illustration of the sequence of events throughout the incident flight is at Appendix 15 and an analysis of the relationship between the critical events and the associated stress is at Appendix 16.

2.4.8 Cause of the roll oscillations

The crew associated the roll oscillations with the extension of the landing gear. Whilst it is true that the gear extension contributed to the onset of the oscillations, the two main factors that accounted for this unusual behaviour by the aircraft were the reduced lateral stability of the aircraft in an abnormal slats/flaps configuration and the pilot's side-stick input. It could be seen from the control law description in para 2.3 that when the slats were at Config 3 (2nd and 4th approaches) or Config 1 (3rd approach) and the flaps at Config FULL (flap lock position) the aircraft was particularly sensitive to roll control. In the circumstances, the extension of the landing gear, which would have

created extra drag and turbulence on the airframe in a random manner especially in turbulent conditions, would cause the aircraft to roll. Since the crew were not aware of the increased sensitivity in roll, the side-stick input applied by the pilot to counteract the roll would result in over-correction and further counter reactions, hence the oscillations normally referred to as pilot-induced-oscillations (PIO).

2.4.9 The touchdown

The aircraft touched down some 165 m beyond the threshold slightly to the right of the centreline at a ground speed of 161 kt. Although medium autobrake was selected during the approach, the right brake actuation pedals were depressed for 28% of the available pedal travel distance approximately two seconds before touchdown.

Significant events during the touchdown and landing roll are shown in Appendix 4. Although manual braking was applied before touchdown, brake pressure would not be available until the nose wheel weight switch sensed wheels-on-ground (WOG). For a 2-second period immediately after touchdown, brake actuation, which is summarised in the following table, shows right brake application to strongly predominate.

Elapse time from WOG (second)	-2	-1	WOG	+1	+2	+3
L Brake pedal actuation angle°	2	0	34	34	52	78
R Brake pedal actuation angle°	22	20	58	58	74	78

Note: 78° is the maximum brake pedal travel available.

Uneven brake application would have caused differential braking within one second of wheels-on-ground. Spoilers, which were armed during the approach, all extended within two seconds from wheels on ground. Although

the difference in braking effectiveness between the right and the left wheels could not be quantified, the right main gear wheels should have generated greater ground friction than the left main gear wheels as a result of the uneven brake application. This is supported by the fact that there was a change of the aircraft track from 319° to 323° within five seconds of touchdown while the rudder input was almost neutral. As the strong easterly wind was from the right of the aircraft, the weather-cock effect would have exacerbated the yaw and veered the aircraft further to the right unless corrected by rudder or differential braking. The difference in braking effectiveness was indirectly confirmed by the relative positions of the beginning of the left and right tyre marks which are represented by events Numbers 5 and 6 in Appendix 4. Tyre marks from the right main gear were evident well before the left main gear tyre marks. As brake pressure could only build up after all wheels were on the ground and there was no evidence of any pre-existing abnormality or defects of the brake and the antiskid system, the difference in tyre mark initiation was an indication of unintentional differential application of brake pedals resulting in differential braking effect. This caused the aircraft to turn to the right.

2.4.10 The landing roll

Appendix 17 shows the sequential pictures of the landing roll of the incident aircraft from shortly after touchdown until it came almost to a complete stop on taxiway B1.

On final approach the Captain had to maintain a large crab angle to compensate for the drift from the strong easterly wind. PAR information showed that the aircraft was on track on final approach. The aircraft track started to veer to the right when the aircraft was flying over the end of the runway but it touched down within the normal touchdown zone close to the centre-line markings.

At touchdown, the aircraft was maintaining a heading of 323.8°T while the

track was 319°T. Four seconds after touchdown, the heading veered to 326°T and the track changed to 323°T. The track gradually synchronised with the heading about 8 seconds after touchdown when the aircraft had already departed the runway on to the adjacent grass area (Appendix 4).

There was no input of left rudder or application of differential brake to the left (see para 2.4.10) to keep the aircraft on the runway. The time available for the Captain to take corrective action before the aircraft left the runway was about 5 seconds. Maximum symmetrical brake pedal travel was recorded 3 seconds after wheels on ground and the reversers were applied almost immediately after touchdown. Shortly after touchdown, the co-pilot assisted on the brakes to stop the aircraft. It was not possible to determine precisely at which point during the landing roll the co-pilot put his feet on the pedals. This was contrary to Standard Operating Procedures in that he should have advised the Captain of his action but did not do so. By not advising the Captain, the co-pilot compounded the lateral control problem after touchdown.

After the aircraft departed the runway, the aircraft track was maintained fairly constantly at 324°T until the aircraft contacted the B1 taxiway lip approximately 750 metres into the landing roll. Maximum symmetrical braking was applied throughout the landing roll but with no correcting left rudder.

About 5 seconds before contacting taxiway B1, significant left rudder was applied but by that time the ground speed had reduced to about 60 kt. The airspeed would be less because of the strong easterly wind and therefore the rudder was relatively ineffective.

The nose wheel steering (NWS) is hydraulically activated and electrically controlled by signals from the Brake and Steering Control Unit (BSCU). The BSCU receives commands from:

1. Captain and co-pilot steering hand wheels (algebraically summed)
2. Rudder pedal inputs
3. Auto-pilot

As the auto-pilot was disengaged throughout the landing roll, any signal to the nose wheel steering would have originated from the hand wheels or rudder pedals.

Above 130 kt rudder pedal input has no effect on NWS, the effect increasing linearly with decreasing airspeed to a maximum of $\pm 6°$ at 40 kt. Therefore when the Captain applied significant rudder pedal input at about 60 kt ground speed, there should be NWS effect to the left.

The aircraft at that time was still decelerating and bumping across the uneven grass area and the cornering force produced by the NWS was insufficient to alter the track of the aircraft. From aerial photographs taken after the incident, the track appears to have been a straight line as it transversed the grass area. Effective NWS was regained when the aircraft rolled on to the paved surface of taxiway B1.

As the aircraft rolled on to taxiway B1, the Captain steered the aircraft to the left away from the eastern edge of the taxiway. It was not possible to determine the amount of steering input from the hand wheels and when this input was applied. The aircraft finally came to a halt by the western edge of the taxiway B1 near runway exit A9 heading 305°T after having travelled about 920 metres on the ground.

The reason for the aircraft departing the runway on to the grass area was attributed to the apparent delay by the Captain to exercise effective directional control after touchdown.

2.5 Fuel reserves

The Dragonair Operations Manual specifies the fuel policy which is reproduced below:

"MINIMUM RAMP FUEL"

The minimum ramp fuel is calculated as follows:-

a. Fuel from departure to destination, plus
b. Contingency fuel (5% of a., but never less than 5% of 1 hour's fuel requirement), plus
c. 30 minutes holding at 1500 ft, plus
d. Sufficient fuel to fly to a nominated alternate plus 5% of this alternate fuel.
e. 100 kg approach fuel.
f. Start up and taxi fuel 100 kgs (10 minutes)"

From the computer flight plan of the incident flight where allowance was made for the estimated en-route wind and temperature, the following fuel figures were noted:

a.	Required fuel burn	5450 kg
b.	Route reserve (5% of a)	300 kg
c.	Final reserve (30 min holding)	1200 kg
d.	Alternate fuel (Guangzhou)	1100 kg
	Total fuel	8050 kg

After arrival in Nanjing, there was 6000 kg of fuel remaining. The Captain uplifted 3600 litres (2876 kg) of fuel and, allowing 100 kg of fuel burn for the

APU and ground taxiing prior to departure, the take-off fuel was estimated to be 8700 kg. This was the fuel figure used by the Captain for loadsheet computation (round down to the nearest hundred).

Therefore the flight met the minimum ramp fuel requirement on departure from Nanjing.

In the event of a diversion, final fuel reserve should be available for holding at the alternate for a minimum of 30 minutes at 1500 ft. However it is not necessary to divert to an alternate solely to meet the 30 minutes requirement, if an approach at the destination is imminent.

For this flight, Guangzhou was the nominated alternate airfield giving a minimum diversion fuel requirement of 2400 kg.

After the flaps were locked at Config FULL, fuel consumption was increased by a factor of two (Appendix 14). At 0844 hr, before the aircraft established on the IGS localizer for the second approach, the Captain made a fuel check which was 2300 kg i.e. 100 kg below the normal diversion fuel. Had the Captain considered diverting to the alternate airfield at that time, there would not have been sufficient fuel to do so since the rate of fuel burn would be doubled.

A fuel check of 1120 kg on board was noted at 0904 hr immediately after the go-around was initiated from the third approach (ILS Runway 31). Post-incident fuel remaining was 480 kg. Therefore the fuel burn during the final attempt to land was 640 kg. If the last approach had not been successful, there would have been insufficient fuel for another approach. The Captain's decision to declare an emergency and to review the ditching check list was therefore prudent.

2.6 Emergency Evacuation

2.6.1 General

At the end of the incident sequence the aircraft came to rest by the western side of the parallel taxiway B1 near the grass area close to runway exit A9 (Appendix 4). The aircraft was not structurally damaged. At that time, the wind was quite strong, 15 to 20 kt from the east. There was no fire but smoke was seen coming from the main landing gear due to overheated brakes. The Captain, after checking that there was no fire, initiated an emergency evacuation from the port side of the aircraft when prompted by the AFC personnel. The entire evacuation took about 3 minutes to complete and was carried out in a satisfactory and expeditious manner. Seven passengers received minor injuries and/or suffered from shock and were taken to hospital for observation and medical treatment. Three of these passengers were classified as having suffered minor injuries.

2.6.2 Crew preparation and passenger safety briefing

Prior to departure from Nanjing, a standard pre-departure passenger safety briefing was performed. A recorded voice broadcast in English was combined with a visual demonstration by the cabin crew of the use of the emergency equipment. Each passenger seat was provided with a passenger safety card stored in the seat pocket in front. Safety cards were presented to passengers in sealed plastic packages, when in these package only one side of the card is visible. Post incident investigation reviewed that most safety cards remained in their sealed plastic packages. It was also noted that at the over-wing emergency exits only the safety cards of seats 11D and 12A had been removed from their packages.

After the first missed approach, the Captain asked the Senior Purser (SP) to prepare the aircraft for a precautionary landing but he instructed the SP not to alarm the passengers. The SP confirmed by repeating the instruction to the Captain and prepared the aircraft cabin for a precautionary landing in accordance with the procedures in the Operations Manual.

Some of the passengers were re-seated to ensure that the over-wing emergency hatches were unobstructed. The Captain subsequently made a PA notifying the passengers of the nature of the problem and the estimated time to land at Hong Kong. Nothing was mentioned about the requirement for a precautionary landing.

After the third go-around, the Captain asked the SP through the interphone to prepare the aircraft for a crash landing. The following is the relevant transcription of the conversations recorded by the CVR.

P1 : NOW THE AIRCRAFT BECAME UNCONTROLLABLE EACH TIME WE LOWERED THE LANDING GEAR I WANT YOU TO PREPARE FOR A CRASH LANDING OK.

About 2 minutes later, the SP entered the cockpit to confirm with the Captain whether it was necessary to brief the passengers. Their conversation was as follows:

SP : WILL WE NEED TO BRIEF THE PASSENGERS FOR OPENING THE DOOR

P1 : AH NO YEAH BUT DON'T DON'T DO NOT EVACUATE UNLESS WE TELL YOU SO OK

SP : OK HOW MANY MINUTES

P1 : IT'S ABOUT 10 MINUTE 5 MINUTES AT LEAST YEAH SEVEN MINUTES

As the available time was limited, the SP told the other cabin crew members to prepare for a crash landing. She then made a PA in English, repeated in Cantonese and Mandarin asking passengers to secure themselves for the landing. Passengers were not briefed to expect a crash landing or to take up the brace position on landing. One of the FAs asked the SP whether it was necessary to instruct the passengers to take up the brace position on landing and the SP told her that the Captain did not want to alarm them. A crew demonstration of the method of using life-jackets was not repeated due to insufficient time and unsuitable flight conditions. Before landing, there was no PA from the cockpit crew to alert the cabin occupants to take up the brace position but all cabin crew took the brace position themselves before touchdown.

2.6.3 Evacuation

Prior to landing, all cabin crews took their assigned cabin attendant seats. Shortly after the aircraft came to a complete stop, all the cabin lights went out and the emergency exit lights came on. Passengers, relieved by the successful landing, became excited; some of them clapping their hands and some standing up to collect their hand baggage. The SP made repeated announcements to calm them down and asked them to remain seated. At that time, there was no PA from the cockpit crew. Cabin crew in the rear cabin left their seats to check the conditions outside and one of them moved up to man the over-wing exit, but they were instructed to return to their crew positions by the SP through the PA system. After a short while, the Captain made a PA announcement but it was not clear. During post incident

interviews with the cabin crew most of them could recall hearing the words "open" and "left door". Post incident investigation reviewed that the PA system was serviced prior to the incident flight. The pre-departure PA system check did not indicate any system defect or degradation in communication quality. The PA system was therefore assessed as being fully serviceable throughout and after the incident flight.

As the Captain's PA announcement was not understood, the SP entered the cockpit to confirm the content with him. When he confirmed the command to evacuate the passengers the SP repeated it through the PA. All cabin crew then responded right away and the front and rear passenger doors on the port side were opened promptly. As some passengers had already left their seats and were obstructing the aisle, FA5 had some difficulties in moving up to the over-wing emergency exits but was eventually able to open one of them. She asked a passenger nearby to open the other exit but the passenger refused. Another passenger volunteered to help and opened the emergency exit without difficulty.

Seats next to emergency exits were not restricted to English speaking and able-bodied passengers. On the passenger safety card, there was no warning to passengers seated next to an emergency exit that they might be required to assist in opening doors.

When the doors were opened, all emergency slides on the port side deployed normally (Appendix 18). However, the strong easterly wind prevented the free end of the slides from making firm contact with the ground. Cabin attendants shouted to the rescue personnel for assistance and the slides were hand-held to the ground by the firemen. Passengers seated in the front rows particularly those who were English speaking were quick to respond to the evacuation command, and rapidly moved towards the emergency exits. Other non-English speaking passengers responded slowly at the outset of the

evacuation as they could not understand the meaning of "EVACUATE". The majority of the passengers were Mandarin speaking and cabin crew had difficulties in translating evacuation instructions instantaneously in the heat of the emergency.

Dragonair's main business operations are in China and most of the passengers they carry speak Cantonese and/or Mandarin. Dragonair's cabin crews are fluent in Cantonese and/or Mandarin but they are not trained to give emergency briefings and commands in these languages. There is no such requirement in the Operations Manual.

Some passengers carried bags and personal belongings as they rushed to the exits. Cabin crew repeatedly told them to leave their hand baggage behind but they were ignored. Cabin crews therefore snatched bags away from passengers as they approached the door exits. Most passengers jumped down the slides without hesitation. About half of the total number of passengers escaped through the over-wing exits, the over-wing emergency slide was a double lane slide which could allow the egress of two passengers at the same time (Appendix 18). The evacuation was carried out in an orderly and expeditious manner and was completed within 3 minutes.

3. CONCLUSIONS

3.1 Findings

3.1.1 Both pilots were properly qualified and licensed to operate the A320 aircraft for the flight (para 1.5.1).

3.1.2 Both pilots were medically fit and there was no evidence that any pre-existing physical condition of either pilot contributed to the incident (para 1.13).

3.1.3 The cabin attendants were properly qualified to carry out their duties (para 1.5.2).

3.1.4 The aircraft was being flown by the Captain who occupied the left-hand control seat.

3.1.5 The aircraft was properly certificated and maintained to the required airworthiness standards (para 1.6).

3.1.6 The aircraft was correctly loaded (para 1.6.1) and sufficient fuel was carried on board for the intended flight under the prevailing weather conditions (para 2.5).

3.1.7 Standby Singal Number 1 was hoisted on the day of the incident and the prevailing strong easterly wind resulted in significant windshear and turbulence on approach and departure routes. (para 1.7).

3.1.8 The meterological information available to the crew was sufficient for them to assess the general weather situation in Hong Kong and to expect windshear and turbulence on approach (para 1.7).

3.1.9 The aircraft encountered a severe gust on short final at about 800 feet which caused the flap to lock at the Config FULL setting (para 2.2). The flap lock mechanism was designed to reduce the possibility of flap asymmetry in the event of asymmetric flap movements (para 1.6.3).

3.1.10 There was no evidence of any pre-existing defects or systems malfunctions in the aircraft except that the right wing strut was 2 mm from the datum rigging length (para 1.12). Although the out-of-rig would make the strut sensitive to movement between inner and outer flap sections (para 1.12), it is not the determining factor for the flap lock since the 'g' loading on the aircraft resulting from the gust encounter was sufficient to cause the necessary asymmetric movement for the flap lock even without the out-of-rig (para 2.2).

3.1.11 On the first go around, the FLAPS lever was raised as required by the normal go-around procedures. It was then set to Config 1 and Config 2 in sequence. (para 2.4.2).

3.1.12 Both pilots misinterpreted the ECAM flap lock indication. They believed the flaps were locked at an intermediate setting (paras 2.4.2 and 2.4.3).

3.1.13 The flaps/slats configuration display on the ECAM was not of a design that could enable immediate apprehension of problem and action required (para 2.4.3) and the crew were insufficiently familiar with the system to make the optimal decision on the first approach. Thereafter the deteriorating fuel state and provocative, apparently undemanded, roll excursions during critical phases of flight caused mounting anxiety with disruptive effects first on problem solving ability, then on procedural and, possibly, handling skills. Degradation in crew performance and increasing lack of situational awareness were evident as the flight progressed (para 2.4).

3.1.14 The aircraft type conversion training included a demonstration on the ECAM display in flap lock situations, there was no exercise on flap lock in abnormal flap/slat configurations (para 2.4.4). There was also no question on flap lock problems in the Type Technical Examination (para 2.4.5).

3.1.15 Information contained in the F/CTL FLAPS FAULT/LOCKED page of the FCOM does not differentiate between procedures to be followed with flaps locked at intermediate settings and at FULL setting. It also published a statement "Do not select Config FULL so as not to degrade handling qualities" (para 2.4.6). Due to a similar incident which occurred a few months prior to this incident, Airbus Industrie published an OEB 117/1 which specified the procedures the crew should follow in the event of flaps locked at FULL. The OEB was inserted in the OEB section at the back of the FCOM (para 1.17).

3.1.16 The OEB 117/1 stated that the ECAM procedure will be modified. At the time of the incident the modification was not embodied and the ECAM display was not consistent with the OEB.

3.1.17 Neither pilot was aware of the existence of the OEB 117/1 which required the use of Config FULL (FLAPS lever selection) for landing to avoid lateral oscillations if flaps were locked at FULL. Even if they were aware of the existence of the OEB, it would be difficult to predict whether or not FULL flap would be reselected by the crew since they firmly believed that the flaps were locked at some intermediate setting (para 2.4).

3.1.18 There is a note at the bottom of the OEB 117/1 which states that :

"Information in this bulletin is recommended by Airbus Industrie but may not be approved by Airworthiness Authorities. In case of conflict with the certified Flight Manual, the latter will supersede."

Clearly, the procedures published by the OEB differ from that of the FCOM. If the Captain had correctly identified the flap lock position and selected Config FULL as recommended by the OEB, he would have operated the aircraft outside the published procedures in the FCOM and the Aircraft Flight Manual (para 1.17.1).

3.1.19 The lateral control laws applied by the flight control computers correspond to the actual positions of the slats and flaps (para 1.6.4). During the event, the gains and kinematics corresponding to the Config FULL were not selected due to the fact that the slats were retracted.

3.1.20 In this incident, flaps were locked at Config FULL (40°) while the FLAPS lever was set at Config 3 for the second approach, Config 1 for the third and Config 3 for the fourth approach (paras 2.4.6 and 2.4.7). The lateral control law was not optimised in these configurations and was liable to generate, in turbulent conditions, lateral oscillations when the autopilot was engaged and to increase the lateral sensitivity in roll when the aircraft was being manually flown (para 2.3).

3.1.21 The failure case "flaps locked in full configuration with procedure of application of landing in Config 3", was not evaluated in flight nor in a simulator during Type Certification or during aircraft development. The only demonstration made is the abnormal configuration 22°/35° tested in flight for CL max in direct law (para 1.16.2).

3.1.22 Localised turbulence generated by the extended landing gear might make the aircraft more susceptible to lateral oscillations. (para 2.4.8)

3.1.23 Excessive roll oscillation occurred in turbulence close to the ground and while the Captain was reacting to the aircraft's instability in roll due to this turbulence. Although the roll input was initiated by the Captain by his moving the side-stick control, the flight control surfaces were not reacting with the control gains that the Captain was familiar with or trained to cope with (para 2.4.8).

3.1.24 The Cabin crew prepared the aircraft for an emergency landing. However passengers were not briefed on what to expect and what to do on touchdown due to insufficient time available, unsuitable flight conditions for any demonstration and the Captain's decision not to alarm the passengers. However, safety briefing and demonstrations were carried out by cabin crews prior to take-off from Nanjing (para 2.6.2).

3.1.25 Proper approach briefings for the third and the fourth approaches were omitted by the Captain and the landing check list was not properly performed (para 2.4.7).

3.1.26 There was no call by the flight crew for the occupants to take up brace position on landing (para 2.6.2).

3.1.27 No standard calls were made by the co-pilot during final approach and landing (para 2.4).

3.1.28 Routine crew communication and coordination on the flight deck broke down completely towards the end of the flight (paras 2.4.6 & 2.4.7).

3.1.29 The aircraft touched down within the normal touchdown zone close to the centre-line marking on runway 31, while tracking about 5° off to the right of the runway centre-line (para 2.4.10).

3.1.30 Manual differential braking action was applied immediately upon touchdown with the right foot brake actuator depressed before the left (para 2.4.9).

3.1.31 The Captain did not succeed in keeping the aircraft on the runway after touchdown (para 2.4.10).

3.1.32 The aircraft departed the runway paved surface onto the adjacent grass area about 5 seconds after touchdown. DFDR data showed that rudder was almost neutral during this time. Significant left rudder input was apparent while the aircraft was rolling over the grass area. (para 2.4.10).

3.1.33 The Captain applied maximum symmetrical manual braking and reverse thrust promptly after touchdown. However, he only applied positive directional control towards the end of the landing roll when the aircraft was approaching taxiway B1 (para 2.4.10).

3.1.34 The co-pilot assisted on the brakes to stop the aircraft shortly after touchdown without informing the Captain of his action (para 2.4.10).

3.1.35 There was no fire. However, the smoke from the hot brakes and the signal from the AFC prompted the Captain to order evacuation (para 1.15.2).

3.1.36 Evacuation instructions to passengers were in English only and non-English speaking passengers responded slowly at the outset of the evacuation as they had difficulty in understanding the instructions (para 2.6.3).

3.1.37 Communications with ATC units were generally satisfactory but the approach and aerodrome control frequencies were rather busy due to the volume of traffic handled at the time (para 1.9).

3.2 **Causes**

There are three main events in this incident: the flap lock, the roll oscillations and the departure of the aircraft from the runway after touchdown. The flap lock triggered the incident but it was not the cause of the other two events. The aircraft could have landed without further incident after the flap lock had the crew continued the first approach to land, or followed the OEB 117/1 procedures in the go-around. There was also no direct relationship between the latter two events because notwithstanding the roll control problem, the crew managed to land the aircraft within the normal touchdown zone close to the runway centre-line at a normal landing speed. The aircraft could have stayed on the runway had effective directional control been exercised early. The causes of the three events are therefore addressed separately:

(a) The flap lock was caused by the 'g' loading on the aircraft resulting from the gust encounter which was sufficient to cause the necessary asymmetric movement for the flap lock. The flap lock mechanism was designed to reduce the possibility of flap asymmetry in the event of asymmetric flap movements.

(b) the roll oscillations were caused by :

Turbulence and Pilot Induced Oscillations due to the flight control laws for the A320 aircraft not being optimized for configurations with slats at 18° or 22° and flaps at 40°. As a result lateral control sensitivity was increased.

Contributing factors included -

(i) The importance of the information contained in the OEB 117/1 was not sufficiently highlighted to A320 operators to require mandatory action by pilots.

(ii) The lack of awareness by the crew of the relevant OEB and of appreciation of the flap lock position.

(iii) The ECAM display and FCOM procedures were not modified in line with the OEB 117/1.

(iv) The performance of the crew degraded as the degree of anxiety and level of stress increased after unsuccessful attempts to identify the cause and solution to the control problem, and as the level of remaining fuel became more and more critical.

(v) The failure case of flaps locked in FULL configuration with slats set for landing in Config 3 was not evaluated during aircraft type certification or development.

(c) The departure of the aircraft from the runway after touchdown was caused by the apparent delay of the Captain in exercising effective directional control. A contributing factor was the disruptive effect of anxiety on the crew's performance.

4. SAFETY RECOMMENDATIONS

It is recommended that:

(a) The aircraft manufacturer, in consultation with its airworthiness certification authority, reviews the system of OEB to ensure that safety related information is effectively brought to the attention of all persons concerned with their implementation.

(b) The aircraft manufacturer reviews the control laws for all possible slats/flaps configurations to ensure they do not give rise to problems with aircraft control and implement any necessary modification as early as possible.

(c) The aircraft manufacturer reviews the actions required in case of flap lock resulting in abnormal slats/flaps configurations, including any modifications required of the aircraft system and documentation to facilitate efficient and effective action by flight crew.

(d) The airworthiness authority responsible for A320 type certification reviews the need for requiring flight tests of the most critical abnormal slats/flaps configurations as part of the type certification of the aircraft.

(e) Hong Kong Dragon Airlines review the syllabus for A320 aircraft type conversion training and technical examination to ensure that there is sufficient coverage of the slats/flaps system and actions required in the event of abnormal slats/flaps configurations.

(f) Hong Kong Dragon Airlines ensure that apart from English, evacuation instructions to passengers are given in a language understandable to the majority of passengers carried for each route.

(g) The Hong Kong Civil Aviation Department includes in the A320 Type Technical Examinations questions on flap lock indications.

(h) The Hong Kong Civil Aviation Department looks into the possibility of using dedicated frequency for ATC units to communicate with emergency traffic similar to this incident.

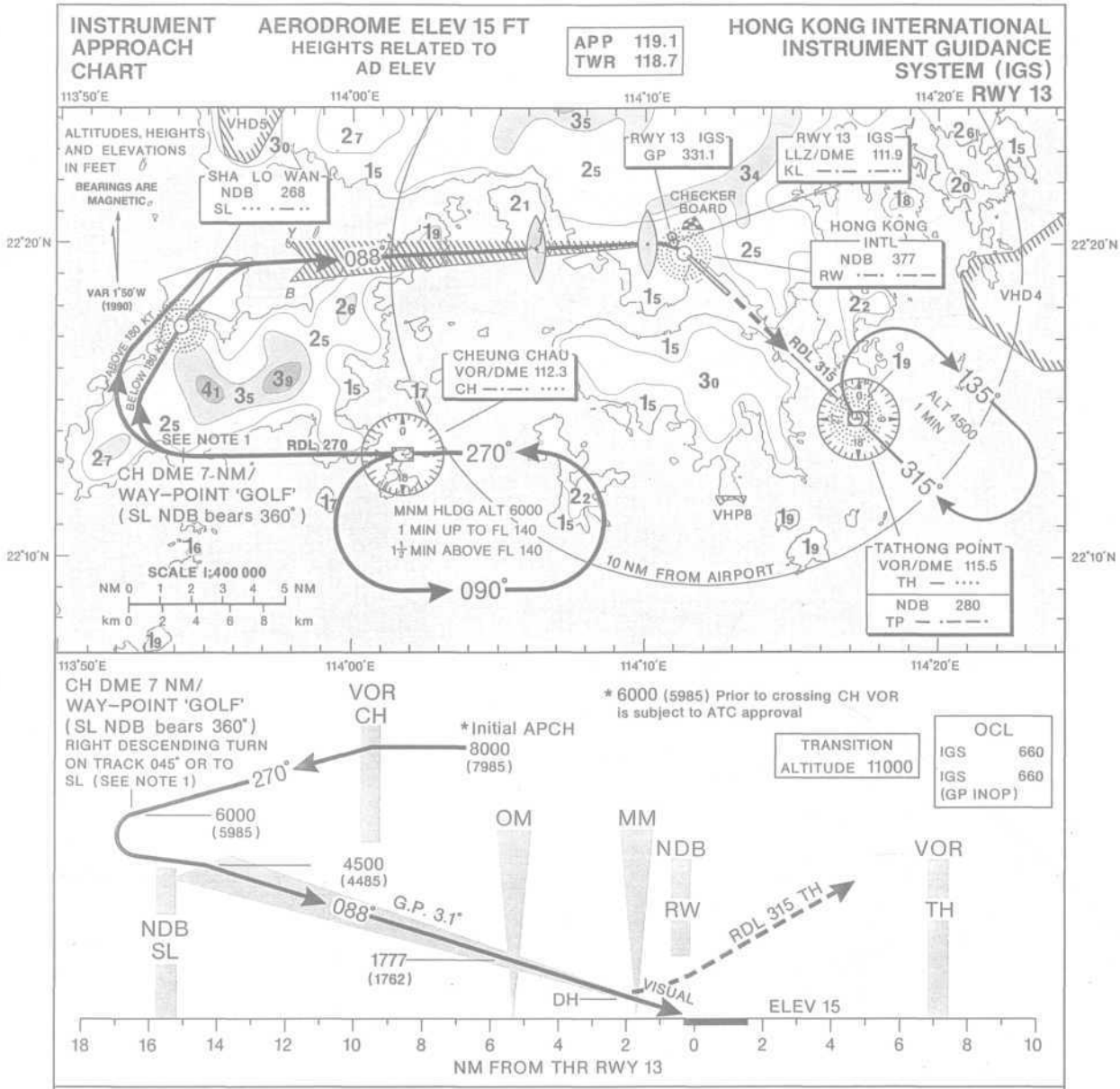
These recommendations are addressed to the regulatory authority of the State having responsibility for the matters with which the recommendation is concerned. It is for that authority to decide whether and what action is taken. During the process of investigation, discussions were held with the aircraft manufacturer and operator and some of the recommendations were actioned as described in para 1.17.3 of the report.

(The invaluable contribution by the following organisations is gratefully acknowledged :-

The United Kingdom Air Accidents Investigation Branch
The Bureau Enquetes-Accidents, France
The Centre for Human Sciences, DERA, United Kingdom)

Jeffrey TO
Inspector of Accidents
Accidents Investigation Division
Civil Aviation Department Hong Kong

IGS Approach Runway 13



MISSED APPROACH: Continue on the IGS LLZ, climbing to 4 500 ft, at the MM (or 2.2 NM from 'KL' DME if MM is unserviceable), turn right to intercept and establish on 'TH' VOR radial 315 and join the 'TH' holding pattern or proceed as directed by ATC. Or, if 'TH' VOR is not available, continue on the IGS LLZ, climbing to 4 500 ft; at the MM (or 2.2 NM from 'KL' DME if MM is unserviceable), turn right to track through 'RW' NDB on 130°M and join the 'TP' holding pattern or proceed as directed by ATC.

Missed approach turn is based on 15° bank, 1.5° per second rate of turn and an average speed of 180 kt whilst turning.

WARNING

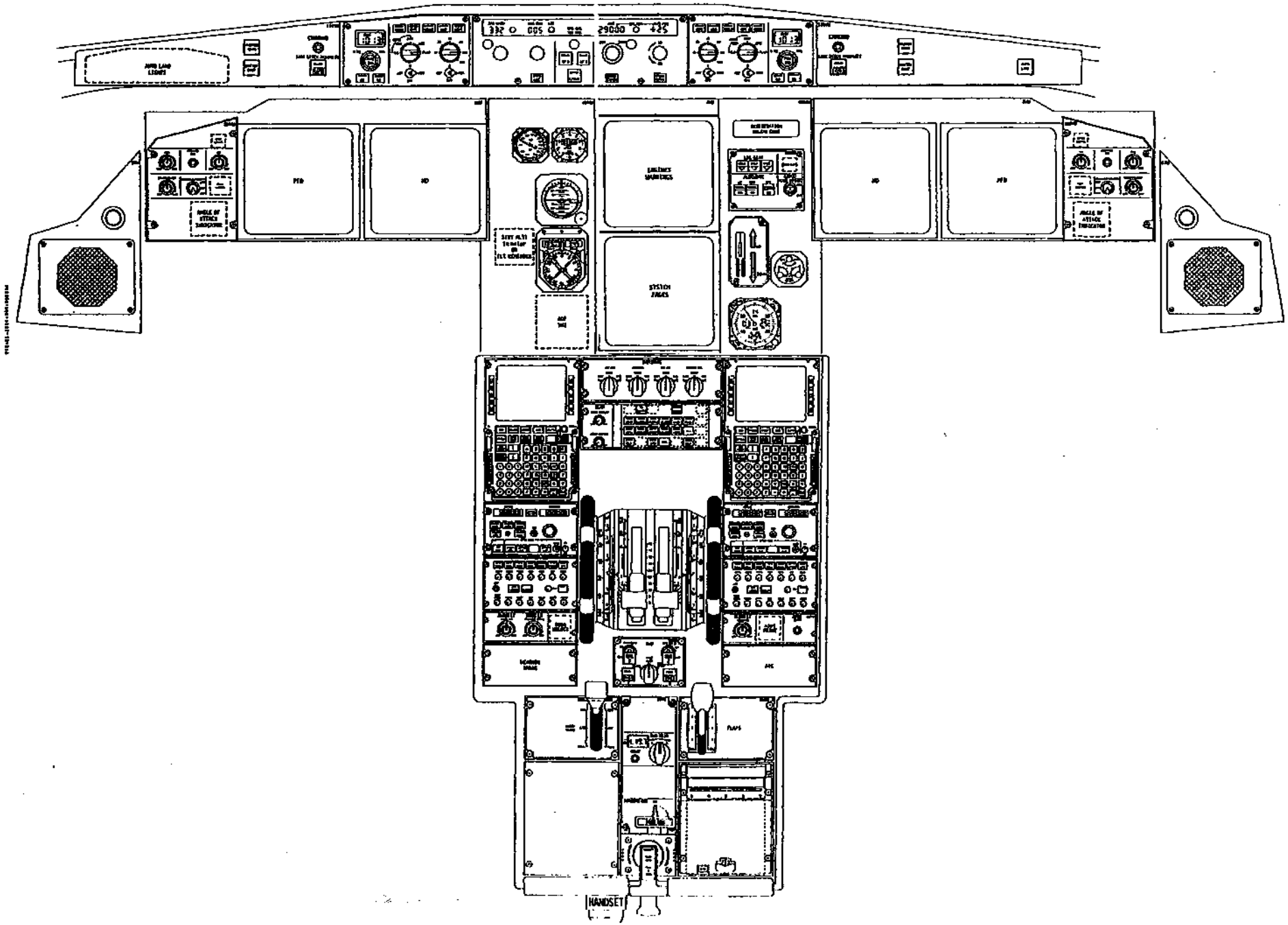
Missed approach is mandatory by the MM if visual flight is not achieved by this point. In carrying out the missed approach procedure, the right turn must be made at the MM (2.2 NM from 'KL' DME if MM is unserviceable) as any early or late turn will result in loss of terrain clearance.
After passing the MM, flight path indications must be ignored.

NOTE 1 At 'CH' DME 7 NM ('SL' NDB bears 360°) further descend to 4 500 ft and:—
(i) turn right to make good a track of 045° M to intercept the LLZ; or
(ii) aircraft flying at less than 180 kt IAS should turn right to 'SL' NDB and thence track 045° M to intercept the LLZ.

NOTE 2 With GP inoperative — When established on the LLZ at 4 500 ft and at not greater than 'KL' DME 15 NM (2219.12N 11356.05E) descend to 3 000 ft. At 'KL' DME 9 NM, descend as for a 3° GP to cross the OM at not less than 1 800 ft, then continue descend to decision height.

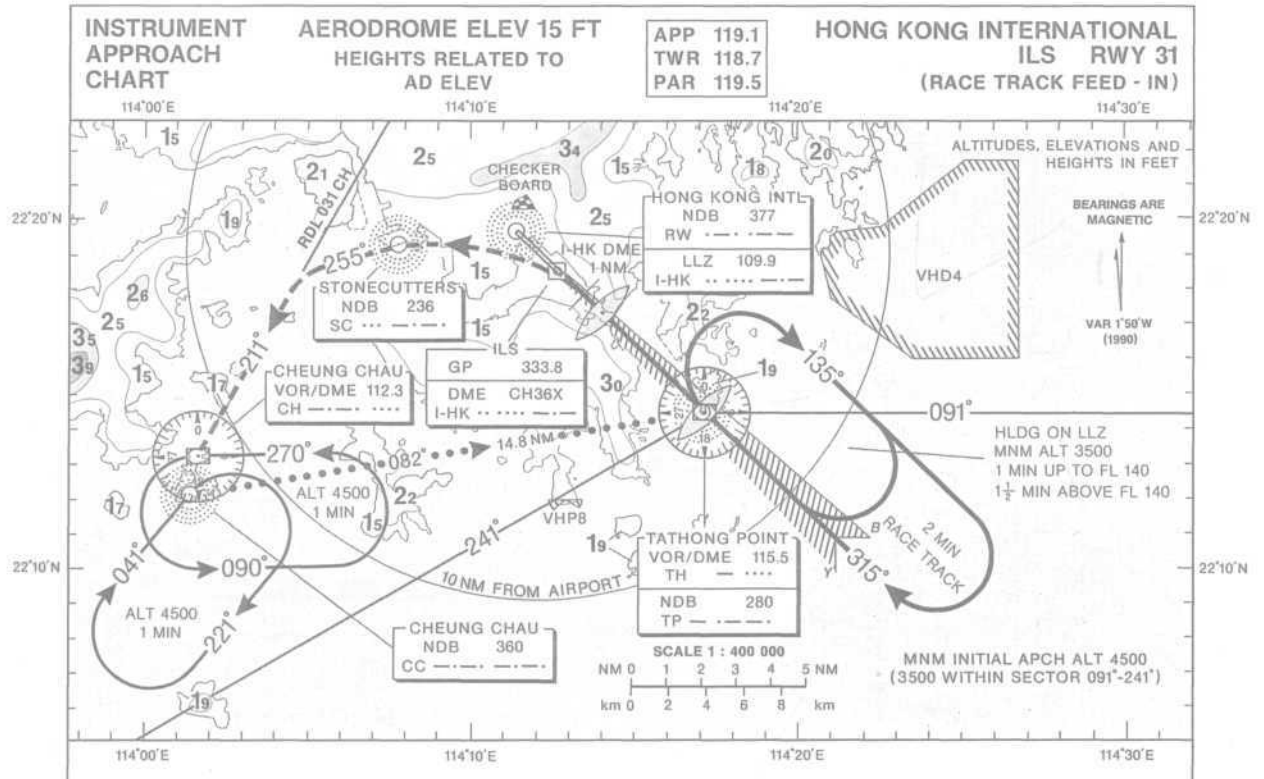
Cartography by Survey and Mapping Office, Lands Department

A320 Aircraft Cockpit Layout

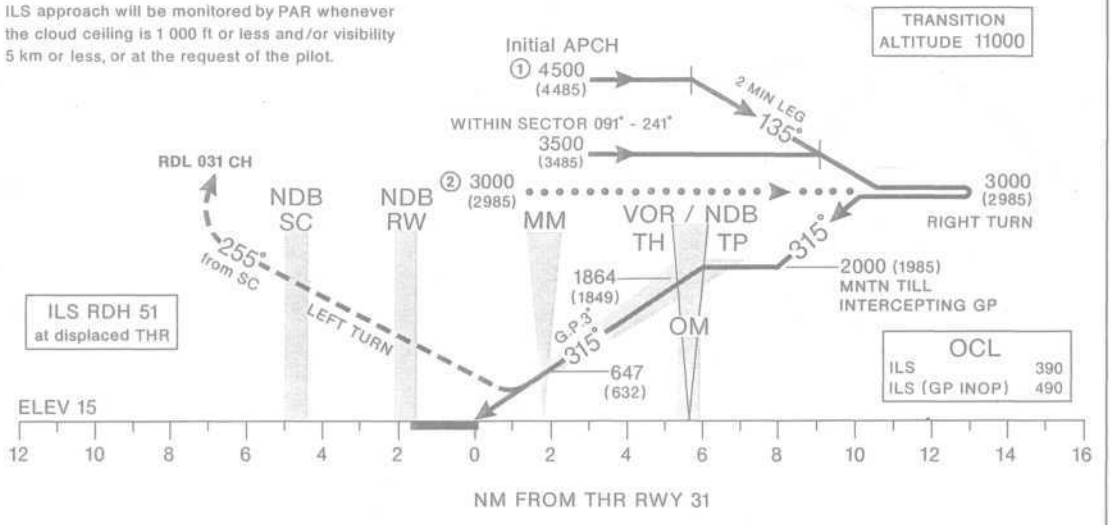


Appendix 2

ILS Approach Runway 31



ILS approach will be monitored by PAR whenever the cloud ceiling is 1 000 ft or less and/or visibility 5 km or less, or at the request of the pilot.



① Aircraft approaching within the sector 091° - 241° may approach at 3500 (3485).

② Aircraft proceeding DCT from CC NDB to TH VOR / TP NDB may be cleared by ATC to APCH at 3000 (2985) providing that holding is neither indicated nor anticipated.

MISSED APPROACH: Climb to and maintain 2 500 ft on track 315°M towards 'RW' NDB. When passing within 1 NM southeast of 'I-HK' DME and above 330 ft, turn left to 'SC' NDB and continue climb to 4 500 ft. From 'SC' NDB track 255°M to intercept 'CH' VOR 031 radial. Turn left to track 211°M to 'CH' VOR and join the 'CH' VOR hold or as directed by ATC.

In the event 'CH' VOR is unserviceable, 'CC' NDB may be used instead. In this case, track 255°M from 'SC' NDB until 'CC' NDB bears 214°M, then turn left to track 211°M to 'CC' NDB and join 'CC' NDB hold at 4 500 ft or as directed by ATC.

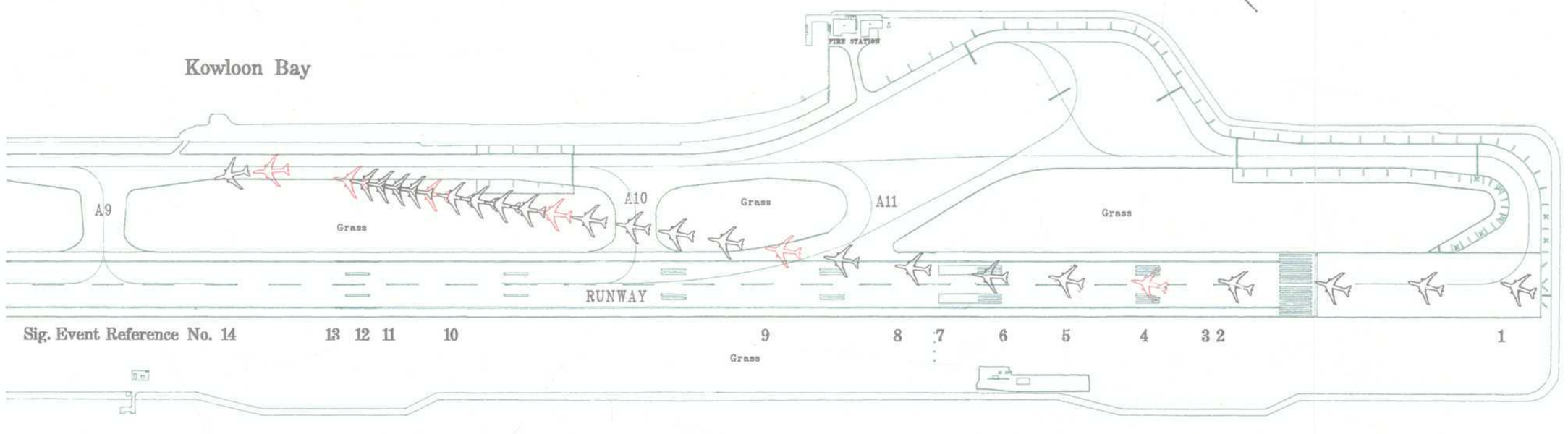
Note: With GP inoperative — Cross the OM at 2 000 ft, descend as for a 3° glidepath. Do not descend below 750 ft until 'I-HK' DME 3 NM, then continue descend to decision height.

Cartography by Survey and Mapping Office, Lands Department

Significant Events on Landing Roll

HDA 323 A320 AIRCRAFT INCIDENT (VR-HYU)

6 JUNE 1994



Legend for significant events :

1 Co-pilot : "OK GO FOR IT"

2 Thrust levers closed ; Co-pilot : "GO FOR IT"

3 Synthetic voice : "RETARD RETARD"

4 Touchdown point

5 Beginning of right main gear tyre marks

6 Beginning of left main gear tyre marks

7 Application of thrust reversers

8 Maximum brake pressure was recorded and maintained

9 Aircraft departed runway paved surface

10 Significant left rudder input was apparent

11 Co-pilot : "STOP IT"

12 CVR noise "BANG" as the right main gear and the nose gear contacted the taxiway lip at the same time

13 CVR noise "BANG" as the left main gear contacted the taxiway lip and punctured the outboard tyre

14 Aircraft came to a complete stop after travelled approx. 920m on the ground

Remarks :

(a) Aircraft symbols are drawn to represent the track made good and the approximate rate of deceleration of HDA 323 on its landing roll.

(b) Aircraft symbols are separated by distance travelled in 1-second intervals except the last symbol which represents the final stopping position of the aircraft.

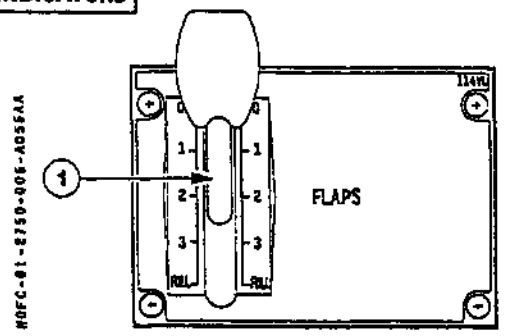
(c) Red aircraft symbols are separated by 5-second intervals.

(d) Information are based on preliminary data obtained from DFDR and CVR of the incident aircraft.
Speed and distance information are less accurate towards the end of the landing roll.

The A320 FLAPS/SLATS Selector
and normal Flaps/Slats Configurations

R **CONTROLS AND INDICATORS**

PEDESTAL



① FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions :

Position	SLATS	FLAPS	Indication on ECAM			
0	0	0			CRUISE	HOLD
* 1	18	0	1			
		10	1 + F	TAKE OFF		
2	22	15	2			APPR
3	22	20	3		LDG	
FULL	27	40	FULL			

Before selection of any position, the lever must be pulled out of detent.
Moreover, balks are provided at position 1 and 3 to avoid excessive flap / slat travel demand by a single pilot action.

Note : It is not possible to select an intermediate lever position.

* Take off in conf 1 :
1 + F (18 / 10) is selected.
If conf. 0 is not selected after take off, the flaps automatically retract at 210 Kts.

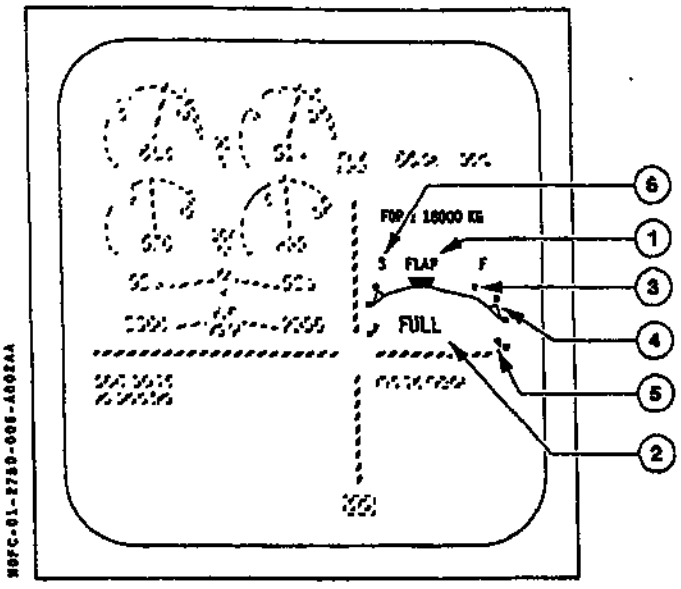
Take off or go around in conf 2 or 3 :
At conf 1 selection : 1 + F (18 / 10) is selected if speed < 210 kts.
If conf. 0 is not selected after take off, the flaps automatically retract at 210 Kts.

0 to 1 in flight :
1 (18 / 0).

Note : After flaps retraction, CONF 1 + F is no longer available until speed is 100 kt or less, except if CONF 2 or more has been previously selected.

ECAM Flaps and Slats Indications

ECAM UPPER DISPLAY



① FLAP indication

« FLAP » indication appears when the slats or the flaps are not fully retracted.

a) White when selected position is achieved.

b) Cyan when flaps or slats are in transit.

c) Amber in case of :

R 1) both relevant hydraulic systems loss (except on ground with engines stopped)

2) wing tip brakes application

3) slats or flaps fault.

② Flap lever position

a) 0,1 + F, 1, 2, 3, or FULL indication is displayed. Refer to CONTROLS and INDICATORS ON PEDESTAL.

. Green when selected position is achieved. 0 not displayed when clean configuration is achieved.

. Cyan during transit.

b) S (F) LOCKED indication appears amber associated with ECAM caution when wing tip brakes are applied or when non alignment between 2 flaps is detected.

c) A-LOCK indication pulses cyan when the slat alpha / speed lock function is active.

Slats flaps position :

③ White points – Selectable position. Not displayed in clean configuration.

④ Green triangles = Actual position

displayed amber in case of :

a) both relevant hydraulic systems loss, except on ground with both engines stopped

b) wing tip brakes application

c) slats or flaps fault

⑤ Blue triangles = Selected position

R (With the current DMC std, the blue triangles may disappear before the selected position

R is totally reached).

⑥ S, F indication

a) normally green

b) displayed amber in case of

1) both relevant hydraulic systems loss, except on ground with both engines stopped

2) wing tip brakes application

3) slats or flaps fault

ECAM Indications with CONFIG FULL selected

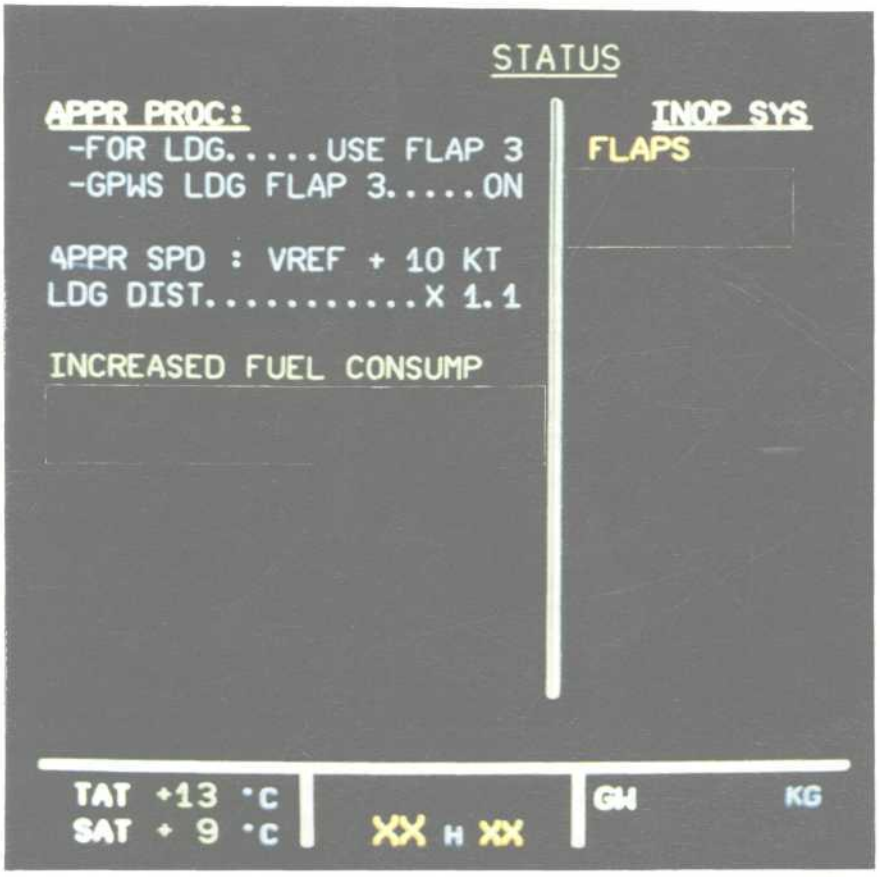
FLAPS lever set at CONFIG FULL
Flap locked at FULL Indications

FLAPS lever set at CONFIG 3
Flap locked at FULL Indications

FLAPS lever set at CONFIG 2
Flap locked at FULL Indications

ECAM Indications

System Pages on Lower Display Unit



Transcript of Radiotelephony Communications of HDA323 with APP/AMC/PAR on Fequencies 119.1/118.7/119.5 Mhz from 0806 to 0917 hr(UTC) on 6 June 1994

Time (UTC)	Station	R/T Communication
	(The following transmissions were on 119.1 MHz)	
0806:58	HDA323	Dragonair Three Two Three, flight level one five zero, released by Guangzhou.
0807:01	APP	Dragonair Three Two Three, after RUMET, heading one three zero, sequencing for IGS Approach, number seven in the sequence.
0807:07	HDA323	RUMET heading one three zero. Dragonair Three Two Three.
0808:34	APP	Dragonair Three Two Three, descend to flight level one three zero.
0808:38	HDA323	Out of flight level one three zero, Dragonair Three Two Three, heading one three zero.
0810:19	APP	Dragonair Three Two Three, descend to one one thousand feet, QNH one zero zero three.
0810:24	HDA323	One zero .. ah one zero one zero three, one one thousand feet, Dragonair Three Two Three.
0810:55	APP	Dragonair Three Two Three, turn right heading one niner zero.
0810:58	HDA323	Right heading one niner zero, Dragonair Three Two Three.
0812:55	APP	Dragonair Three Two Three, fly heading one eight zero, ah, track adjustment.
0812:59	HDA323	Heading one eight zero, Dragonair Three Two Three.
0813:46	APP	Dragonair Three Two Three, confirm levelled one one thousand?
0813:49	HDA323	Affirm, Dragonair Three Two Three.
0813:50	APP	Roger.
0815:16	APP	Dragonair Three Two Three, turn right heading two five zero.
0815:19	HDA323	Right heading at two five zero, Dragonair Three Two Three.

Contd. ..... /p. 2

Time (UTC)	Station	R/T Communication
0815:25	APP	Dragonair Three Two Three, expect six zero miles.
0815:28	HDA323	How many miles, say again please.
0815:30	APP	Six zero.
0816:10	APP	Dragonair Three Two Three, descend to eight thousand feet.
0816:13	HDA323	Leaving one one thousand down to eight thousand, Dragonair Three Two Three.
0817:01	APP	Dragonair Three Two Three, your speed now?
0817:03	HDA323	Speed one nine zero knots.
0817:05	APP	Roger.
0818:35	APP	Dragonair Three Two Three, turn right heading ah three zero zero.
0818:39	HDA323	Right heading three zero zero, Dragonair Three Two Three.
0819:21	APP	Dragonair Three Two Three, descend to six thousand.
0819:24	HDA323	Roger, six thousand feet, Dragonair Three Two Three.
0821:39	APP	Dragonair Three Two Three, turn right heading three five zero.
0821:42	HDA323	Right heading at three five zero, reaching six thousand feet, Dragonair Three Two Three.
0821:46	APP	Roger, ah Three Two Three, descend to four thousand five hundred feet.
0821:49	HDA323	Continue descend to four and a half thousand feet, Dragonair Three Two Three.
0823:14	APP	Dragonair Three Two Three, turn right heading zero three zero.
0823:17	HDA323	Right heading at zero three zero, Dragonair Three Two Three.
0824:27	APP	Dragonair Three Two Three ah heading zero four zero to intercept the Localizer, cleared IGS Approach.

Contd. ..... /p. 3

Time (UTC)	Station	R/T Communication
0824:32	HDA323	Heading zero four zero intercept Localizer, cleared IGS, Dragonair Three Two Three.
0826:25	HDA323	Three Two Three, intercept Localizer.
0826:28	APP	Say again.
0826:29	HDA323	Dragonair Three Two Three established Localizer.
0826:31	APP	Roger, Three Two Three, reduce speed to one eight zero knots to maintain until Outer Marker, radar service terminated, contact Tower one one eight seven.
0826:38	HDA323	Cleared reduced one eight zero knots till Outer Marker, to Tower, Dragonair Three Two Three.
		(The following transmissions were on 118.7 MHz)
0827:04	HDA323	Evening, Dragonair Three Two Three, establish IGS, one nine miles, speed one eight zero knots.
0827:11	AMC	Dragonair Three Two Three, report Outer Marker.
0827:14	HDA323	.. Two Three.
0832:10	HDA323	Three Two Three, Outer Marker.
0832:12	AMC	Dragonair Three Two Three continue, departure ahead.
0832:14	HDA323	Three Two Three.
0832:24	AMC	Dragonair Three Two Three, wind check zero nine zero degrees, one eight knots, expect a late landing clearance.
0832:29	HDA323	Three Two Three, roger.
0833:37	AMC	Dragonair Three Two Three, caution wind shear on final, wind on the Threshold zero nine zero degrees, one five knots, and up to one eight knots at the Stop End, cleared to land.
0833:45	HDA323	Cleared to land, Three Two Three.
0834:08	HDA323	We go around.
0834:12	AMC	Roger, traffic ahead ah just airborne, it is a Boeing Seven Four Seven and climb to four thousand five hundred feet.

Contd. ..... /p. 4

Time (UTC)	Station	R/T Communication
0834:18	HDA323	Five hundred feet ..
0834:29	AMC	Three Two Three, expedite through two thousand five hundred feet and report when clear.
0834:33	HDA323	.....
0834:35	AMC	Dragonair Three Two Three, climb to four thousand five hundred feet.
0834:37	HDA323	Four thousand five hundred.
0834:39	AMC	Roger, report clear of two thousand five.
0835:11	AMC	Dragonair Three Two Three confirm climbing to four thousand five hundred feet.
0835:15	HDA323	.. climbing Dragonair Three Two Three.
0835:17	AMC	Roger, traffic is a Cathay Seven Four Seven four miles ahead.
0835:21	HDA323	We are now passing two thousand three hundred.
0835:24	AMC	Roger.
0836:03	AMC	Dragonair Three Two Three, contact Approach now one one nine one.
0836:07	HDA323	Nine one.
		(The following transmissions were on 119.1 MHz)
0836:17	HDA323	Approach, Dragonair Three Two Three, passing four thousand.
0836:21	APP	Dragonair Three Two Three, maintain four thousand five hundred feet, turn right heading two four zero.
0836:25	HDA323	Heading two four zero, maintain four thousand five hundred, Dragonair Three Two Three, say again heading.
0836:30	APP	Heading two four zero.
0836:32	HDA323	Two four zero.
0837:57	HDA323	Control, Dragonair Three Two Three.
0838:00	APP	Go ahead.

Contd. ..... /p. 5

Time (UTC)	Station	R/T Communication
0838:01	HDA323	Yes sir, we do have a flight control problem, we like to maintain this heading for a while and advise you our intention in a couple of minutes' time.
0838:09	APP	Roger.
0840:44	HDA323	Approach, ah Dragonair Three Two Three, rea.. ready for approach now.
0840:48	APP	Dragonair Three Two Three, roger, maintain present heading, I'll vector you for IGS Approach, confirm you have solved the problem.
0840:55	HDA323	Affirm, it's still ... OK, stand by, stand by.
0840:58	HDA323	Negative, we did not solve the problem, we still have the flight control problem. It's flap locked and would like to commence the approach as soon as possible, please, Dragonair Three Two Three.
0841:08	APP	Roger.
0841:15	APP	Dragonair Three Two Three, ah turn right heading two niner five.
0841:20	HDA323	Right heading two niner five, Dragonair Three Two Three.
0842:10	APP	Dragonair Three Two Three, say again problem.
0842:13	HDA323	Dragonair Three Two Three, we have the flap ah flight control flap locked, flap lock problem.
0842:20	APP	Roger.
0842:48	APP	Dragonair Three Two Three, turn right heading three five zero.
0842:51	HDA323	Right heading ah three five zero, Dragonair Three Two Three.
0843:15	APP	Dragonair Three Two Three, do you require the Fire Services to stand by on your landing?
0843:22	HDA323	Ah affirm, Dragonair Three Two Three.
0843:25	APP	Roger.

Contd. ..... /p. 6

Time (UTC)	Station	R/T Communication
0843:59	APP	Dragonair Three Two Three, can you reduce speed to one seven zero indicated?
0844:04	HDA323	OK, we try one seven zero knots, confirm?
0844:06	APP	Ah, if not, advise what speed do you like to maintain ?
0844:10	HDA323	OK, now one seven five.
0844:13	APP	Roger, you can maintain one seven five.
0845:17	APP	Dragonair Three Two Three, turn right heading zero four five to establish Localizer, cleared IGS Approach.
0846:23	HDA323	Heading zero four five, intercept Localizer, cleared for IGS, Dragonair Three Two Three.
0846:31	HDA323	Approach, Dragonair Three Two Three, what is the surface wind now please?
0846:36	APP	Roger, surface wind on the north-west end zero eight zero degrees at the one five and south-east end also the same.
0846:44	HDA323	Three Two Three.
0848:05	HDA323	Dragonair Three Two Three established Localizer.
0848:08	APP	Dragonair Three Two Three, roger, contact Tower one one eight seven.
0848:11	HDA323	Tower, Dragonair Three Two Three.
		(The following transmissions were on 118.7 MHz)
0848:18	HDA323	Tower, Dragonair Three Two Three established IGS, one five miles.
0848:22	AMC	Dragonair Three Two Three, roger, continue to Finals One Three.
0848:26	HDA323	Roger.
0850:18	AMC	Dragonair Three Two Three, just want to confirm your approach speed on Finals will be faster or slower than normal?

Contd. ..... /p. 7

Time (UTC)	Station	R/T Communication
0850:23	HDA323	Will be a bit faster than normal, Dragonair Three Two Three. What we have is the flap's been locked at the intermediate position.
0850:32	AMC	Roger.
0851:53	HDA323	Dragonair Three Two Three, we do have a serious problem with the flight control, the aircraft becomes uncontrollable and we are on a missed approach at the moment trying to solve the problem again.
0852:06	AMC	Dragonair .. Air Hong Kong Eight Seven One, can you abort your departure?
0852:18	HDA323	Dragonair Three Two Three request heading ah now, request Three One, request Three One landing.
0852:23	AMC	Three Two Three, roger, carr.. carry out standard missed approach, maintain four thousand five hundred feet.
0852:29	HDA323	Request heading, request present heading please.
0852:32	AMC	Three Two Three, your passing level?
0852:34	HDA323	Four and half thousand, five thousand now.
0852:37	AMC	Three Two Three, roger, maintain ah your present level and track direct to Charlie Hotel.
0852:42	HDA323	Present heading, Charlie Hotel, Dragonair Three Two Three.
0853:59	AMC	Dragonair Three Two Three, contact Approach one one nine one.
0854:02	HDA323	Nine one.
		(The following transmissions were on 119.1 MHz)
0853:23	APP	Dragonair Three Two Three, Hong Kong.
0853:29	HDA323	...five hundred feet, we do have a serious malfunction with the flight control the minute we lower the landing gear and the aircraft became completely uncontrollable. Ah we are a bit short on the fuel, we would like to turn back, if possible for Runway Three One please.

Contd. ..... /p. 8

Time (UTC)	Station	R/T Communication
0853:46	APP	Dragonair Three Two Three, affirm, fly a heading now one three zero, maintain four thousand five hundred feet.
0853:53	HDA323	Three ah ... say again the heading please.
0853:56	APP	Heading one three zero.
0856:16	APP	Dragonair Three Two Three, turn left on a heading of zero, correction, turn left on heading one one zero, expect twenty two miles touch down.
0856:27	HDA323	Roger, Dragonair Three Two Three, left heading one one zero.
0856:31	APP	Affirm.
0856:32	HDA323	If you could reduce the ah ...track mile please.
0856:36	APP	Roger, ah turn left on a heading of two ah zero nine zero, heading zero nine zero. I give you two zero miles.
0856:42	HDA323	Roger, heading zero nine zero, Dragonair Three Two Three.
0857:47	HDA323	Dragonair Three Two Three, requesting three thousand feet now.
0857:51	APP	Dragonair Three Two Three, cleared to three thousand five hundred feet.
0857:54	HDA323	Three thousand five hundred feet, Dragonair Three Two Three, trying to short down our flight distance please.
0858:31	APP	Dragonair Three Two Three ah, descend now to three thousand feet, turn left on a heading of zero four zero for base leg.
0858:39	HDA323	Three thousand, say again left heading.
0858:42	APP	Zero four zero.
0858:43	HDA323	Zero four zero, Dragonair Three Two Three.
0858:46	APP	Affirm, expect a further left turn on final in about three miles.
0858:50	HDA323	Roger.

Contd. ..... /p. 9

Time (UTC)	Station	R/T Communication
0859:50	APP	Dragonair Three Two Three, two-minute mean wind at this moment is zero nine zero degrees at one seven knots, do you anticipant any difficulties in landing on Runway Three One?
0900:03	HDA323	Dragonair Three Two Three, we accept.. Runway Three One and we are ready for the airport.
0900:10	APP	Dragonair Three Two Three, turn left now on a heading three four five to intercept the Localizer and cleared to two thousand feet. You are cleared for the ILS Approach.
0900:23	HDA323	Heading three five zero?
0900:25	APP	Three Four Five.
0900:36	APP	Dragonair Three Two Three, give about one mile to the left of the Localizer, adjust your own heading for the (turn?) on. Your ILS departure will be monitored by Precision Radar.
0900:44	HDA323	Roger, Dragonair Three Two Three ..... (interrupted) ...after that.
0900:55	APP	Dragonair Three Two Three, Tower, continue the ILS Approach, contact Precision on one one nine decimal five for your monitored approach.
0901:04	HDA	One one niner five, Three Two Three.
		(The following transmissions were on 119.5 MHz)
0901:06	HDA323	Precision, Dragonair Three Two Three.
0901:08	PAR	Dragonair Three Two Three, Hong Kong Precision, continue ILS Approach, how do you read, over.
0901:12	HDA323	Reading you five, sir.
0901:14	PAR	You are ..(transmission in and out) six miles from touch down, coming up to the final approach track miles, continue approach, I will pass you advisory information, do not .... (fading out).
0901:27	HDA323	Precision, one one nine five, cannot hear you, one one nine five.

Contd. ..... /p. 10

Time (UTC)	Station	R/T Communication
0901:28	PAR	Reading you five. How do you read me?
0901:32	HDA323	I am reading you intermittent.
0901:34	PAR	Roger, just continue the ILS Approach, I say again, continue the ILS Approach, how do you read me now? Over.
0901:39	HDA323	Reading you five.
0901:40	PAR	Roger, you are four and a half miles from touch down ah (transmission in and out) .. on track and slightly above the Glide Path.
0901:51	PAR	Ah Dragonair .. Three Two Three, you are above the Glide Path, above the Glide Path, over.
0901:57	HDA323	Yes, Approach, we are adjusting, adjusting.
0901:59	PAR	Roger, roger.
0902:16	PAR	...from touch down, ah approaching the Glide Path from above ah the surface wind is zero nine zero degrees at one eight knots. You are cleared to land, I say again, you are cleared to land. Over.
0902:26	HDA323	Cleared to land, roger.
0902:28	PAR	Roger.
0902:34	PAR	Two miles.
0902:40	PAR	Final wind check, one zero zero degrees at two two knots.
0902:55	PAR	Two miles.
0903:22	PAR	Dragonair Three Two Three, I see you are going around, continue with the Standard Missed Approach Procedure, climb to four five zero zero feet, over.
0903:32	HDA323	Precision, Three Two Three, ah we cannot, we have a shortage of fuel, we have a shortage of fuel.
0903:38	PAR	Roger roger, contact Hong Kong Approach now one one nine decimal one, understand shortage of fuel, what is your diversion fuel, over?

Contd. ..... /p. 11

Time (UTC)	Station	R/T Communication
0903:48	HDA323	No more, no more diversion fuel, cannot ah divert anywhere.
0903:52	PAR	Understand cannot divert anywhere, roger.
0904:00	PAR	Dragonair Three Two Three, copied, contact Approach one one nine one for reposition for another approach, over.
0904:19	HDA323	Approach, Dragonair Three Two Three.
0904:22	PAR	Three Two Three, I say again, contact Approach one one nine decimal one for positioning for another approach, what is your intention, over.
0904:28	HDA323	Confirm one one nine ah confirm one one nine five?
0904:30	PAR	One one nine decimal one, one one nine decimal one, continue with the Missed Approach Procedure, over.
		(The following transmissions were on 119.1 MHz)
0905:00	APP	Dragonair Three Two Three, Approach.
0905:02	HDA323	Approach, Dragonair Three Two Three, reaching five thousand ..(jammed)
0905:06	APP	Three Two Three, maintain five thousand and report your intention.
0905:10	HDA323	OK, stand by, stand by, give us a few seconds.
0905:21	APP	Dragonair Three Two Three, maintain five thousand feet, what is your intention?
0905:45	APP	Dragonair Three Two Three, continue to Charlie Hotel.
0905:49	HDA323	Roger, continue to Charlie Hotel, Three Two Three.
0905:52	HDA323	Dragonair Three Two Three, we like to make one more attempt, if it is possible, we are very short of fuel.
0906:00	APP	What runway, what runway do you prefer? Surface wind zero seven zero degrees at one seven knots.
0906:07	HDA323	Say again the wind.

Contd. ..... /p. 12

Time (UTC)	Station	R/T Communication
0906:08	APP	Zero seven zero degrees, one seven knots.
0906:14	HDA323	I will go for Runway Three One again please if that is possible?
0906:18	APP	Roger, turn left now on heading one two zero.
0906:21	HDA323	Left turn heading one two zero and Dragonair Three Two Three, the aircraft became totally uncontrollable with the landing gear down.
0906:30	APP	That's understood, heading one two zero.
0906:32	HDA323	Heading one two zero.
0907:00	APP	Dragonair Three Two Three, ah confirm you would maintain five thousand feet.
0907:03	HDA323	Request ah fur.. further descent, further descent.
0907:05	APP	Roger, stand by.
0907:40	APP	Dragonair Three Two Three, turn left heading one zero five.
0907:43	HDA323	One zero five left heading, Three Two Three, request descent.
0907:46	APP	Dragonair Three Two Three, descend to three thousand feet.
0907:51	HDA323	Three thousand feet, Three Two Three.
0908:36	HDA323	Dragonair Three Two Three, request immediate landing ..
0908:40	APP	Affirm, no delay for the landing, expect two two miles, it is the shortest route.
0908:48	APP	Dragonair Three Two Three, report when you are Victor Mike Charlie.
0909:53	HDA323	Roger, Three Two Three.
0909:56	APP	Dragonair Three Two Three, are you visual?
0910:01	APP	Cross transmission, Dragonair Three Two Three are you visual?
0910:04	HDA323	Ah, negative, we are now three thousand, request further descent.

Contd. ..... /p. 13

Time (UTC)	Station	R/T Communication
0910:08	APP	Ah negative, maintain three thousand feet.
0910:10	HDA323	Maintain three thousand, heading ah now one zero five.
0910:11	APP	Affirm.
0910:35	HDA323	Three Two Three, we now have the Tathong Point in sight I think.
0910:39	APP	Dragonair Three Two Three, roger, can you continue on a visual approach to Runway Three One.
0910:46	HDA323	Not at the moment, ah not at the moment.
0910:49	APP	Dragonair Three Two Three, roger, turn left ah heading zero nine zero.
0910:54	HDA323	Left heading zero nine zero, three thousand feet, we are Dragonair Three Two Three.
0911:58	APP	Dragonair Three Two Three, one three miles touch down.
0912:01	HDA323	Roger.
0912:30	HDA323	OK, Three Two Three, we've got to turn left now.
0912:32	APP	Dragonair Three Two Three, roger, turn left on a heading zero five zero to be intercepting at around Outer Marker.
0912:39	HDA323	Roger.
0912:41	APP	Dragonair Three Two Three, descend to two thousand five hundred feet.
0912:45	HDA323	Two thousand five hundred feet.
0913:15	HDA323	Three Two Three, approaching two and a half thousand feet.
0913:20	APP	Three Two Three, roger, maintain. Confirm you are still not visual.
0913:23	HDA323	Ah we ..now .. now visual now.
0913:27	APP	Roger, can you maintain Victor Mike Charlie for the visual approach?
0913:31	HDA323	Affirm.

Contd. ..... /p. 14

Time (UTC)	Station	R/T Communication
0913:32	APP	Roger, you are cleared for the visual approach to Runway Three One.
0913:36	HDA323	Visual approach Runway Three One, Dragonair Three Two Three.
0914:14	APP	Dragonair Three Two Three, continue to final approach and you are cleared to land Runway Three One. Surface wind zero nine zero degrees at one niner knots, Stop End zero eight zero degrees at one three knots, over.
0914:29	HDA323	OK. Understand cleared to land, Dragonair Three Two Three.
0914:54	PAR	Dragonair Three Two Three, you are cleared to land, I say again you are cleared to land. .... is zero seven zero degrees at one four...
0915:02	HDA323	Cleared to land, Three Two Three.
0915:20	PAR	... check ... do not acknowledge, one zero seven degrees, one five.
0915:37	PAR	... wind zero six zero at one two.
0915:56	PAR	....wind check, zero five zero degrees, one five, ... 2 miles from touch down.
0916:23	PAR	One mile from touch down, on track on Glide Path, wind check zero nine zero degrees, one three knots.
0917:22	PAR	..... Ground Control now one two one decimal six.
0917:32	PAR	Dragonair Three Two Three contact Ground one two one six.
0917:35	HDA323	One two one six.

oooOooooo

Relevant cockpit conversations before and after the 2nd IGS approach on flap lock position

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENT
0844:23	P1	SO SO THE FLAP LOCKED ACTUALLY AT TWO THERE IS NOTHING TO TELL US		BEFORE COMMENCEMENT OF THE SECOND IGS APPROACH
0844:50	P1	JUST TRY TO DRAW A QUICK PICTURE OF WHAT'S HAPPENING HERE IS AMBER THERE IS FLAP LOCKED AT TWO		SEE APPENDIX 6D. THAT WAS WHAT THE CAPTAIN SAW ON THE ECAM DISPLAY
0845:09	P2	YEAH I AM SURE WE ARE AT FLAP TWO		
0845:39	P1	ALIGNMENT FAULT WE HAVE		
0845:42	P2	BECAUSE THAT WINDSHEAR BUMP		
0846:02	P2	THAT'S MAYBE ?????? OUGHT TO MAINTAIN THIS CONFIGURATION YOU MEAN ???? OUGHT TO MAINTAIN THIS CONFIGURATION		
0846:05	P1	THAT'S WHAT THE BOOK SAYS THERE'S NOTHING IN THERE		
0846:07	P2	YEAH BECAUSE WERE		
	P2	LOCKED ALREADY		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENT
0848:36	P1	FLAPS INOPERATIVE SYSTEM SLATS FOR LANDING USE FLAPS THREE WE DID APPROACH SPEED Vref + TEN		
0849:04	P1	I TRIED TO RECYCLE NOTHING HAPPENED BECAUSE THAT'S WHAT THE BOOK SAYS SO		
0849:11	P1	FLAP TWO		
0850:18	AMC		DRAGON AIR 323 JUST WANT TO CONFIRM YOUR APPROACH SPEED WILL BE FAST OR SLOW	
0850:23	P1	IT WILL BE A BIT FASTER THAN NORMAL DRAGON AIR 323 WHAT WE HAVE IS THE FLAPS BEING LOCKED AT THE INTERMEDIATE POSITION		BOTH PILOTS BELIEVED THAT FLAPS WERE LOCKED AT CONFIG 2
0854:24	P1	HAECO ENGINEERING DRAGON AIR 323		AFTER THE SECOND GO-AROUND
0854:29	HAECO		323 THIS IS HAECO	
0854:31	P1	OK WE ARE IN SERIOUS PROBLEM NOW WE HAVE THE FLIGHT CONTROL PROBLEM THE FLAPS BEING LOCKED AT POSITION TWO THE MINUTE WE LOWER THE LANDING GEAR AND THE SPEED WAS ONE SEVEN SEVEN KNOTS THE AIRCRAFT BECAME COMPLETELY UNCONTROLLABLE ON RWY 13		SEVERE ROLL OSCILLATIONS COMMENCED AFTER THE GEARS WERE EXTENDED. ITS EFFECT WAS SO DRAMATIC WHICH LED THE CAPTAIN TO ASSOCIATE THE PROBLEM WITH THE GEAR EXTENSION.

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
0854:48	HAECO		THAT IS COPIED AHM CAN YOU ADVISE PLEASE ADVISE IF YOU HAVE LANDED OR ARE GOING AROUND	
0854:54	P1	NEGATIVE WE ARE HOPING FOR RWY 31 AT THE MOMENT AND WE ARE GOING TO LAND ON RWY 31		
0855:02	HAECO		THAT IS ALL COPIED 323 WE'LL ENSURE SOMEONE IS AT BAY 33 TO MEET YOU	
0855:09	P1	OK WE TRIED TO RECYCLE THE FLAPS NO LUCK & ITS LOCKED AT POSITION TWO & WE'LL BE LANDING RWY 13 HOPEFULLY		
0855:18	HAECO		THAT'S COPIED ?????? DO YOU HAVE ANY FLAP ASYMMETRY	
0855:25	P1	NEGATIVE NOT FROM THE INDICATIONS THAT WE HAVE WHAT WE REALLY HAD IS WE HAD A SEVERE SINKING WINDSHEAR AT THE VERY SHORT FINALS AND THEN THAT LED TO FLIGHT CONTROL FLAPS LOCKED ALIGNMENT FAULT AND WE WENT THROUGH THE PROCEDURES		
	P1	AND IT SEEMS IT'S LOCKED AT POSITION TWO SORRY ONE		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	P1	POSITION ONE ACTUALLY		OBVIOUSLY BOTH PILOTS MISIDENTIFIED THE FLAP SELECTOR INDICATION AS THE FLAP LOCKED POSITION.
0855:50	P2	NOW BACK AT ONE IT WAS TWO BEFORE		

Relevant cockpit conversations on gears extension
and fuel shortage during the 3rd and the 4th approaches

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENT
0856:14	P2	I THOUGHT IT MIGHT BE BECAUSE WE LOWERED THE GEAR		
	P1	YEAH		
0856:45	P2	SO MASTER CAUTION		
	P2	FUEL IN RIGHT WING LOW LEVEL		
0856:51	P1	OK THAT'S UNDERSTOOD		
0856:54	P1	NOW WE HAVE TO LAND OUT OF HIS ONE WE CANNOT		
0856:58	P2	DO YOU WANT TO CARRY OUT ECAM MESSAGE FUEL CROSS FEED ON		
	P1	YES PLEASE		
0857:00	P2	FUEL CROSS FEED ON		
	P1	ON		
	P1	RIGHT TANK PUMP		
	P2	ONE ON		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENT
	P2	FUEL AMBER LAMPS		
	P1	WE HAVE TO LAND		
0857:09	P1	FUEL IS AMBER FUEL IS BALANCED		
0857:10	P2	YEAH		
0858.06	P1	RIGHT SO WHAT DO YOU THINK IT WAS		
	P2	I THINK BECAUSE YOU SET ONE SIXTY ONE BEFORE YOU SELECT A SPEED WHEN WE LOWER THE GEAR THE SPEEDS TOO FAST FOR THIS FLAP		
	P1	YEAH COULD BE NO NOT REALLY NO A BIT HIGH ON THAT ONE		
	P2	COULD BE MAYBE YEAH		
	P1	SO THE MAX SPEED IS ONE SEVEN SEVEN AGAIN ISN'T IT		BOTH PILOTS WERE UNABLE TO CORRELATE THE FULL FLAP LIMITING SPEED WITH THE FLAP LOCK POSITION
	P2	AFFIRM TRY TO RECALL MAXIMUM SPEED ONE SEVEN SEVEN		
0858:54	P2	DO WE NEED TO OPEN THE CROSSFEEDS		
	P1	YEAH GO AHEAD		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	P2	FUEL FUEL CROSS FEEDS ON		
	P1	MASTER CAUTION FUEL LOW LEVEL		
	P1	FUEL CROSS FEED OFF		
	P2	FUEL CROSS FEED OFF AGAIN		
	P1	OK SO WHATS YOUR MAXIMUM SPEED AGAIN ONE SEVEN SEVEN		LIMITING SPEED WAS MENTIONED AGAIN
0859:30	P2	YEAH		
		REDUCING IT NOW		
0903:22	PAR		DRAGON AIR I SEE YOU ARE GOING AROUND CONTINUE WITH THE STANDARD MISSED APPROACH PROCEDURE	HDA 323 COMMENCED THE MAP FOR RUNWAY 31
0903:27	P1/PAR	WE CANNOT WE HAVE TO	CLIMB TO FOUR FIVE ZERO ZERO FEET OVER	
0903:32	P2	WE DON'T HAVE WE DON'T HAVE WE DON'T HAVE AH FUEL ENOUGH		
	P2	PRECISION WE CANNOT WE HAVE A SHORTAGE OF FUEL WE HAVE A SHORTAGE OF FUEL		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	PAR		ROGER ROGER CONTACT HONG KONG APPROACH ONE ONE NINE DECIMAL ONE UNDERSTOOD A SHORTAGE OF FUEL AH WHAT IS THE DIVERSION FUEL OVER	
	P1	WE HAVE NO DIVERSION FUEL		
	P2	WE ARE NO MORE WE HAVE NO MORE DIVERSION FUEL WE CANNOT AH DIVERT ANYWHERE		
0903:52	PAR		UNDERSTAND CANNOT DIVERT ANYWHERE	
0904:06	P1	HOW MUCH FUEL WE HAVE MATE		
0904:09	P2	WHA ONE THOUSAND ONE HUNDRED TWO ZERO		
0905:55	P1	DRAGON AIR 323 WE WOULD LIKE TO MAKE ONE MORE ATTEMPT AS SOON AS POSSIBLE WE ARE VERY SHORT OF FUEL SAY AGAIN WE ARE DECLARING AN EMERGENCY WE ARE VERY SHORT OF FUEL		TRANSMISSION WAS CROSSED, LATTER PART OF THE MESSAGE WAS NOT HEARD BY ATC
0906:14	P1	I GO FOR RWY 31 AGAIN PLEASE VECTOR US AS SOON AS POSSIBLE		
	P1	DRAGON AIR 323 THE AIRCRAFT BECAME TOTALLY UNCONTROLLABLE WITH THE LANDING GEAR DOWN		THE CAPTAIN THOUGHT THAT THE PROBLEM IN ROLL WAS CAUSED BY THE GEAR EXTENSION

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	APP		THAT'S UNDERSTOOD HEADING ONE TWO ZERO	
0906:48	P1	HAECO DRAGON AIR 323		
	HAECO		DRAGON AIR 323 GO AHEAD	
	P1	THE AIRCRAFT BECAME UNCONTROLLABLE WITH THE LANDING GEAR DOWN WE ARE ON VERY SHORT OF FUEL WE ARE GOING TO MAKE ONE MORE ATTEMPT IF NOT WE DO NEED YOUR ADVICE		
	HAECO		HAECO COPIED YOU ARE VERY SHORT OF FUEL YOU ARE GOING TO TRY ANOTHER LANDING RIGHT	
	P1	THAT'S RIGHT WE HAVE NO MORE FUEL THIS IS OUR LAST CHANCE		
	HAECO		COPIED 323	
0908:22	P1	LAST CHANCE WE HAVE TO LAND OUT OF THIS ONE		
0908:36	P1	DRAGON AIR 323 REQUEST AN IMMEDIATE LANDING PLEASE		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	APP		AFFIRM NO DELAY FOR THE LANDING EXPECT TWENTY TWO MILES ITS THE SHORTEST ROUTE	
0908:45	P1	GOD THAT'S TOO MUCH		
	APP		DRAGON AIR 323 REPORT WHEN YOU ARE VICTOR MIKE CHARLIE	
0909:05	SP	WILL WE NEED TO BRIEF THE PASSENGERS FOR OPENING THE DOOR		
	P1	AH NO YEAH BUT DON'T DON'T DO NOT EVACUATE UNLESS WE TELL YOU SO OK		
	SP	OK HOW MANY MINUTES		
	P1	IT'S ABOUT 10 MINUTES 5 MINUTES AT LEAST YEAH SEVEN MINUTES		
0909:37	P1	OH BOY 800 PAGES OH NO GOD		
0910:23	P1	OK WE ARE VISUAL NOW WELL SORT OF ISN'T IT		
0910:33	P2	323 NOW WE HAVE THE TATHONG POINT INSIGHT I THINK		
	APP		323 ROGER CAN YOU CONTINUE ON A VISUAL APPROACH TO RUNWAY 31	

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	P1	WE CANNOT NOT VICTOR MIKE CHARLIE		
0910:49	APP		DRAGON AIR 323 ROGER TURN LEFT ON HEADING ZERO NINE ZERO	
0911:53	P2	DO YOU HAVE IT IN SIGHT		
	P1	NOTHING IN SIGHT MATE		
	P1	NOW JUST IN CASE		
	APP		DRAGON AIR 323 THIRTEEN MILES TOUCHDOWN	
	P2	ROGER		
	P1	WHERE'S THE DITCHING		
	P1	CABIN CREW NOTIFY ATC TRANSPONDER NOTIFY .....JUST HAVE IT IN HERE JUST IN CASE		
0913:15	P2	323 APPROACHING TWO AND A HALF THOUSAND FEET		
	APP		323 ROGER MAINTAIN CONFIRM STILL NOT VISUAL	
	P2	WE'RE NOT AH		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
	P1	AFFIRM VISUAL NOW		
	P2	VISUAL NOW		
	APP		ROGER CAN YOU MAINTAIN VICTOR MIKE CHARLIE FOR THE VISUAL APPROACH	
	P2	AFFIRM		
0913:32	APP		YOU ARE CLEAR FOR THE VISUAL APPROACH TO RWY 31	
0913:56	P1	YEAH WE'LL DELAY THE LANDING GEAR FOR A WHILE		
	P1	OH GOD		
0914:54	APP		DRAGON AIR 323 YOU ARE CLEARED TO LAND WIND ZERO SEVEN ZERO AT ONE FOUR	
	P2	OK CLEAR TO LAND 323		
0915:26	P1	OK GEARS DOWN		
	P1	OOPS NOT YET		
	P2	NO NOT YET		

TIME (UTC)	SOURCE	FLIGHT CREW	GROUND STATIONS	COMMENTS
		OH NO GOD AH NO		
	APP		THREE MILES FROM TOUCHDOWN WIND ZERO SIX ZERO AT ONE TWO	
0915:38	P1	GEAR DOWN		
0916:23	APP		ONE MILE FROM TOUCHDOWN ON TRACK ON GLIDEPATH WIND CHECK ZERO NINE ZERO AT 13 KNOTS	
0916:38	P2	OK GO FOR IT		REFER TO APPENDIX 4 FOR EVENTS DURING LANDING ROLL

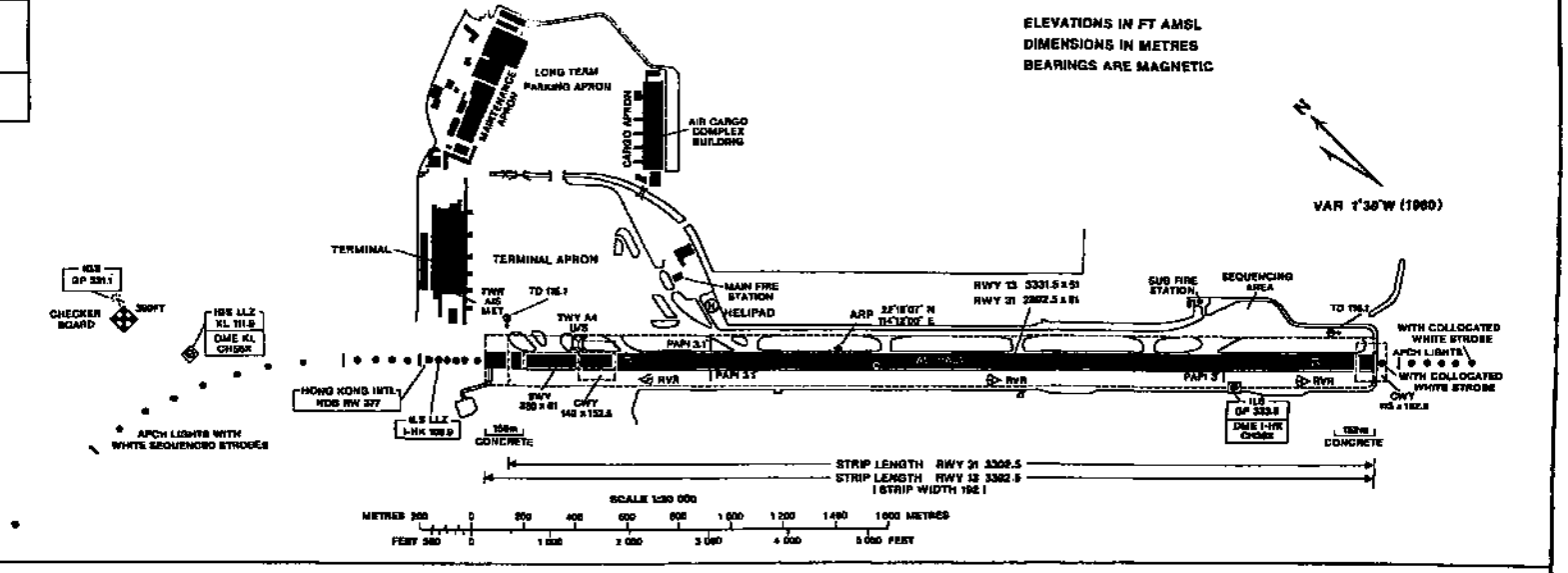
PLAN DIAGRAM OF HONG KONG INTERNATIONAL AIRPORT

RWY	DIRECTION	THR	BEARING STRENGTH
13	135°	22°19'24" N 114°11'38" E	PCN 61/F/B/X/U RUNWAY AND ALL TAXIWAYS
31	315°	22°18'24" N 114°12'45" E	
APRONS		BEARING STRENGTH PCN 60/R/B/X/U	

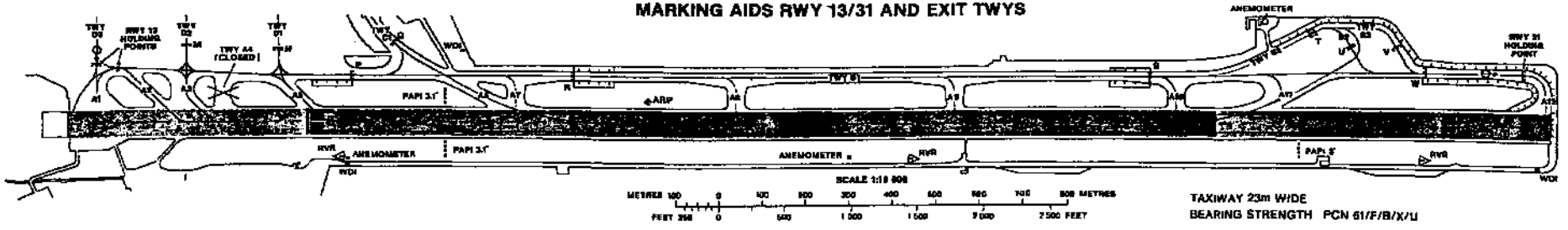
ELEVATIONS IN FT AMSL
DIMENSIONS IN METRES
BEARINGS ARE MAGNETIC

VAR 1°36'W (1990)

LEGEND	
VOR CHECK PT AND FREQ	TD 116.1
TAXI-HOLDING POSITION STOP-BAR LIGHTS	
RUNWAY CENTRE LINE LIGHTS	
RUNWAY EDGE LIGHTS	
TAXIWAY EDGE LIGHTS	
TAXIWAY CENTRE LINE LIGHTS	
TAXIWAY SHOULDERS	

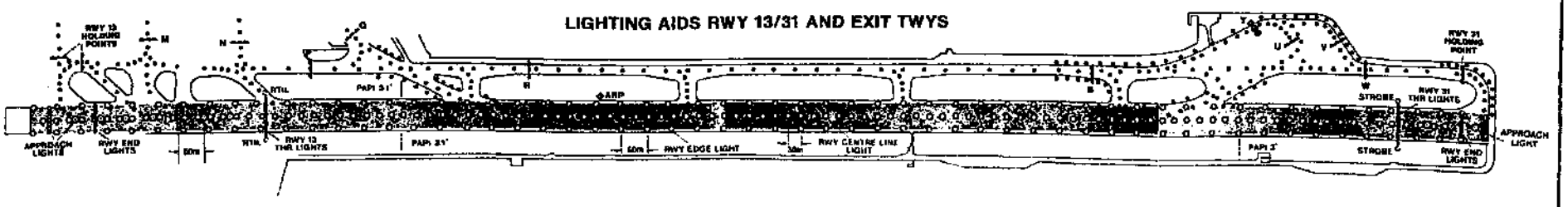


MARKING AIDS RWY 13/31 AND EXIT TWYS



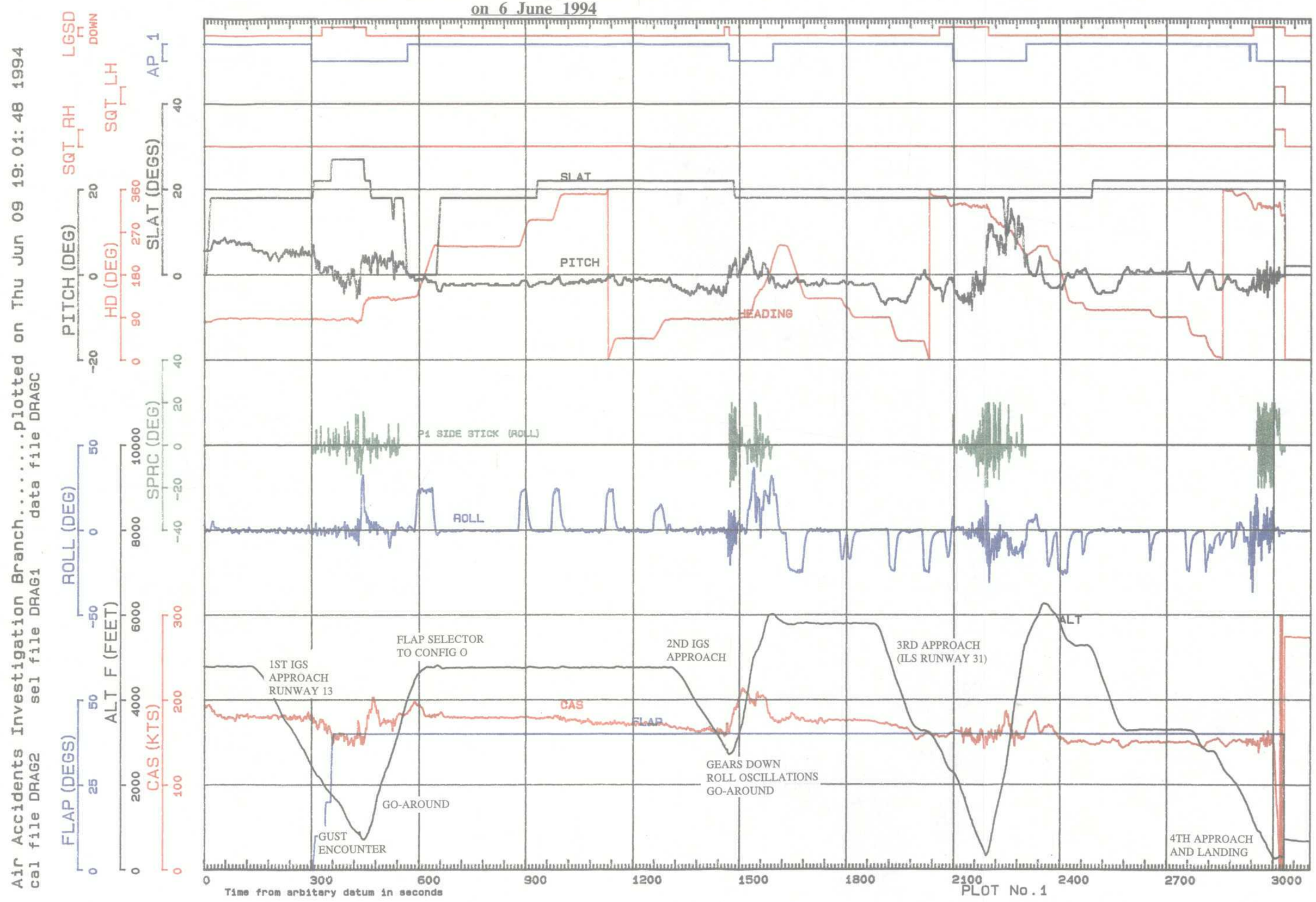
TAXIWAY 23m WIDE
BEARING STRENGTH PCN 61/F/B/X/U

LIGHTING AIDS RWY 13/31 AND EXIT TWYS



Appendix 10

DFDR plot for all the approaches of HDA323 on 6 June 1994



OEB on Flaps Locked/Fault

Airbus Industrie **O E B**

FLIGHT DIVISION — OPERATIONS ENGINEERING BULLETIN

BP No 33, 31707 Blagnac Cedex France — A320/A321

Issued by: AI/EV-O	File in FCOM vol 3	VALIDITY : ALL A320/A321	BULLETIN N° : 117/1 DATE : MAR 94

SUBJECT : FLAPS LOCKED/FAULT

REASON FOR ISSUE :

A case of lateral oscillations during approach with flaps locked in configuration full has been reported.

EXPLANATION

In case of flaps locked in configuration full, the ECAM procedure requires to select CONF 3 for landing.

The selection of the flap lever to the position 3 (and consequently the retraction of the slats to CONF 3 position) leads to the selection of autopilot and flight controls gains which are not fully optimized with the real aircraft aerodynamic configuration. The consequence is an increased lateral sensitivity in manual control which can be avoided if CONF FULL is maintained for landing.

ACTION

The ECAM procedure will be modified.

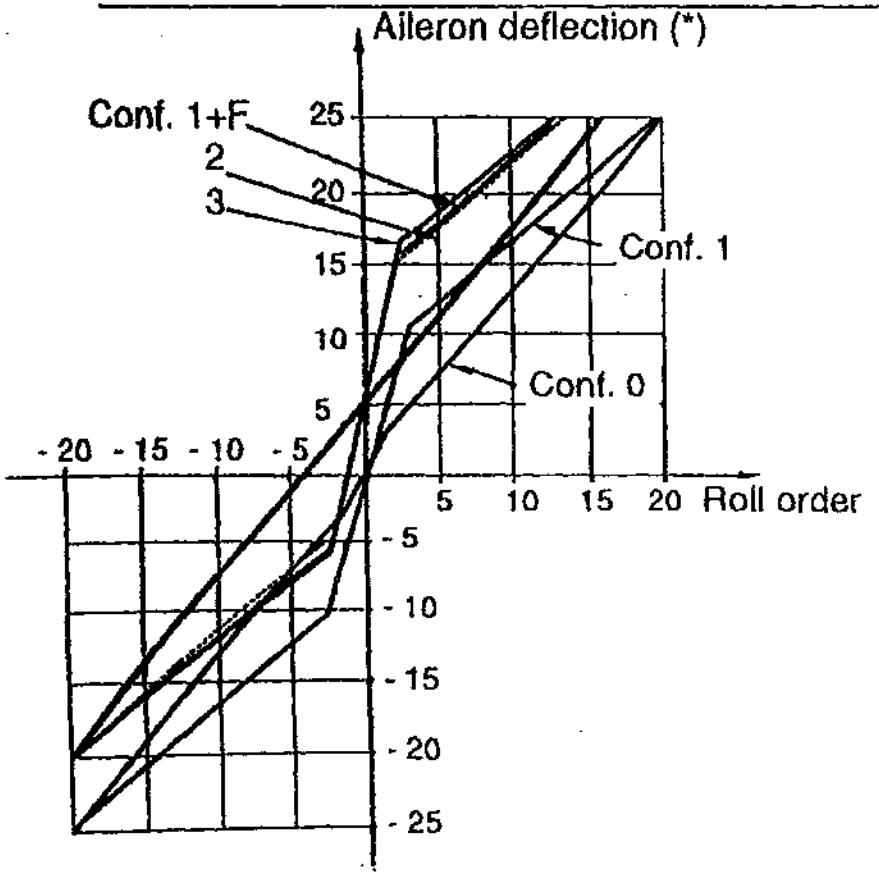
PROCEDURE

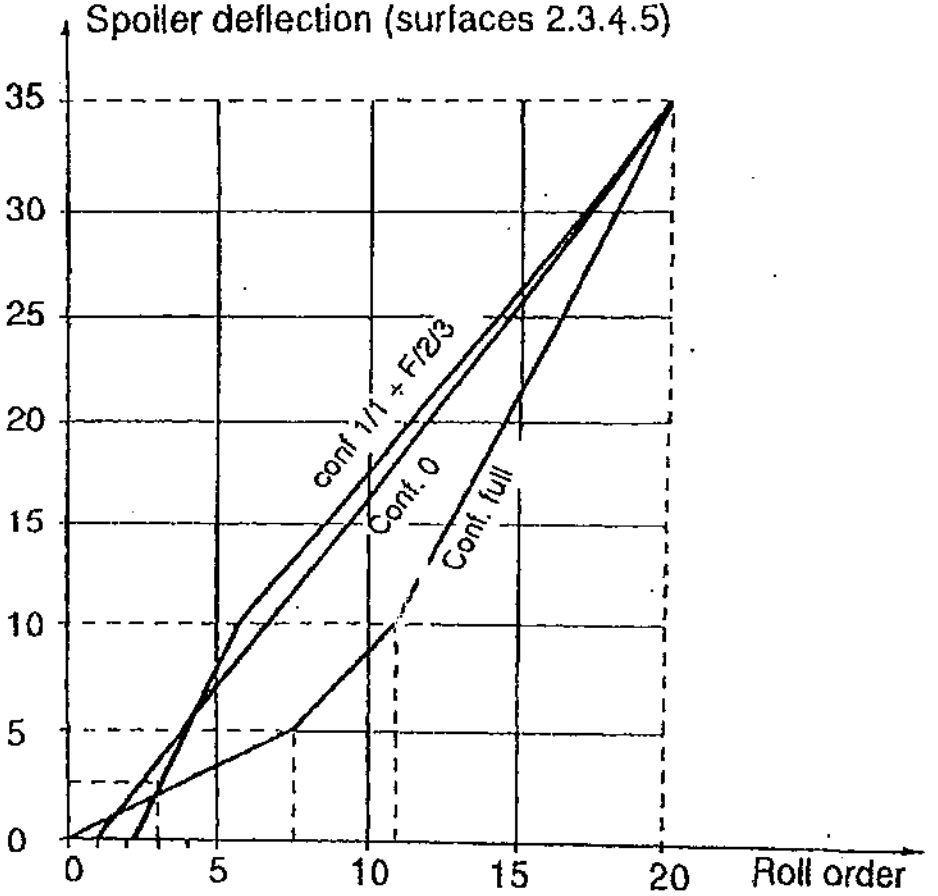
If "F/CTL FLAPS LOCKED" or "F/CTL FLAPS FAULT" ECAM warning is triggered with FLAPS at more than CONF 3 :

- leave flaps lever in CONF FULL position to keep the achieved FLAPS/SLATS position for landing.

Use of autopilot is not recommended with abnormal SLATS/FLAPS configurations.

Normal roll kinematics (cont.)





(*) Positive down going

FCOM Procedures for F/CTL FLAPS FAULT/LOCKED

F/CTL FLAPS FAULT/LOCKED

- **If Flaps locked**
  - WING TIP BRK ON or ALIGNMENT FAULT

- MAX SPEED ..... See page 3

Speed is limited to the VFE corresponding to the next flaps position

- FLAPS LEVER (if flaps not locked) ..... RECYCLE

- **If unsuccessful :**

Refer to FCOM 3.02.10 for flight pattern.

R

STATUS

R ENG 1 APPR IDLE ONLY (only in case of
R FLAPS FAULT)
R ENG 2 APPR IDLE ONLY (only in case of
R FLAPS FAULT)

MAX SPEED ..... See page 3

APPR PROC

- FOR LDG ..... USE FLAP 3

Do not select CONF FULL so as not to degrade handling qualities.

- GPWS FLAP MODE (if Flaps < 3) .. OFF
- GPWS LDG FLAP 3 (if Flaps ≥ 3) ... ON

APPR SPD ..... See page 3

LDG DIST ..... See page 3

Landing distance is increased due to increase of approach speed.

INCREASED FUEL CONSUMP

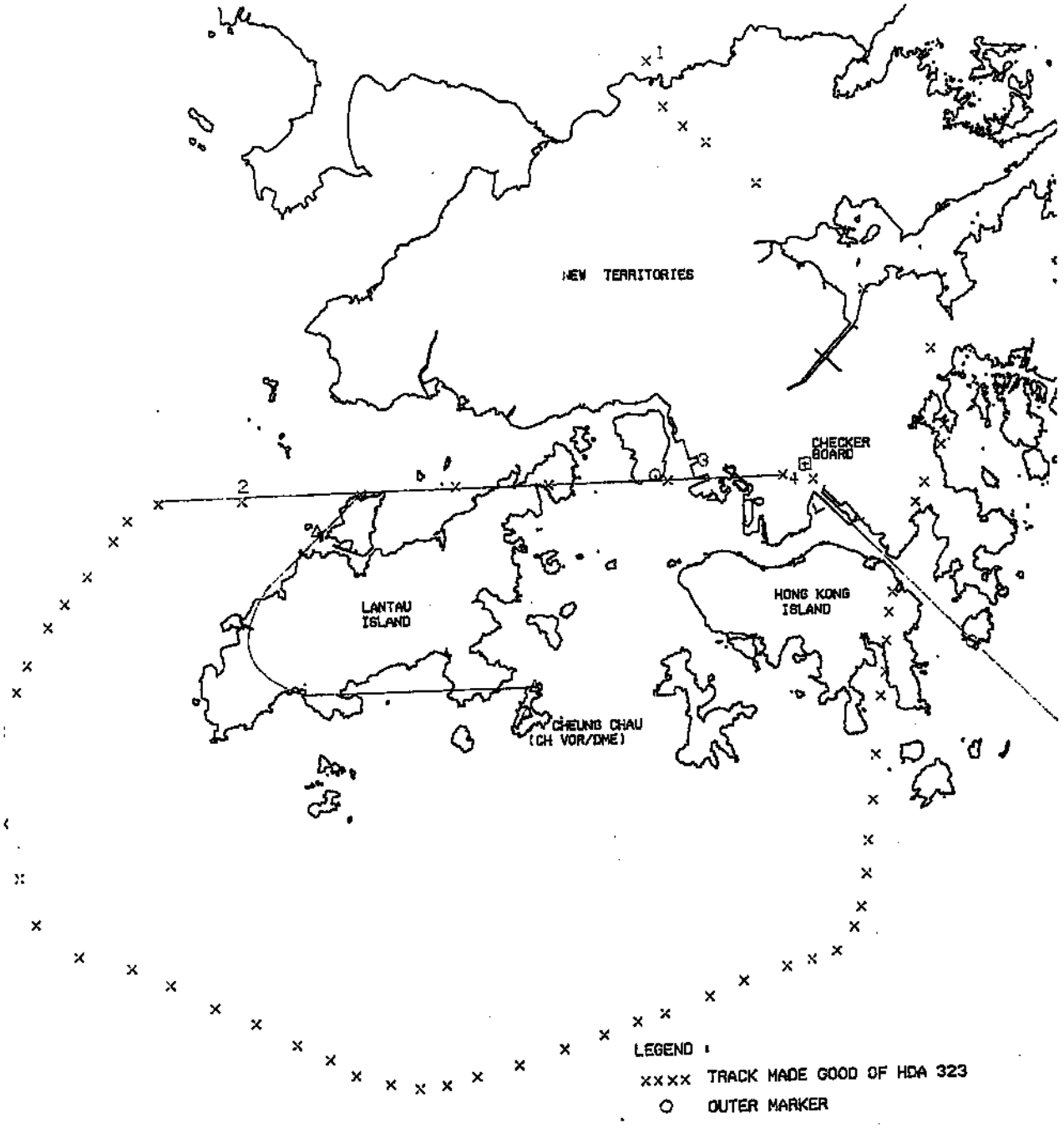
Fuel consumption (KG/NM) is multiplied by about 2 (valid for all config.)

CAT 2 ONLY

INOP SYS
FLAPS
CAT 3

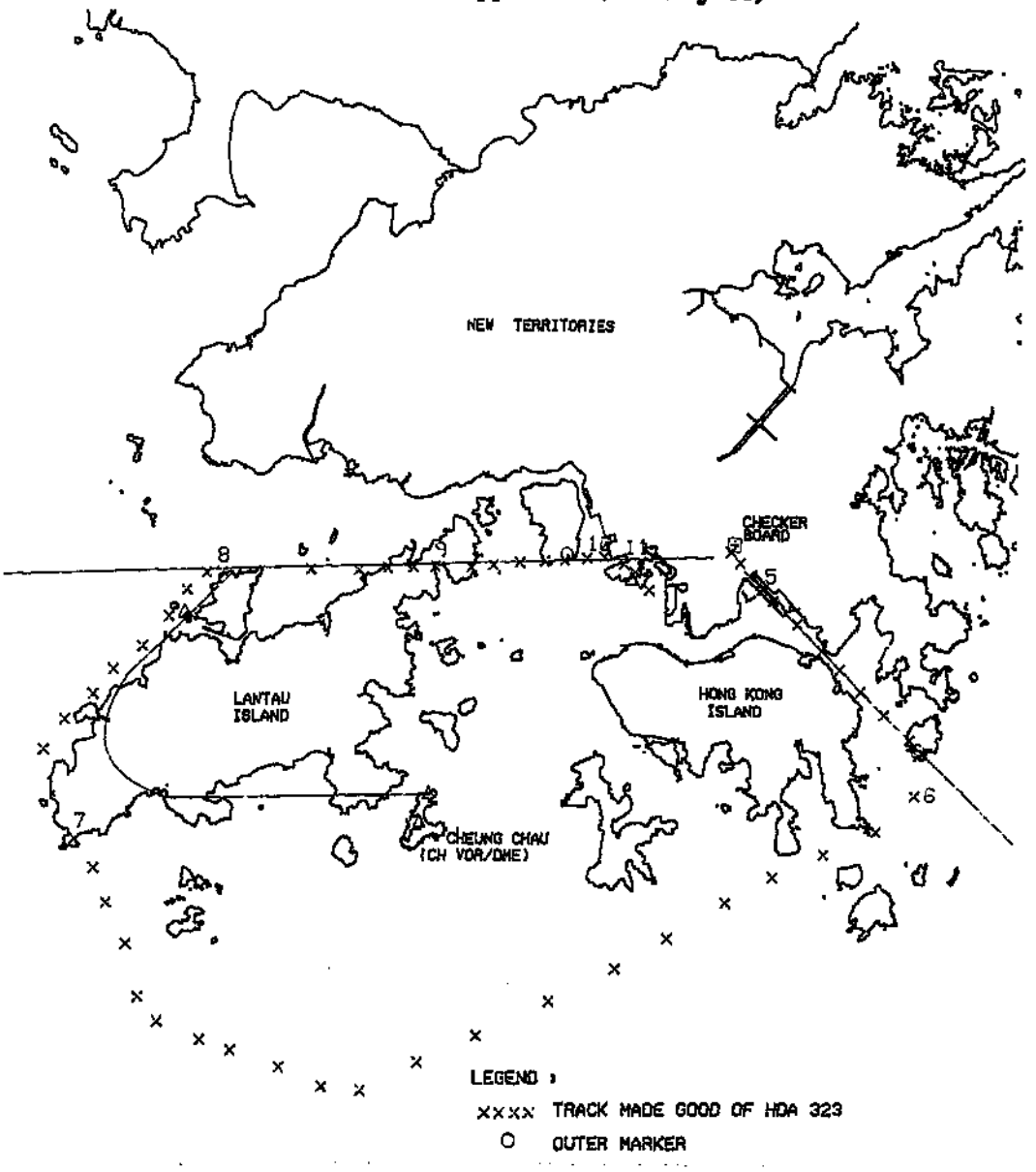
Track-made-good of HDA323 within Hong Kong Airspace and Sequence of Events throughout the incident flight

HDA 323 1st Approach (Runway 13)



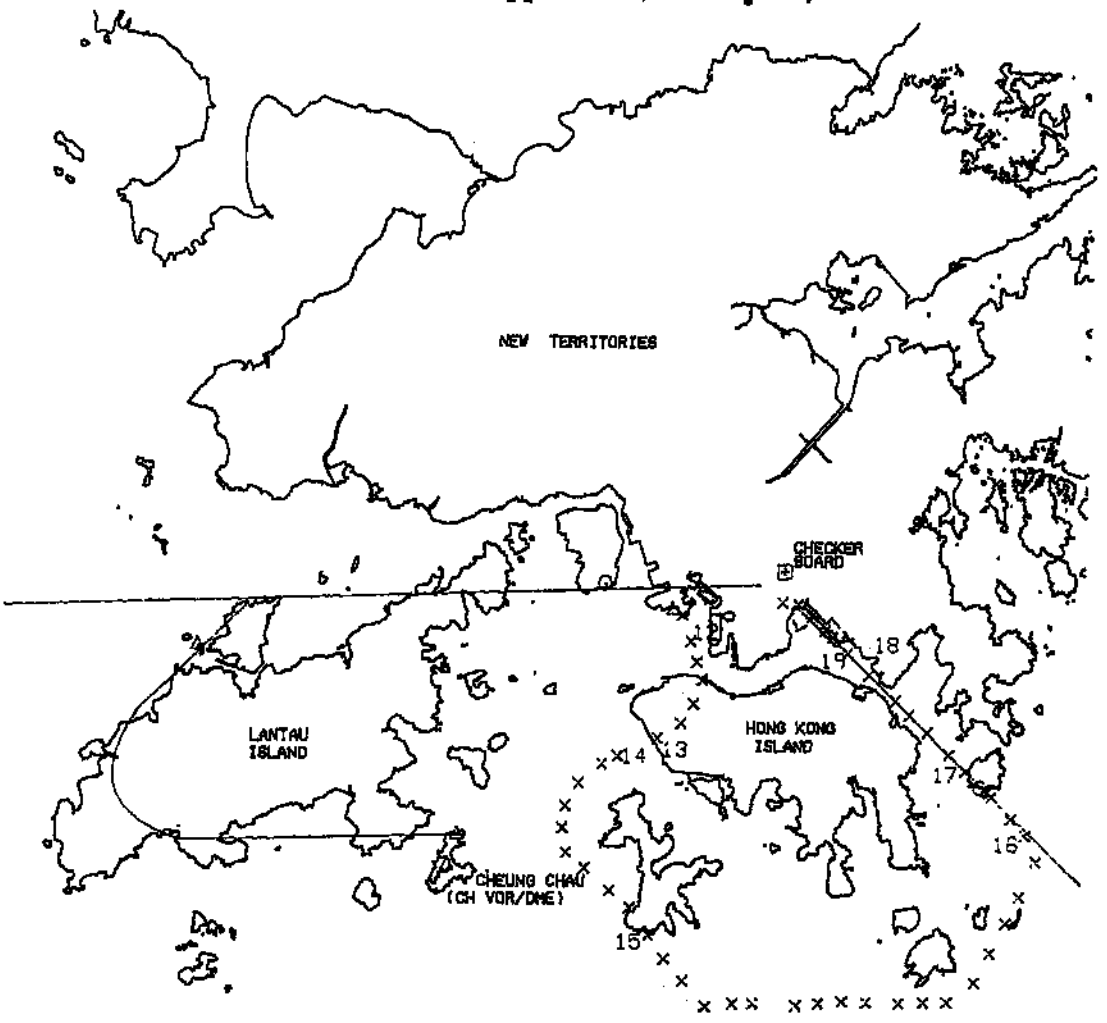
Event No	Time (UTC)	Event
1	0806	HDA 323 entered Hong Kong airspace and was provided with radar service by the Hong Kong Approach.
2	0827	Aircraft established IGS at 4500 ft.
3	0833	Aircraft fully configured for landing runway 13 (ie Flaps at 40° and slats at 27° landing gears extended).
4	0834	Aircraft encountered a severe gust, flaps were locked at CONFIG FULL. The Captain immediately carried out the standard MAP and the flap selector was raised to UP position in stages by the Co-pilot.

HDA 323 2nd Approach (Runway 18)



Event No	Time (UTC)	Event
5	0835	Standard MAP runway 13.
6	0838	Aircraft maintained 4,500 ft and the Captain notified ATC that they have a flight control problem.
7	0844	Beginning of CVR taped conversations.
8	0848	Aircraft established IGS for its second approach.
9	0850	Landing gears were extended and roll oscillations began. Captain initiated the MAP.
10	0852	HDA 323 request runway 31 and radar assistance.
11	0852	Aircraft turned onto a south-easterly heading and climbed through 4,500 ft.

HDA 323 3rd Approach (Runway 31)



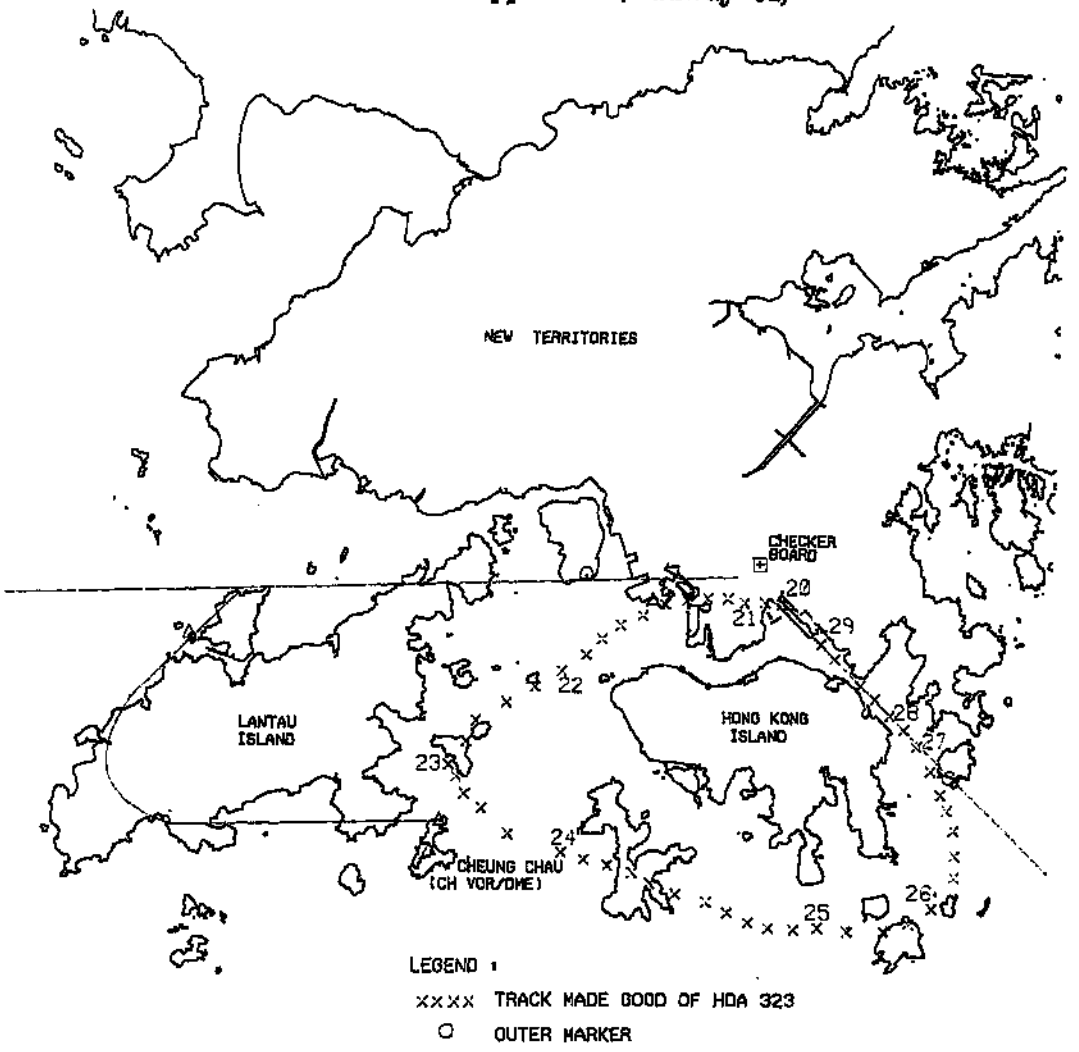
LEGEND :

×××× TRACK MADE GOOD OF HDA 323

O OUTER MARKER

Event No	Time (UTC)	Event
12	0852	HDA323 was cleared by ATC to maintain present level and track direct to CH.
13	0853	The Captain reported to ATC that they have a serious problem with the flight control and the aircraft became uncontrollable when landing gears were extended. He also reported that they were short of fuel and requested runway 31.
14	0854	Captain contacted HAECO for engineering advice.
15	0856	Master caution: Fuel in right wing tank - LOW LEVEL.
16	0900	Landing gears extended, flap selector at CONFIG 1.
17	0901	Roll oscillations began.
18	0903	GPWS: 'SINK RATE SINK RATE'.
19	0903	Significant oscillations in roll and pitch, Captain initiated the MAP at about 0.5 nm from touch down.

HDA 323 4th Approach (Runway 31)



Event No	Time (UTC)	Event
20	0903	HDA 323 reported to ATC that they were short of fuel and could not divert to anywhere. ATC up-graded the 'LOCAL' stand-by to a 'FULL EMERGENCY' stand-by.
21	0904	A fuel check was made, fuel remaining was 1120 kg.
22	0906	Captain declared emergency, transmission was crossed and was not heard by ATC.
23	0907	Captain advised the SP to prepare the cabin for a crash landing.
24	0908	Captain made a request to ATC for an immediate landing.
25	0912	Captain reviewed the ditching check list.
26	0913	Aircraft was in VMC.
27	0915	Landing gears was extended.
28	0916	Spoilers were armed.
29	0917	Aircraft touched down and ran off the paved surface.

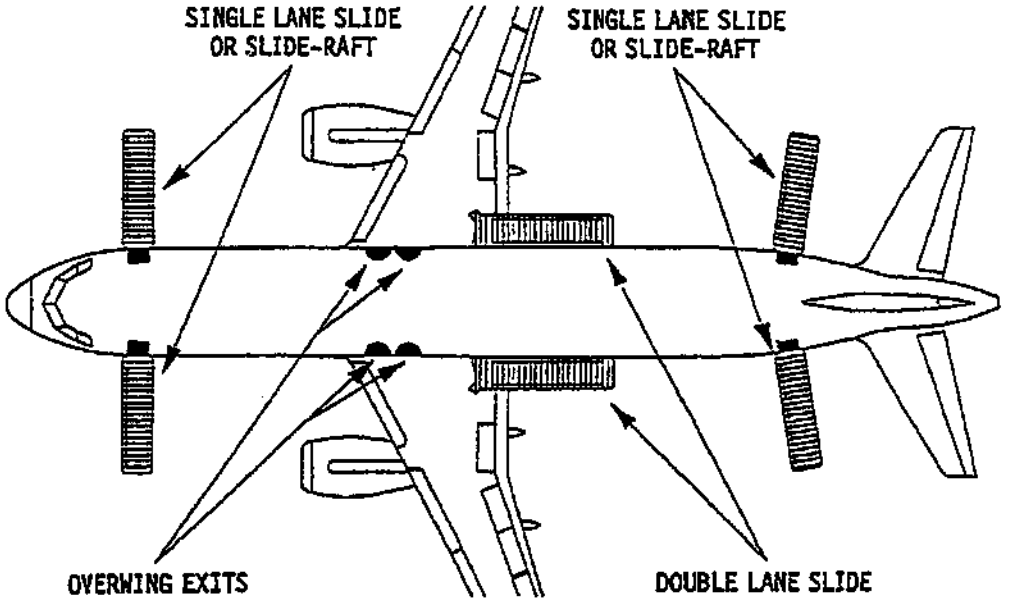
Critical events and the associated stress

Time (UTC)	Critical Events	Significance	Crews' Action/Decision or State of Mind
0834	- Gust encounter	- physical agitation - ECAM flap lock warning - Aural warning (master caution)	- Abandoned the approach
0834	- Flap selector was raised in stages	- Instability in roll	- crews were confused of the flap lock position after the missed approach because the ECAM indication was changed by the movement of the flap selector.
0851	- Gear extension on second IGS approach	- roll oscillations began - stress level and work load were increased significantly	- Gears were retracted and MAP was initiated immediately. - Crews confused the gears with the flight controls - selection of runway 31 for subsequent approaches - Requested assistance from HAECO - Approach briefings were omitted
0903	- GPWS warning "SINK RATE SINK RATE" on short final runway 31	- Excessive rate of descent - Instability in roll and pitch axes	- A go-around was initiated at 0.5 nm from touch down
0904	- Low on fuel	- landing was imminent - stress level and work load were further increased	- Full emergency was declared - Voice appeared to be in a state of despair
0915	- Severe roll oscillations from 1200 ft until touch down	- last chance - possible crash landing	- Captain fixated on the prime task of flying the aircraft onto the ground and stopping the aircraft as soon as possible

Sequential Pictures showing the landing roll of the incident aircraft HKDA323 on 6 June 1994

Escape Slide Arrangement

Passenger doors are equipped with single lane escape slide or slide raft and emergency exits are equipped with dual lane escape slide.



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