AIRCRAFT ACCIDI[illegible] RE[illegible]PT [illegible]0

ACCIDENTS INVESTIGATION DIVISIC N

Civil Aviation Department
Hong Kong

Report on the accident to Hawker Siddeley Trident 2E B-2218 at Hong Kong International Airport on 31 August 1988

ng Kong
e 1990

民 航 處
香港金鐘道66號
金鐘道政府合署四十六樓

CIVIL AVIATION DEPARTMENT
46th floor,
Queensway Government Offices,
66, Queensway,
Hong Kong.

June 1990

檔案編號 OUR REF:

來函檔號 YOUR REF:

電 話 TEL. NO.

電報掛號 CABLES: AIRCIVIL HONGKONG

專用電訊 TELEX: 61361 CAD HK

His Excellency the Governor, Hong Kong
Government House
Hong Kong

Sir,

I have the honour to submit the report by Mr. P J Birkett, an Inspector of Accidents, on the circumstances of the accident to Trident 2E, B-2218, which occurred at Hong Kong International Airport on 31 August 1988.

I have the honour to be
Sir,
Your Excellency's obedient servant

P K N Lok
Director of Civil Aviation

Contents

ABBREVIATIONS USED IN THIS REPORT

AC	Alternating current
ADC	Air data computer
ADF	Automatic direction finder
ADI	Attitude Director Indicator
AIP	Aeronautical Information Publication
AMC	Air Movement Controller
AMO	Airport Meteorological Office
amsl	Above mean sea level
AOM	Aerodrome operating minima
APU	Auxiliary power unit
ASI	Airspeed indicator
ATC	Air Traffic Control
ATCI	Air Traffic Control Instruction
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Services
BAe	British Aerospace Limited
BFO	Beat frequency oscillator
C	Celsius
CAA	Civil Aviation Authority (UK)
CAAC	Civil Aviation Administration of China
CAD	Civil Aviation Department, Hong Kong
Cb	Cumulonimbus
CCTV	Closed circuit television
cm	Centimetre(s)
COM	Communication
COO	Approach co-ordinator
CSD	Constant speed drive
CVR	Cockpit voice recorder
DC	Direct current
deg	Degree(s)
DH	Decision height
DME	Distance measuring equipment
DV	Direct vision
E	East
EAS	Equivalent airspeed
EGT	Exhaust gas temperature
ENE	East-northeast
EPR	Engine pressure ratio
FAL	Facilitation
FIR	Flight Information Region
ft	Feet
GMC	Ground Movement Controller
GPWS	Ground Proximity Warning System
HHMMSS	Hour(s)minute(s)second(s)
HK	Hong Kong

HKIA	Hong Kong International Airport
HP	High pressure
hPa	Hectopascal(s)
hr	Hour(s)
HSI	Horizontal situation indicator
IAS	Indicated airspeed
ICAO	International Civil Aviation Organisation
IGS	Instrument Guidance System
ILS	Instrument Landing System
kg	Kilogram(s)
kHz	Kilohertz
kt	Knot(s)
lb	Pound(s) avoirdupois
LP	Low pressure
LYM	Lei Yue Mun
m	Metre(s)
MATC	Manual of Air Traffic Control
mb	Millibar(s)
MHz	Megahertz
min	Minute(s)
mm	Millimetre(s)
MSL	Mean sea level
MTWA	Maximum take-off weight allowed
NAV	Navigation
NDB	Non-directional radio beacon
NE	Northeast
nm	Nautical mile(s)
NNW	North-northwest
NW	Northwest
OAT	Outside air temperature
P1	Pilot-in-command
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
psi	Pounds per square inch
QFE	Atmospheric pressure at aerodrome elevation
QNH	Altimeter sub-scale setting to obtain elevation above mean sea level
RAC	Air traffic rules and services
RIV	Rapid Intervention Vehicle
RMI	Radio magnetic indicator
rpm	Revolutions per minute
R/T	Radiotelephony
RTF	Radiotelephone
RVR	Runway visual range(s)
RW	Runway
SDAU	Safety Data Analysis Unit
SE	Southeast

SVDS	Stuck valve detector strut
TAF	Terminal area forecast
TVOR	Terminal very high frequency omnidirectional range
UFDR	Universal flight data recorder
UK	United Kingdom
UTC	Universal Time Coordinated
VHF	Very high frequency
VOLMET	Routine broadcast of meteorological information for aircraft in flight

ACCIDENTS INVESTIGATION DIVISION

CIVIL AVIATION DEPARTMENT

Aircraft Accident Report No 1/90

Owner and operator	:	Civil Aviation Administration of China (CAAC)
Aircraft - Type	:	Hawker-Siddeley Trident
Model	:	2E
Nationality	:	Chinese
Registration	:	B-2218
Place of Accident	:	Hong Kong International Airport
Date and time	:	31 August 1988 at 0119 hr (daylight)

All times in this report are UTC

SYNOPSIS

The aircraft was making an ILS approach, in heavy rain, to runway 31 at Hong Kong International Airport (HKIA). As it neared the runway the right outboard trailing edge wing flap struck the innermost approach light and the right main landing gear tyres hit the facing edge of the runway promontory. The right main gear was torn from the wing. The aircraft became airborne again and next contacted the ground 600 metres down the runway. It then veered off the runway to the right, yawed to the right and slid diagonally sideways across the grassed runway strip. The nosewheel and left main gear collapsed, and the aircraft continued until it crossed the parallel taxiway and slid sideways over the edge of the promontory into Kowloon Bay. The aircraft came to rest in the water with the rear extremity of the fuselage supported on a ledge of stone blocks that jutted out from the promontory. Part of the forward fuselage, including the flight compartment, was partially detached from the remainder of the fuselage and hung down at a steep angle into the water from control cables and secondary structure. A fire started in the centre engine intake duct. The aircraft was carrying 78 passengers, three cabin attendants, two security officers and a flight deck crew of six.

The rescue services were quickly on the scene and the fire was soon extinguished. Seventy-six passengers escaped from the passenger cabin on to the right wing or into the water and from there were rescued to the promontory or on to nearby boats and rescue craft. The two passengers remaining in the wreckage were extricated by the rescue services personnel. The cabin attendants and security

officers escaped safely from the aircraft but the six flight deck crew were trapped in the submerged flight compartment and all drowned. One injured passenger later died in hospital.

From the limited evidence available it was not possible to positively determine the cause of the accident. The report concludes that the final approach became unstable, and that windshear may have been a contributory factor. The final deviation below the normal approach path was probably due to a sudden reduction and distortion of the visual reference caused by heavy rain.

1. FACTUAL INFORMATION

1.1 History of the flight

Scheduled passenger flight CCA301 departed Guangzhou (People's Republic of China) at 0033 hr on 31 August 1988 for Hong Kong International Airport using the callsign "China 301". The flight deck crew comprised two Captains, a Flight Engineer, a Navigator, a qualified Radio Operator and a Radio Operator under training. The Captain designated as the aircraft commander occupied the right control seat and acted as non-handling pilot whilst the other Captain acted as handling pilot from the left control seat. In the passenger cabin the crew consisted of three cabin attendants (female) and two security officers (male). There were 78 passengers on board. The planned flight time to Hong Kong International Airport was 30 minutes and the cruising altitude 10000 ft.

At 0043 hr China 301, whilst still in the Guangzhou FIR, contacted Hong Kong Approach Control on 119.1 MHz, gave its position as SHILONG NDB at 10000 ft and confirmed receipt of HK ATIS Information Delta. This was acknowledged by the approach controller with instructions to call 20 miles before RUMET, the reporting point on A461 marking the Guangzhou/Hong Kong FIR boundary. At 0045 hr China 301 contacted Hong Kong Approach again and advised of its intention to deviate 12 miles left of track to avoid cumulonimbus. The deviation was approved and shortly afterwards China 301 was told of weather returns showing on the approach radar in the letdown area associated with the runway 13 Instrument Guidance System (IGS). An ILS approach to runway 31, monitored by Precision Approach Radar (PAR), was offered and the following weather passed:

"...the surface wind is between 090 to 140 degrees at 10 knots... heavy shower over the airfield...the visibility on runway 31 is 5000 metres and on the IGS is 3000 metres...advise."

China 301 elected to make an ILS approach. The time was 0048 hr.

The ensuing radar sequencing to the ILS took considerably longer than normal, mainly due to weather avoidance at the request of the aircraft and in part to ATC accommodating departing traffic on runway 13.

At 0107 hr China 301 was heading 270 degrees at 5000 ft, approaching the runway 31 centreline from the east. To facilitate a departure from runway 13 it was the controller's intention to take the aircraft through the centreline before initiating a right turn on to the localiser. At 0109 hr the aircraft was told to turn right onto a heading of 360 degrees to intercept the localiser; however, a left turn was requested to avoid cumulonimbus. This was approved and at 0112 hr China 301 was at 4500 ft, heading 360 degrees to intercept the localiser, and cleared for an ILS approach. The latest weather was then broadcast-

".....wind 120 to 150 degrees..5 to 10 knots..runway surface wet.. visibility 4500 metres in rain.."

China 301 acknowledged the weather broadcast and confirmed its intention to use runway 31.

At 0114 hr when the aircraft was established on the localiser it was again cleared for an ILS approach and informed that the approach would be monitored by PAR. This was acknowledged and after a frequency change to 119.5 MHz two way contact with Hong Kong Precision was confirmed at 0115 hr, at which time the aircraft was approximately 10 to 12 nm from touchdown. Although the precision radar controller could see from his adjacent approach radar that China 301 was maintaining the localiser centreline he was unable to gain radar contact on the PAR due to rain clutter. He immediately advised China 301 that there was no precision radar contact - passed the surface wind (090/07 kt) - and cleared the flight to land.

The last recorded transmission from China 301 was the acknowledgment of this clearance at 0116:59 hr.

The aircraft's right outboard trailing edge wing flap struck the innermost approach light which is situated 21 ft above MSL and 12 m before the runway promontory. Almost simultaneously the right main landing gear tyres struck the runway promontory just below the sloping lip of the sea wall and three of the four tyres on the axle burst. The complete right main landing gear with its support structure, sections of the upper and lower wing skins and the inboard wing flap and flap tracks were then torn from the wing. The left main gear touched down on the paved surface approximately 2 m from the sea wall, the aircraft then bounced and continued to track just to the right of the runway centreline until it contacted the ground again approximately 600 m down the runway. From this point it started to yaw to the right, departed from the runway and slid sideways across the grass toward the parallel taxiway. The yaw continued past the direction of travel until the aircraft was sliding almost completely sideways. As it traversed the grassed runway strip the left main and nose landing gears collapsed. The aircraft continued until it crossed the parallel taxiway, slid over the sea wall and fell off the runway promontory into Kowloon Bay. When it came to a halt it was resting in a slightly nose high attitude, heading ENE, with the rear extremity of the fuselage supported on a ledge of stone blocks at the base of the sea wall. It had travelled 1485 m from the point of first impact with the runway promontory.

The main part of the fuselage remained above the water but the rear of the passenger cabin was partially submerged. The flight compartment and the front portion of the forward passenger cabin remained attached to the fuselage only by control cables and secondary structure and drooped steeply down into the water with the nose resting on the sea bed. At the rear of the aircraft the centre engine detached from the airframe and a fire started in the centre engine intake duct. A thin layer of fuel spread over the surrounding water.

At 0119 hr the duty officer at the Airport Fire Services substation, on the northern edge of the runway promontory, saw a landing aircraft pass by in an unusual attitude on the runway and pressed the crash alarm. As a result it took less than a minute for the rescue services to arrive on the scene.

The fire in the centre engine intake duct was soon extinguished by a fireman climbing on to the fuselage with a handline and spraying water into the intake. Meanwhile foam was sprayed over the fuel floating on the surrounding water and the wreck secured by lines to the shore.

The passengers escaped from the aircraft through the forward right overwing emergency exit and the midships passenger door. Some stood on the wing in the heavy rain and waited to be rescued, others jumped into the water and a few were able to scramble ashore. Two remained trapped in the wreckage and were extricated by the rescue personnel. Forty-one of those rescued were taken on board the fire services rescue launch and five on to junks that happened to be in the vicinity. The remainder were rescued on to the runway promontory by the land rescue crews.

The two security officers and one cabin attendant were seated in the first two rows of the front passenger cabin and were cut off from the rest of the passenger compartment by the break in the fuselage. They were unable to help in the evacuation and left the wreck through a break in the side of the fuselage. The remaining two cabin attendants were seated at the midships passenger door. One was rendered unconscious and later rescued from the water by emergency services personnel. The other opened the midships passenger door and directed the evacuation of the passengers. After checking that the passenger cabin was clear she left the aircraft.

The rescued passengers were taken to a First Aid Point and the uninjured were conveyed to the airport terminal building. Those suffering from injuries were removed directly to the Queen Elizabeth Hospital for treatment. One passenger later died in hospital from his injuries.

Attempts were made by divers to enter the submerged flight deck but these were hampered by the very poor visibility in the polluted water, the strong current and by wreckage blocking the entrance to the flight deck. When entry was finally gained, approximately 75 minutes after the accident occurred, all flight deck crew members were found drowned.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	6	1	-
Serious	2	2	-
Minor	1	10	-
None	2	65	-

1.3 Damage to aircraft

Damaged beyond economic repair.

1.4 Other damage

Substantial damage was sustained by the innermost approach light and several runway and taxiway lights. Minor damage was caused to the runway and taxiway surfaces and to the grassed areas which the aircraft traversed.

1.5 Personnel information

1.5.1 Flight Crew

Commander	:	Male, aged 38 years
Licence	:	Chinese Pilot's Licence:renewed 28 Feb 88
Type ratings	:	Trident
Instrument rating	:	Current
Medical Certificate	:	25 Jan 88 - valid
Last flight check	:	3 Mar 88
Flying experience		
Total all types	:	8,419 hr
Total on type	:	4,101 hr (of which 2,750 were as P1 & 514 as Training Captain)
Total last 30 days	:	76 hr
Duty time	:	Off duty for 24 hr preceding the flight

<u>Captain</u>		
(handling pilot)	:	Male, aged 25 years
Licence	:	Chinese Pilot's Licence:renewed 28 Jun 88
Type rating	:	Trident
Instrument rating	:	Current
Medical Certificate	:	23 Jan 88 - valid
Last flight check	:	28 Jun 88
Flying experience		
Total all types	:	3,143 hr
Total on type	:	2,613 hr (of which 1,063 were as P1)
Total last 30 days	:	77 hr
Duty time	:	5 hr in the previous 24 hr

<u>Flight Engineer</u>	:	Male, aged 39 years
Licence	:	Chinese Flight Engineer's licence renewed 18 Dec 87
Medical Certificate	:	25 Jan 88 - valid
Flying experience		
Total all types	:	6,480 hr
Total on type	:	3,300 hr
Total last 30 days	:	79 hr
Duty time	:	Off duty for 48 hr preceding the flight.

<u>Flight Navigator</u>	:	Male, aged 45 years
Licence	:	Chinese Flight Navigator's licence renewed 25 Aug 87
Medical Certificate	:	01 Feb 88 - valid
Flying experience		
Total all types	:	10,802 hr
Total on type	:	7,326 hr
Total last 30 days	:	78 hr
Duty time	:	3.5 hr in the previous 24 hr

<u>Radio Operator</u>	:	Male, aged 29 years
Licence	:	Chinese Radio Operator's licence
	:	renewed 19 Sep 87
Medical Certificate	:	21 Jan 88 - valid
Flying experience		
Total all types	:	4,366 hr
Total on type	:	3,244 hr
Total last 30 days	:	79 hr
Duty time	:	Off duty for 24 hr preceding the flight

<u>Radio Operator</u>		
(under training)	:	Male, aged 42 years
Licence	:	Chinese Radio Operator's licence renewed 23 Sep 87
Medical Certificate	:	21 Jan 88 - valid
Flying experience		
Total all types	:	9,046 hr
Total on Type	:	3,253 hr
Total last 30 days	:	45 hr
Duty time	:	3 hr in the previous 24 hr

1.5.2 Cabin Staff

The Cabin Staff consisted of two security officers and three cabin attendants. All were qualified in accordance with CAAC requirements to carry out their allotted duties and were medically fit.

1.6 Aircraft information

1.6.1 Leading particulars and general description

Manufacturer	: Hawker-Siddeley
Type/Model	: Trident 2E
Date of Manufacture	: 1973
Certificate of Airworthiness	: Issued 5 Feb 1987 - valid
Certificate of Maintenance	: Valid until 3 Dec 1988
Total airframe hours at time of accident	: 14,332.01
MTWA	: 65,090 kg
Max Ldg Weight	: 51,256 kg
Weight at time of accident (est)	: 47,117 kg
Centre of gravity	: In normal range

Engines

The Trident 2E is powered by three rear-mounted Rolls-Royce Spey MK512-5W/15 engines. The two podded side engines are fitted with thrust reversers. The centre engine is mounted within the rear fuselage fairing behind and below the fuselage primary structure. The intake duct entry is at the forward base of the fin where it meets the roof of the fuselage.

Hydraulics

Three independent systems work continuously in parallel and power three separate jacks at each primary flying control surface. Secondary services are powered by two systems in combination. In case of failure the faulty system is shut down - there is no change-over function. Back-up power is by two electrically driven pumps and a ram air turbine. Apart from the primary flying controls other hydraulically powered services include trailing edge flaps, leading edge slats, airbrakes, lift dumpers, landing gear, nosewheel steering and wheel brakes.

Electrics

Three constant speed units drive three AC generators which supply the three phase AC mains system. The three channels are isolated electrically and physically. A DC supply is available through three transformer rectifier units. In the event of complete power generation failure the aircraft's battery can provide DC power direct and AC power through a static inverter.

Flying controls

The Trident employs fully powered flying controls on all surfaces, operated by hydraulic power. The ailerons, tailplane and rudder are each operated by three hydraulic jacks, each jack being powered by one of the three separate main hydraulic systems. The tailplane control is a simple mechanical system and consists of duplicated main input circuits and a trim circuit. The stick input is linked through stuck valve detector struts (SVDS) to the control valves on the three tailplane jacks. The trim input is by a chain driven screwjack operated by a handwheel on each side of the control pedestal. The input of the autopilot servos is effected through the trim circuit system so that when the autopilot is disengaged the aircraft is left in trim.

Aileron and spoiler control inputs are carried by a simple mechanical circuit to a mechanism beneath the cabin floor and from there to the aileron jack control valves by means of a duplex torque tube, duplicated cable circuit, duplex lever linkage and SVDS's. Trim input is through a chain-driven screwjack.

The rudder control system uses a mechanical linkage similar to that used for the tailplane system. Duplicated yaw dampers provide damping and turn coordination.

Two airbrakes\spoilers are positioned on the upper surface of each wing ahead of the outboard trailing edge flaps. The input from the airbrake selector lever is by single cable circuit to a centre section drum and from there to a pulley in the wing by duplicated cables. The remainder of the circuit to the spoiler jack control valves consists of a rod and lever mechanism.

The aircraft is fitted with two pairs of double slotted trailing edge flaps. The flaps are powered by two hydraulic motors. The flap selector lever has five gated positions and is connected to the control units on the hydraulic motors by a cable circuit. The drive from the hydraulic motors to the screwjacks at the flap surfaces is through a system of torque shafts and bevel gears. Each section of flap is supported by a pair of steel tracks. Simple mechanical circuits ensure synchronous operation.

The leading edge slat is operated by a system of torque shafts and screwjacks similar to that used for flap operation.

The lift dumpers are located immediately forward of the inboard flaps and are powered by single hydraulic jacks. When the airbrake selector lever is moved beyond the full airbrake position and the aircraft is on the ground the lift dumpers are extended. Alternatively the airbrake lever may be lifted into a prime position in the air and is then driven by an actuator into the lift dump position on touch-down.

1.6.2 Maintenance history

The maintenance records of the aircraft showed the last comprehensive inspection prior to the accident was carried out on 2 August 88. The maintenance requirements were based on a schedule issued by British Aerospace (BAe) and the aircraft was covered by the appropriate company maintenance document. There was no evidence of any previous defects that might have had a bearing upon the accident.

1.7 Meteorological information

1.7.1 Airport meteorological office

Forecasts and reports issued by the Airport Meteorological Office (AMO) at HKIA were disseminated in real time by video monitor, by point-to-point dedicated circuits and by scheduled broadcasts, with additional meteorological information available on request. Routine, special and extra meteorological reports, trend-type landing forecasts, aerodrome forecasts, SIGMET information, current RVR's, aerodrome warnings and other relevant supplementary information were provided to the air traffic services units. Meteorological information transmitted by closed circuit television (CCTV) to displays at the various ATC positions comprised half-hourly reports, special reports, aerodrome forecasts, surface wind information and windshear warnings for HKIA, together with half-hourly reports for Cheung Chau

At the time of the accident aerodrome surface wind was measured at two points, the first, known as the SE anemometer, being situated at a position 510 m NNW of runway 31 threshold with the other, the NW anemometer, being situated 130 m south of runway 13 threshold. (In late 1988 a third anenometer was installed at a mid-runway position.) The surface wind measured by the SE anemometer was the one used in official weather reports and forecasts, and was the value given to approaching aircraft. If the reading from the NW position was significantly different it was also passed.

RVR's were measured by three transmissometers, designated south, centre and north, located on the southwest side of the promontory at a distance of 91 m from the runway centre line. The south transmissometer was located abeam runway 31 threshold, the centre abeam the midpoint of the runway and the north abeam runway 13 threshold. The separate readings from these sources were fed to a computer which continuously calculated the 30 second moving average for each sector. When the value for any sector changed, a hard copy of the RVR for all three sectors was straightaway printed out. Additionally, at 15 seconds intervals the processed RVR values were transmitted for use on digital displays in the AMO, and in ATC at the approach control, precision approach radar and aerodrome control positions. The displayed RVR values at the above locations were identical and were valid for the actual runway light intensity setting in use. The extract from the computer printout reproduced at Appendix 1A shows the processed transmissometer readings over the period of the accident but, due to the 15-second update interval of the digital displays, it does not necessarily show the values that were displayed at the same time in ATC. In stable or slowly changing situations, such as fog, the possibility of significant differences existing between the recorded and displayed readings is slight. But with rapidly fluctuating RVR values, such as might be the case in passing rainshowers, this is not necessarily the case.

A locally designed low level windshear detection system was in use on a trial basis at the airport. It consisted of a microcomputer and five anemometers, with one anemometer situated at each end of the runway and the other three covering the approaches. Readings from these anemometers were fed continuously to the computer and windshear values, in knots per 30 metres of altitude-change, calculated for each end of the runway from the 30 seconds mean winds for the 5 locations and the height difference between the anemometer pairs. The location of the anemometers is shown at Appendix 2. In the case of runway 31, the readings from the SE and the LYM anemometer pair were utilized. The system was essentially a simple one with only the longitudinal wind components being considered in determining the "lifting" or "sinking" effects of the variation in the wind. The system did not measure the vertical wind component and so could not detect vertical air currents, such as might occur in the vicinity of heavy showers. The magnitude of the windshear was displayed for each end of the runway on a video terminal in ATC together with a description of whether the shear was lifting, sinking or no shear. If the magnitude of the shear reached 8 knots per 30 metres of altitude-change the display showed "significant lifting", or "significant sinking", and blinked to attract the controller's attention.

1.7.2 General weather situation

On the morning of 31 August 88 an unstable southwest monsoon, enhanced by upper air disturbances, brought heavy showers and poor visibilities to the South China coast. The 0000 hr surface synoptic chart showed areas of low pressure to the west of Hong Kong and an area of high pressure over the Pacific to the east of the Philippines. Hong Kong was in an area of slack pressure gradient between these two systems. The upper-air sounding launched at 0000 hr from the downtown Meteorological Station revealed the light east to southeasterly winds near the surface were replaced by southwesterly winds above approximately 1000 ft, although the vertical shear was only of the order of 5kt/1000 ft. The air over Hong Kong was unstable and almost saturated from the surface to the 600 hPa level (appx. 13800 ft). The Geostationary Meteorological Satellite pictures taken at the same time showed dense cloud cover to the south and east of Hong Kong with some build-ups to the southwest, in the area of Macau. Information from the weather radar was not available at the Airport Meteorological Office during the period covering the accident as fluctuations of the mains power supply to the radars had caused them to trip off-line.

1.7.3 Weather at Hong Kong International Airport

Prolonged heavy showers affected the area from 0015 hr until 0450 hr, the heaviest being between 0030 and 0200 hr during which period a total rainfall of 59.5 mm was recorded. The peak recorded rates were 141 mm/hr at 0105 hr, 135 mm/hr at 0110 hr and 97 mm/hr at 0125 hr.

The surface wind speed at the southeast end of the runway was generally less than 10 kt with the maximum gust of only 13 kt recorded during the period of heavy showers. The wind direction was mainly east-southeast prior to the accident but by 0115 hr had become easterly where it remained over the period of the accident. Later the direction backed to the northwest when thunderstorms began to affect the airport.

Meteorological visibility between 0030 hr and 0135 hr was generally about 4000 m, but after this period it fell to 2000 m.

RVR values were measured continuously throughout the accident period and an extract from the printed record is shown at Appendix 1A. For runway 31 the south value corresponds to a touchdown zone reading, the centre to the midpoint and the north to the upwind zone. The extract shows that the RVR at the southern site reduced below 2000 m at 0113:36 hr, fell to 1500 m at 0115:33 hr, briefly recovered to 1600 m and then reduced to 1000 m at 0118:36 hr. One and a half minutes later it was back up at 1600 m and from then it gradually improved to greater than 2000 m by 0125:07 hr. The central RVR reduced below 2000 m at 0114:58 hr, reached 1600 m at 0117:08 hr and recovered gradually to over 2000 m by 0118:01 hr where it remained until after the accident. The north RVR remained above 2000 m throughout the period.

The low level windshear detection system computer printout covering the period of the accident (Appendix 3) shows the presence of some sinking windshear on the runway 31 approach from 0117:30 hr until 0122:30 hr but this did not reach the 'significant' level until 0122:30 hr (three minutes after the accident) when a shear of 8 kt per 100 ft was recorded. Significant shear then persisted until 0125 hr with the maximum shear recorded being 9 kt per 100 ft.

Meteorological reports and short term landing forecasts issued around the time of the accident were as follows:-

0030 hr Wind 090/09 kt; met visibility 4000 m, 6 km to SE; shower; 1/8 at 500 ft, 3/8 at 1800 ft, 6/8 at 8000 ft; temperature and dewpoint 25 degrees C; QNH/QFE 1010 hPa; tempo visibility 3000 m; 1/8 cumulonimbus at 1200 ft, 5/8 1400 ft.

0100 hr wind 110/02 kt; met visibility 4500 m; heavy shower; 2/8 at 600 ft, 4/8 at 1500 ft, 6/8 at 8000 ft; temperature and dewpoint 25 degrees; QNH 1011 hPa, QFE 1010 hPa; significant wind shear and moderate to severe turbulence in vicinity of cumulonimbus in approach; tempo visibility 3000 m, 1/8 cumulonimbus at 1200 ft, 5/8 at 1400 ft.

0121 hr (Extra Report)	wind 100/09 kt; met visibility 4200 m; heavy shower;2/8 at 600 ft, 4/8 at 1400 ft, 6/8 at 8000 ft; temperature and dewpoint 25 degrees; QNH 1011 hPa, QFE 1010 hPa; significant windshear and moderate to severe turbulence in vicinity of cumulonimbus in approach; tempo wind variable 15 kt maximum 28 kt, visibility 2500 m, thunderstorm, 1/8 cumulonimbus at 1000 ft, 5/8 at 1400 ft.
0130 hr	wind 100/06 kt; met visibility 3500 m; thunderstorm; 2/8 at 600 ft, 1/8 cumulonimbus at 1200 ft, 4/8 at 1400 ft, 6/8 at 8000 ft; temperature and dewpoint 25 degrees; QNH 1011 hPa, QFE 1010 hPa; thunderstorm 6 km to SE , significant windshear and moderate to severe turbulence in vicinity of cumulonimbus in approach: tempo wind variable 15 kt maximum 28 kt; visibility 2500 m; thunderstorm; 1/8 cumulonimbus at 1000 ft, 5/8 at 1200 ft.
0135 hr (Special Report)	wind 310/04 kt; met visibility 2000 m; RVR RW31 1200 m; thunderstorm; 2/8 at 600 ft, 1/8 cumulonimbus at 1200 ft, 4/8 at 1400 ft, 6/8 at 8000 ft; temperature 25 degrees and dewpoint 25 degrees; QNH 1011hPa, QFE 1011 hPa; Thunderstorm 6 km to SE; significant windshear and moderate to severe turbulence in vicinity of cumulonimbus in approach: tempo wind variable 15 kt maximum 28 kt; visibility 1500 m; thunderstorm; 2/8 cumulonimbus at 1000 ft, 5/8 at 1400 ft.

These reports were consistent with the following aerodrome forecasts (TAFs) for HKIA which would have been available to the commander before take-off, and from HK Volmet broadcasts in flight:

2100-0600	issued 30 August 2030 hr; variable 05 kt; visibility 10 km; 1/8 at 1200 ft, 3/8 at 1800 ft, 6/8 at 9000 ft: tempo 2100-0600 wind variable 16 kt max 32 kt; visibility 2500 m; heavy shower or thunderstorm; 2/8 at 800 ft, 2/8 cumulonimbus at 1200 ft, 5/8 at 1400 ft.
0000-0900	issued 30 August 2330 hr; wind variable 05 kt; visibility 10 km; 1/8 at 1400 ft, 3/8 at 2000 ft, 6/8 at 9000 ft: tempo 0000-0600 wind variable 16 kt max 32 kt; visibility 2500 m; heavy shower or thunderstorm; 2/8 at 800 ft, 2/8 cumulonimbus at 1200 ft, 5/8 at 1400 ft: tempo 0600-0900; visibility 4000 m; shower; 7/8 at 1400 ft.

The meteorological reports and short term landing forecasts for HKIA broadcast on the ATIS and available to China 301 were as follows:

0035 hr	information "DELTA": 090-150/10 kt; visibility 5000 m; rain; 1/8 at 500 ft, 3/8 at 1800 ft; temperature 25 degrees; QNH 1010 hPa; tempo visibility 3000 m.

0058 hr information "ECHO": variable 05 kt; visibility 4000 m to the west, 6 km in rain to the southeast; 1/8 at 500 ft, 3/8 at 1800 ft; temperature 25 degrees; QNH 1010 hPa; tempo visibility 3000 m.

0111 hr information "FOXTROT": 120-150/5-10 kt; visibility 4500 m in rain; 2/8 at 600 ft,4/8 at 1500 ft; temperature 25 degrees; QNH 1011 hpa; expect significant windshear and moderate to severe turbulence in the vicinity of Cb; tempo visibility 3000 m.

During the time that China 301 was in contact with HK approach control the following meteorological data was either passed specifically to the aircraft or broadcast by approach control:

0048 hr 090-140/10 kt; heavy shower over the airfield; visibility on runway 31 is 5000 m and 3000 m on the IGS.

0113 hr 120-150/05-10 kt; visibility 4500 m in rain.

1.8 Aids to navigation

All relevant navigational aids were serviceable over the accident period.

1.8.1 Approach aids

ILS runway 31

HK International Airport had an ILS facility on runway 31. The localiser centreline was on 315 degrees magnetic; the glidepath had a three degree slope. The obstacle clearance limit was 390 ft.

The associated 75 MHz markers were located as follows:

Outer Marker	5.66 nm from runway 31 threshold
Middle Marker	1.83 nm from runway 31 threshold

Also situated at the Outer Marker was the NDB "TP" radiating on 280 kHz and the TVOR "TH" on frequency 115.5 MHz.

The ILS approach procedure is shown at Appendix 4.
The serviceability of the ILS was confirmed by a post accident flight check.

Precision Approach Radar (PAR)

PAR was available on runway 31. The glidepath was set at three degrees and was coincident with that of the ILS. Provision was made to monitor ILS approaches by PAR whenever the cloud ceiling was 1000 ft or less and/or the visibility was 5 km or less, or at the request of the pilot. While monitoring an ILS approach no action was taken by the precision radar controller provided the aircraft remained within a funnel subtending approximately half a degree above and below the PAR glidepath, and two degrees either side of the centreline.

The PAR equipment used was an X-band pulse radar designed to detect an aircraft of five square metres echoing area up to 9 nm from the antennae. Along with all PAR operating in the X-band it was susceptible to signal attenuation by precipitation which, if the target was relatively small and the precipitation heavy enough, could lead to the masking of an aircraft's radar return. Several facilities were available on the equipment to help alleviate this problem, but controllers nevertheless reported that it was not unusual for a small target (such as a Trident) to be completely masked by rain clutter. The problem was not as severe with larger aircraft due to their greater radar reflecting area.

The RAC section of the HK Aeronautical Information Publication (AIP) contained information regarding the availability of PAR approaches and departures at HKIA, and also the conditions under which PAR monitored ILS approaches and departures were available. It did not mention the possibility of radar contact with smaller aircraft being lost during these procedures in conditions of heavy precipitation.

HKIA was not equipped with facilities for making radar recordings of the en-route radar, approach radar or PAR approaches and departures.

The duties of the PAR controller during an ILS approach monitored by PAR were laid down in the Manual of Air Traffic Control (See 1.17.1). Included was an instruction to notify pilots of any significant changes in weather conditions passed to the PAR controller by aerodrome control.

At 0114:37 hr China 301 called established on the localiser and was told by the approach controller to expect the ILS approach to be monitored by PAR. At 0115:20 hr a frequency change was given and two-way contact established with the PAR controller. The PAR controller saw on his adjacent approach radar display that China 301 was on the ILS centreline at about 10 - 12 nm, but he was unable to see the aircraft on the PAR display due to rain clutter. He tried various settings of the various PAR controls but without success. At 0116:01 hr, whilst he was still trying to obtain radar contact, the air movement controller (AMC) in the tower called him over the intercom and told him the visibility was around 3000 m and added " ...I don't know what's wrong with the RVR". The PAR controller acknowledged the call and the AMC then passed him the landing clearance for China 301. Forty-five seconds later, still unable to see the aircraft on the PAR, the PAR controller informed China 301 that he was unable to gain radar contact, passed the surface wind and cleared the aircraft to land - but he omitted to pass the visibility. The call was acknowledged by China 301. At 0117:46 the PAR controller again told China 301 that he had no radar contact and to continue the ILS approach. This message was not acknowledged. The aircraft crashed approximately one and a half minutes later. Throughout the approach the controller had tried various combinations of the control settings, but was unable to obtain radar contact due to heavy clutter on the PAR screen between the touchdown point and 3 nm out, and to some lighter clutter further out.

The serviceability of the PAR was confirmed by a post accident flight check.

1.9 Communications

At 0043 hr China 301 established radio communication with Hong Kong approach control on 119.1 MHz and continued on this frequency until 0115 hr when the aircraft was passed to precision radar control on 119.5 MHz. Continuous speech recording equipment was in operation on both frequencies and a satisfactory transcript of the messages that passed between the accident aircraft and ATC was obtained (Appendix 5).

The tape recordings showed that radiotelephony (RTF) conversations were conducted in English and proceeded normally. No difficulties of transmission or reception were evident and communications are not considered to have been a factor in the accident.

1.10 Aerodrome information

1.10.1 General

The single runway 13/31 at Hong Kong International Airport (a plan of which is at Appendix 6) was situated on a promontory of reclaimed land which was 242.3 metres wide and protruded into Kowloon Bay. The elevation was 15 feet amsl and the runway had no slope. A full length parallel taxiway ran along the eastern edge of the promontory and was separated from the runway by a grass area approximately 69 m wide. The distance between the centre line of the runway and the centre line of the parallel taxiway was 111 m. Operational services at the airport, together with the fire fighting and rescue services, were provided by departments of the Hong Kong Government.

Runway 31 was the instrument runway and had the following physical characteristics :

Direction	:	315 degrees (magnetic)
Strip Length	:	3302 m
Threshold	:	Displaced by 212 m
Width	:	61 m
Surface	:	First 152 m concrete, remainder asphalt. Full length grooved.

1.10.2 Lighting aids

Runway 31 approach lighting consisted of a red (low intensity) or white (high intensity) centre line and a single cross bar. There were four white strobe lights, one at the outermost centre line approach light, one at the centre line approach light immediately northwest of the single cross bar and one at either side of the runway threshold. There was a PAPI to the left of the runway set at a nominal approach angle of three degrees.

Runway lighting consisted of lead-in, threshold with wing bars, centre line, runway edge and end lights.

The white centreline and cross bar approach lighting, the runway lighting and the PAPI were switched on, serviceable and at 100% high intensity during the period of the accident.

1.10.3 Airport fire service

The airport had two fire stations, a main station and a substation, the locations of which are shown at Appendix 6. When a "poor visibility" stand-by was initiated by ATC both the main and substation fire services personnel were brought to immediate readiness and staff on observation duties in the fire station towers were alerted to closely monitor all runway movements. At 0115 hr a "poor visibility" stand-by was declared and personnel on duty at both the main and substations were informed of this.

Appliances available at the time consisted of:-

Main Fire Station	Substation
Command Car	Rapid Intervention Vehicle
Hoselayer/Foam Carrier x 2	Foam Tender
Rapid Intervention Vehicle	Hoselayer/Foam Carrier
Foam Tender x 2	Rescue Launch
Personnel & Equipment Carrier	Inflatable Z boats x 2

1.11 Flight recorders

1.11.1 General

In accordance with the relevant ICAO Standard the aircraft was fitted with a Flight Data Recorder (FDR) set up to record four parameters against time - altitude, airspeed, magnetic heading and normal acceleration. The recorder (a Sundstrand Universal Flight Data Recorder [UFDR]) was extracted from the wreckage soon after the accident and sent "water immersed" to the United Kingdom Air Accidents Investigation Branch to be read. The tape was removed, cleaned and dried and a satisfactory replay was obtained using a Sundstrand copy recorder.

Two defects in the replayed data were apparent:-

1. The heading parameter was excessively noisy and lacked normal resolution.

2. The recorder only recorded data whilst the aircraft was in flight, i.e. the recorder started when the aircraft became airborne and stopped on initial contact with the ground.

The UFDR was taken to the UK agent for Sundstrand for test and check calibration. Although it exhibited signs of corrosion on some printed circuit boards the unit was found to be fully functional and within calibration. As no defect could be discovered it was concluded that the inaccuracy in the heading parameter was aircraft related.

An examination of recorded data from previous flights suggested that the power supply to the UFDR was controlled via squat switches on the main undercarriage with no time delay. (The ICAO requirement is that a flight recorder should record continuously from wheels rolling until engines off, and the normal practice is to control the FDR through the parking brake or the engine start circuits).

From the recorded parameters it was apparent that the UFDR had stopped and restarted more than once during the attempted landing. The UFDR initially wrote data to a semiconductor buffer memory, and data stored within this memory and not transferred to tape was lost on recorder power-down. In practice this meant that up to 1.5 seconds of data could be lost. Additionally, the power up sequence involved initializing the microprocessor control circuits for an indeterminate period, which could have been up to seven seconds in extreme cases.

1.11.2 Data Analysis

The small number of recorded parameters and the unreliability of the recorded heading parameter meant that only a rudimentary analysis of the aircraft's behavior and performance was possible. A more meaningful analysis would have required information on PITCH, ROLL, FLAP POSITION and ENGINE THRUST.

Analysis was therefore limited to an attempt to calculate the descent profile, values for pitch and roll and to determine an altitude for selection of LAND flap.

The recorded data indicated that the UFDR stopped on initial contact with the ground. As the design of the recorder installation was such that the most recently recorded parameters were lost on power down, normal g at impact was not available. To quantify the amount of data lost an extrapolation of the recorded altitude and airspeed during the descent was carried out. It was concluded from this that approximately 0.75 seconds of sampled data was lost. When the recorder restarted the aircraft was airborne or at least partially airborne again. It was not possible to determine how long the recorder was inoperative and therefore, apart from concluding that the aircraft bounced after impact, it was not possible to draw any conclusions from the data subsequent to the initial electrical power interrupt.

Correcting the recorded airspeed and altitude for transducer and position error, and using the wind profile calculated by the UK Meteorological Office, a flight profile for the final 2000 ft of the descent was plotted together with a line representing the three degree glideslope. From this plot it was evident that the aircraft had not maintained the glideslope, particularly in the latter stages of the approach. From the recorded data it was not possible to directly deduce what influenced the aircraft's descent path. An attempt was therefore made to calculate additional parameters using the recorded parameters and representative performance information on the Trident 2E supplied by BAe. Pitch and roll were derived for various flap settings, and these and a total energy plot were then used in an attempt to determine the altitude at which LAND flap was selected. These calculations, however, proved inconclusive.

Appendix 7 shows plots covering the approach profile, including derived pitch angle.

1.11.3 Cockpit voice recorder

The aircraft was not equipped, neither was it required to be equipped, with a cockpit voice recorder (CVR). The aircraft was wired with a small voice activated domestic cassette recorder at the navigator's table, the tape from which revealed only radiotelephony conversation between air traffic control and the aircraft and no flight deck conversation.

1.12 Wreckage and impact information

1.12.1 Aircraft configuration

At impact all trailing edge flaps were fully down and all eight slat sections fully out. Both lift dump and airbrake surfaces were fully retracted and the nose and main landing gear units were down and locked. There was evidence to show that the radome, centre engine and rear equipment bay doors were closed and locked.

1.12.2 Impact sequence

From the disposition of the contact marks of the right main gear tyres on the facing edge of the sea wall, and the left main gear tyres on the paved undershot surface, a roll attitude at impact of five degrees right wing low was determined. The precise pitch attitude of the aircraft at this time could not be determined from either the ground witness marks or the UFDR. However by manipulation of scale drawings it seems probable that at all likely pitch attitudes the aircraft was descending. This view is supported by the fact that the aircraft failed to strike the single crossbar light structure immediately before the approach light that was hit. Appendix 8 depicts the impact sequence and shows the wreckage distribution.

The first object to be struck by the aircraft was the last of the red approach light structures located 12 m before the sloping sea wall at the start of the undershoot area to runway 31 (elevation 15 ft) and projecting 21 feet above the water. The aircraft's right outboard flap hit the light and damaged it for a distance of 1.58 ft down from its top, with corresponding damage occurring to the wing flap at a point 7.57 m from the aircraft's centreline. Almost simultaneously the right main landing gear tyres struck the inclined edge of the sea wall approximately 1.5 ft below the top, bursting three of the four tyres on the axle, severely damaging the fourth and breaking most of the wheel rims. (The Trident mainwheels are disposed line-abreast.) The rims then dug into the paved undershoot surface about 2 m beyond the sea wall. It was at this point that the complete right main landing gear assembly together with its support structure, sections of upper and lower wing skins, and the inboard flap, were torn from the aircraft.

The left main gear wheels contacted the paved horizontal undershoot surface about 2 m from the sea wall, without damaging the tyres, and left four white tracks (characteristic of aquaplaning) for a distance of approximately 9 m before they faded out. The aircraft's track at this time was 312.5 degrees magnetic. No evidence of nose wheel contact was found in the initial impact area and no further identifiable ground contact marks attributable to the crashed aircraft were found for a distance of 609 m down the runway. Then, at a point some 10 m beyond the runway touchdown markings, the left main gear tyres started to leave marks 9 m to the right of the runway centreline. From this position the aircraft departed the runway to the right and progressively yawed to the right as it slid across the grass between the runway and taxiway, supported now by the left main and nose gears and the right outer trailing edge flap. As its heading and track began to significantly differ, the nose gear failed, allowing the forward fuselage to strike the ground. It is likely that it was at this point that structural damage first occurred to the front fuselage in the area behind the flight compartment. The aircraft continued travelling almost completely sideways until, after losing two leading edge slat sections from the right wing, it struck the edge of the taxiway at the A9 turn off. Here the left gear collapsed inwards, disrupting the local wing and inner flap support structure. The aircraft continued on an essentially straight path until it came to the edge of the sea wall adjacent to the taxiway, some 1463 m from its first point of impact. As it went diagonally sideways over the sea wall on to a ledge of stone blocks 12 ft below it still had enough forward speed to continue along the same track and further damage was caused to the underside of the fuselage, centre engine, left flaps and left wing. It seems probable that it was at this point that the forward part of the fuselage ruptured and became structurally detached. The aircraft eventually came to rest in Kowloon Bay in a slightly nose up attitude, heading ENE, with the rear extremity of the fuselage supported at water level on the ledge of stones that jutted out from the promontory. The centre engine was detached from the airframe, the left wing structure was damaged and a fire started internally in the centre engine intake duct. Fuel spread over the surface of the surrounding water. Most of the fuselage remained above water but the aircraft's attitude meant that the rear of the passenger cabin was partially submerged. The flight compartment and front portion of the front passenger cabin was attached to the remainder of the aircraft only by control cables and secondary structure and hung down into the water at a steep angle, with the nose resting on the sea bed. The aircraft had travelled 1485 m from the point of first impact with the runway promontory.

1.12.3 Wreckage examination

Airframe

The aircraft suffered severe structural damage during the impact sequence. Some further damage occurred during the salvage operation. The major areas found damaged were the lower and front fuselage, the wings in the region of main landing gears, the left wing torsion box at the aileron mid span position and the centre engine bay. This damage was consistent with being caused during the impact and all fracture surfaces examined had the appearance of being due to the resultant overload. All significant parts of the aircraft were present in the wreckage trail with the exception of the front passenger door which is believed to still be in the water near where the aircraft came to rest. Scratch and scrape marks were present on the lower surfaces of the right wing, centre engine bay doors and rear equipment bay doors. The direction of the scoring was consistent with the impact sequence described in 1.12.2 above.

There was no evidence of any bird strikes, lightning strikes or fire whilst airborne. The flight compartment's three forward facing windshields were present and free from outer surface defects which could have impaired vision, although the right one showed evidence of the reported attempts of rescuers to gain access to the flight deck by breaking this window.

During the examination of the wreckage the baggage was recovered from the aircraft. Forty eight items of hand baggage were taken from the passenger cabin, 59 items of checked baggage from the rear baggage hold, 3 items from the front hold and 7 mail bags. No attempt was made to establish their weight as all were sodden with water.

Flight Deck information

The following information was established by direct reference to the wreckage and to photographs taken shortly after the accident.

Instruments that had returned to their power off positions are not listed below.

LEFT PILOT'S PANEL

ASI
Pointer showing 110 kt, speed bug at 134 kt, power failure flag showing.

ALTIMETER
Pointer and drum counter showing 200 ft, sub-scale set at 1011 mb, power failure flag showing, height bug set at 400 ft.

ADI
Presentation parked showing 20 degrees right bank, attitude failure and director flags showing, flight director index wires at full right and full down positions.

FLIGHT COMPASS
Heading counter set at 315 degrees, aircraft heading at power off 018 degrees, steering index set at 315 degrees, track pointer at 315 degrees, roller blind showing yellow/blue ILS mode with the yellow/blue intersection 1.5 dots to the left of the aircraft symbol, radio coupling switch set to out, compass controller set to compass mode.

VSI
Pointer showing in excess of 6000 fpm dive.

RADIO ALTIMETER
Pointer at 0 ft, power off flag showing, height bug at 15 ft.

RMI
Aircraft heading 010 degrees, Red pointer 009 degrees, green pointer 340 degrees.

<u>RIGHT PILOT'S PANEL</u>

ASI
Pointer showing 146 kt, speed bug set at 135 kt, power failure flag showing.

ALTIMETER
Pointer and drum counter showing -30 ft, sub-scale showing 1011 mb, power failure flag showing, height bug set at 400 ft.

ADI
Presentation parked showing 20 degrees right bank, attitude failure and director flags showing, flight director wires bars at full right and full down positions, glide path flag showing.

FLIGHT COMPASS
Heading counter set at 315 degrees, aircraft heading at power off 013 degrees, steering index set at 315 degrees, track pointer set at 315 degrees, roller blind showing yellow/blue ILS mode with aircraft symbol over yellow/blue intersection, radio coupling switch set to out, compass controller set to compass.

VSI
Zero rate of climb/descent

RADIO ALTIMETER
Pointer at 0 ft, power off flag showing, height bug set at 15 ft.

RMI
Aircraft heading 020 degrees, red pointer showing 160 degrees, green pointer showing 040 degrees.

CENTRE PANEL

EGT and RPM Gauges
All at power off position.

EPR Gauges
Left 118%, centre 103%, right 118%; all three bugs set at 100%.

WEATHER RADAR
Selected ON, 20 nm range, 2 degrees down tilt, set to weather.

THROTTLE BOX

Pitch trim set at 3.25 divisions.

Roll trim set at .75 divisions to the right.

Yaw trim set at 1 division to the right.

Airbrake lever vertically out of detent into lift dump prime position and deployed to maximum airbrake position by lift dump lever actuator.

Parking brake lever - off/yellow system.

Throttle levers - left fully back with reverse thrust lever deployed; centre forward by 60% of full travel; right forward by 43% of full travel with the reverse thrust lever stowed.

Gear selector down.

HP & LP fuel cock levers all in their ON gates.

Relight switches - all three ON.

Top temp over-ride switches - all three OFF.

Windscreen wiper speed - both set at maximum.

PEDESTAL

Slat lever set to out and locked into gate.

Flap lever out of gate but close to the 23 degree position. This lever was distorted to the left and had made contact with the edge of the cover over the lever mechanism. Witness marks on the lever showed it was moving forward as it was distorted.

Flight controller - IAS window showing 125 kt and switch set to IAS; select height window showing 9500; set pressure window showing 1013 with switch set to lock; prime switch set to glide; 20 degree bank limit set; pitch and azimuth levers OFF (to rear); damping to ON (central position); select descent switch to 0.

LEFT RADIO
COM 119.50 - corresponding to Hong Kong Precision
NAV 109.90 / DME off - corresponding to RW31 ILS.

RADIO INPUT SELECTORS
Left to NAV 1, Right to NAV 2.

RIGHT RADIO
COM 119.50
NAV 109.80 / DME off - 0.1 off tune for RW31 ILS.

Transponder set to 3101.

<u>OVERHEAD PANELS</u>

Hydraulic system selectors - GREEN, YELLOW and BLUE systems ON.
UFDR input panel set
UFDR ON/TEST switch - gated in the ON position.
No smoking/fasten belts switches - ON
Left/right landing light switches OFF
Light position switch set at retract.
Taxi light switch OFF
Essential and radio supply switches 1 and 2 - ON
Radio cooling duct switch OFF
Ice inspection and nav light switches OFF
Beacon lights switch ON
Windscreen heat switches ON
Emergency exit lights switch - ARM (gated) position
Instrument panel light switches all ON
Floor and freight light switches OFF

<u>FLIGHT ENGINEERS PANEL</u>

Fuel system
Fuel contents gauges - Left outer 3000 lb, left inner 4300 lb, centre tank empty, right inner 4950 lb, right outer 750 lb.

Fuel used gauges - No 1 engine, 2432 lb, No 2 engine 2453 lb, No 3 engine 2258 lb.
Boost pump switches (2 per tank) - All ON except those for the centre tank, which were OFF.

Electrical systems

CSD disconnect switches - all to CSD.
AC Bus tie switches - all three to parallel.
DC Bus tie switch to parallel.
Battery switch ON

AIR CONDITIONING
HP Air levers all ON
Depressurization valve shut.

RADIO OPERATORS/NAVIGATORS PANEL

ASI
Pointer showing 147 kt, speed bug set at 135 kt, power failure flag showing.

ALTIMETER
Pointer and drum counter showing -45 ft, sub scale set at 1011 mb, failure flag showing.

DRIFT INDICATOR
Pointer showing 1 degree starboard drift, ground speed counter showing 142 kt.

DOPPLER DISTANCE INDICATOR - Showing 00000
OAT gauge - 33 deg C
ADF 1
Freq. 280.0, set to ADF, sharp, BFO OFF.
ADF 2
Freq. 377.0, set to ADF, sharp, BFO ON.

DOPPLER SWITCH - ON

WEATHER RADAR SWITCH - to navigator

INTERCOM SWITCH - OFF

Doppler controller set to stage 2 and showing DIST 000, TRACK ANGLE 153 degrees, ACROSS DIST 02-R.

Flying controls - general

All the primary and secondary flying control system mechanisms from the flight deck to the respective hydraulic power units were examined, the aircraft's structure being cut open where necessary to gain access. Due to the deformation of the lower flight compartment structure it could not be established with any certainty if any pre-impact jams or restrictions had occurred but it was possible to confirm that circuit continuity had been present for the three primary flying control systems prior to impact. The tailplane and rudder mechanisms were still connected to their respective q-feel pots, although failures had occurred to the pipes from the pitot heads due to the impact.

When the right main landing gear assembly was wrenched from the aircraft the (3) hydraulic systems' pressure and return pipes to the flying control actuators in the right wing were ruptured. This would have brought about a rapid and total loss of hydraulic pressure and therefore any attempt to control the aircraft by use of the flying controls after initial impact would have been ineffective. That hydraulic pressure was lost in this way was supported by the fact that the trailing edge flaps were found fully extended (with no signs of rotational damage present on the flap torque shafts) with the flap selector out of the fully extended position and close to the 23 degree position.

Primary flying controls

The cable circuits in the fuselage for each system was intact but those driving the ailerons in each wing, and which run along the wing rear spar, had all failed in the region of the main gears. Each cable failure (eight in all) was examined and all possessed the characteristics of overstressing, this being consistent with occurring as the airframe became disrupted in these areas. Also, failures had occurred to the mounting brackets of each fuselage circuit cable tension compensator, this almost certainly being due to high loads applied as the front section of the fuselage was disrupted. The fact that these failures occurred was strongly indicative that all cables were connected prior to the accident.

The input mechanism (mounted on the fin front spar) to the hydraulic actuators of the tailplane was free to operate over its full range once it had been disconnected at the tailplane. This was necessary due to the weight of the tailplane causing it to sag to a full nose up position (a normal event when the hydraulic systems are powered down) whilst the trimmed position of the pitch circuit had remained as set at the time of the accident. The flight compartment value of this was 3.25 divisions on the trim scale, which correlated closely with the trim screw jack extension in the input mechanism of 47 mm. The out of balance moment of the tailplane represents, at the actuators, a small percentage of their maximum output load (approximately 10 tonnes each). The action of the tailplane sagging after the accident demonstrated that no seizure of any significance had occurred within any of the three units. It was also established that the three SVDS were free to operate, as was each hydraulic valve on the actuators. The mechanism which moves the elevator directly as a result of tailplane movement was examined and found to be free from damage, although a bearing in the linkage was worn.

The autopilot servo motor was examined but could not be functioned. There were, however no external signs of damage and all visible wiring to this unit was free from pre-impact damage. A post impact fire which had developed in the centre engine bay had deposited soot over all the components in this area but temperatures had not risen sufficiently to cause heat damage.

The rudder hydraulic actuators and their SVDS were checked with no defects becoming apparent, the rudder and its input mechanism in the fin being free to move over a wide range. The trim position of this circuit was established as one division to the right on the flight deck scale, with a corresponding displacement of the output lever of the trim gearbox in the fin. Minor damage was caused to the bottom of the rudder surface during the final part of the impact sequence by the auxiliary power unit (APU) as this was pushed upwards by the centre engine.

The aileron input mechanisms in the wings were affected by water immersion and structural distortion. The mechanism in the right wing could be made to function only over a limited range, but sufficient to establish that there had been no disconnects, that the SVDS would operate and that the hydraulic valve on each actuator was capable of movement. The mechanism on the left wing, however, was seized and only parts of the input mechanism up to the spring struts could be moved. The three hydraulic actuator valves and their operating torque shafts were immobile, almost certainly due to the corrosive effect of water immersion, but all linkages were correctly connected and continuity was established back to the input quadrant.

The flight deck trim indication for the aileron circuit was one division to the right (raise left wing sense). The trim screw jack in the fuselage centre section, however, was fully retracted, but as the cables which drive this unit had not failed they were probably pulled differentially as the forward section of the fuselage failed. The trim gearbox was free to move.

The right aileron surface had suffered some deformation to its inboard end as the aircraft skidded sideways over the grass and there was evidence that it had overtravelled in the up sense.

Airbrakes/lift dumpers

Examination of the lift dump surfaces revealed both to have been in the closed position when damaged by the main gears removal and collapse. The airbrake surfaces, which also acted differentially as the roll spoiler surfaces, both from direct examination and photographic evidence, were similarly in the closed position during the impact sequence. All parts of their input mechanism in the wings were connected, as were their aileron interconnect linkages. The dual control cables from the flight deck were intact except in the region of the main gear structure in the wings where, like the aileron cables, impact overload failures had occurred. The airbrake selector lever in the flight deck was found in the lift dump primed position (pulled vertically out of a detent to expose a white arrow at its base) and at the full airbrake setting. This was due to the pedestal mounted electric lever actuator, which normally physically moved this lever past the full airbrake position into the lift dump position on touchdown, having operated but not to its full extent.

Flaps

There was copious evidence from the flap surfaces, witness marks left by rollers on the flap tracks, flap screwjack extensions and from the flap motor feedback screwjack that all four flap surfaces were in the land (45 deg) position. The right inboard surface was detached and broken as the right main gear was torn away. The right outboard flap was severely disrupted by striking the approach light fixture and supporting some of the weight of the aircraft as it skidded over the ground. The left inboard flap became detached.

as the left main gear collapsed. The left outboard flap was the only one to remain relatively intact on the aircraft. All failures seen in the flap system, including the drive shafts and gearboxes, were as a result of overload. None of the failures to these shafts showed any sign that they were rotating at the moment damage was sustained. The cable circuit to the flap hydraulic motor (situated just forward of the left main gear) was intact, but slack due to structural damage of the forward fuselage. The flap selector lever on the pedestal was found out of any gated position, at approximately 25 degrees, and distorted. It seems very likely that this was inadvertently moved during the accident sequence at a time when, almost certainly, no hydraulic power would be available on the aircraft.

Power plants

All three throttle levers had been connected via their respective cables and linkages to the engines. Analyses of oil samples taken from all three engines after the accident were normal.

The left engine (No.1) thrust reverser lever was in the deployed position with the clamshell doors on the engine in the corresponding closed position. There was extensive damage to the upper and lower engine cowls. The nose cowl was intact. There was no evidence of any external fire or flame break out on this engine, or of any mechanical failure. Inspection of the LP compressor blades revealed evidence of foreign object damage consistent with the ground slide suffered by the aircraft. The jet pipe was damaged as the aircraft slid over the sea wall.

The right engine (No.3) throttle lever was in the forward thrust position and the clamshell doors on the engine were open. The intake had been struck by debris and damaged, presumably as the right main gear was torn off, with rotational damage also evident to the first stages of the compressor. There were also signs of sooting in the intake, the most likely cause of this being the entry of hydraulic fluid from the broken pipes in the wing. The jet pipe had been damaged as a result of the aircraft sliding over the sea wall. There was no evidence of external fire or flame break out or of any mechanical failure.

Heavy ground impact damage and detachment of the centre engine (No.2) occurred late on in the ground slide and as the aircraft went over the edge of the sea wall. The fire that developed forward of this engine was centered in the middle part of the intake duct but there was no evidence of flame break out on this engine, or of external fire damage or any mechanical failure.

Hydraulic systems

All three hydraulic selector levers in the flight compartment roof were selected to ON and located in their gates. Examination of the aircraft failed to reveal any evidence of long or short term fluid leakage from pipelines, hoses, hydraulic components or engine driven pumps, although not all of the systems could be examined due to the nature of the wreckage. Inspection of the rear equipment bay, in and around which the system reservoirs, accumulators, filters and selector valves were located failed to reveal any obvious pre-impact defects, pipe disconnects or evidence of fire. All three main accumulators were still charged with gas at the correct pressure of 1000 psi, all three selector valves were in the on position. The three system reservoirs were intact but all contained little fluid as severe damage to their supply pipes had occurred.

Examination of the three hydraulic systems filter housings showed all the red pop-out buttons (which indicate the presence of a blocked filter) to be in.

Electrical system

No evidence was seen of any burning or distress to the visible parts of the electrical systems, except in areas associated with the post impact fire or mechanical disruption. The three alternators and their constant speed drives (CSD) on each engine showed no signs of pre-impact damage and it was noted that none of the CSD disconnect switches on the electrical systems panel were in the disconnect position after the accident. In addition, all three bus tie switches were in the parallel position. It was also evident from the flight instrumentation, which required both AC and DC power, that electrical power was available up to and probably slightly beyond the first moment of impact as, for example, the main altimeters and HSI's were presenting information consistent with the aircraft's position at that time.

Fuel system

All the wing tanks booster pumps switches were found set to ON with those for the centre tank set to off - a condition consistent with the indications on the contents gauges.

As much fuel as could be accessed by cutting holes in the upper wing skins was decanted from the aircraft. None was taken from the outboard wing tanks or centre tank, approximately 1860 litres were removed from the right inner wing tank and 1000 litres from the left inner tank. These figures do not necessarily reflect the quantity of fuel present at the time of impact but do confirm that fuel was available on the aircraft. The total amount of fuel used recorded on the fuel panel was 7143 lb, and that remaining in the tanks 13000 lb, although this figure should be considered subject to some error due to fuel sloshing as the electical power went off. The total fuel at the start of the journey, therefore, should have been approximately 20000 lb. It was recorded in the technical log as 22000 but with no units stated.

Samples of fuel were taken from both wing tanks and sent for analysis. The results revealed nothing unusual apart from a poor result for thermal stability, and this was thought to be due to the less than optimal storage conditions the fuel was subjected to between the time of the accident and the time the fuel was sampled.

Windshield wiper/Rainboe systems

This aircraft was fitted with an electrically powered wiper system, which is designed to clear the screens immediately in front of the two pilots. As it is known that the aircraft was landing in heavy rain, this system was examined in some detail. It was established that mechanical integrity existed from each electric motor through to the wiper blades, and that no jams had occurred in either gearbox. The electric motors could not be tested due to the effects of corrosion but were strip examined with no obvious pre-impact defects being apparent. Similarly, no pre-accident defects were identified in the circuit breakers associated with these motors. Both wiper blades were in reasonably good condition and were adjusted to give firm pressure against the windshields. No evidence was seen of scratches or other pre-accident defects on the two pilot's screens that might have impaired their vision.

A Rainboe rain repellant system was fitted to the crashed aircraft. In this particular installation, rain repellant fluid could be sprayed onto the three front windshields from three strategically placed spray heads. These spray heads were fed, through small-bore armored hosepipes, from one of two supply bottles (selected by a change-over valve) mounted in a frame on the rear left flight compartment bulkhead, below the navigator's table. Integral with each spray head was a solenoid valve which could be triggered through a timer circuit from two push buttons on the instrument panel. Examination revealed that fluid was available from only one bottle, the one to which the change-over valve was selected, and it was noted that this bottle was stamped 14 December 1971. The full integrity of the piping could not be checked as it had been crushed and broken in several places in the accident. However the piping that remained intact was free to pass the rain repellant. Scrutiny of the spray heads showed several of the small holes on each head to be blocked by paint. Those holes that were not blocked had had the paint chipped away from them. The solenoid valves when examined revealed no apparent pre-accident defects. The maintenance records for this aircraft show that the Rainboe system was inspected during an 'M8' check on 2 August 1988, but it is not clear whether it was tested for serviceability at that time.

Pitot static system

The pitot installation on this aircraft supplied pressure data to two Air Data Computers (ADC), which in turn electrically drove the main ASI's, altimeters and machmeters for the two pilots. The piping for this system was of light alloy, joined by flexible sections, from two pitot heads and static plates. The VSI's, standby altimeter and standby ASI were purely manometric instruments.

The extent of disruption of the lower forward fuselage, where most of this system was located, precluded any examination as a system. However, all damage seen was consistent with being caused by the accident. The two ADC's, which were still connected to their pitot static pipes, had been immersed in the water and were slightly distorted. These units, together with the HSI, ADI, altimeter and VSI units, were returned to the UK and examined in conjunction with the manufacturers.

Of particular interest was the altimeter display for the left pilot. This was indicating +200 ft on 1011 mb whereas the other two units were showing -30 ft and -45 ft with the same sub-scale setting. Internal physical examination of the left altimeter and the ADC supplying the left altimeter revealed corrosion of the gear trains due to water immersion and mechanical seizure. Without moving the seized gear trains the output synchros and force balance pickup of the ADC were electrically energised and monitored from an external source and the output to the altimeter measured. Again, without moving the seized gear trains the input synchros and height encoder of the altimeter were electrically energised and monitored from an external source and the input to the altimeter measured. The results of these tests showed a close correlation between the output of the ADC and the instrument reading. It can reasonably be assumed therefore that the altimeter was functioning correctly, and that there was an altitude input signal and an altitude output signal present at the ADC, at the point of electrical failure.

The VSI's were of the conventional manometric type. After the accident the right instrument showed nil rate of climb or dive but the left instrument showed in excess of 6000 fpm dive. On strip examination the right instrument was found free of water and in good condition. When functionally tested it proved to be serviceable and accurate. The left instrument had sea water trapped inside and had suffered corrosion. The pointer was stuck due to corrosion products at the sector gear/pointer pinion interface and the capsule was found at the zero rate position. After the pointer mechanism was freed, and moisture removed from the capsule and capillary tubing, the instrument was functionally tested. In the test the unit responded to pressure changes with high sensitivity and excessive friction. This was attributed to corrosion effects and to contamination of the diffuser valve by detritus in the sea water. This instrument was submerged under several feet of water, it would only require 2.5 inches of static water pressure in the static connector to cause the instrument to display maximum rate of dive - the condition in which it was found. If the rate of flow of the water through the diffuser valve was then low, as it would be with contaminated water, the indication would remain long enough to allow the corrosion to seize the pointer mechanism in the maximum rate of dive position.

Flight control system

The main elements of the flight control system were recovered from the wreckage and, again, most items were located in the forward part of the aircraft and had been immersed in water. Parts of this system relevant to the operation of ADI's and HSI's were sent to the manufacturer for examination. The examinations failed to reveal any pre-accident defects in the units, but the effects of salt water immersion precluded full functional testing, and therefore a complete assessment of their serviceability state could not be made.

1.13 Medical and pathological information

Pathological examination of the bodies of the flight crew members revealed injuries which were consistent with having been involved in an aircraft accident; however, the cause of death in each case was found to be drowning. No evidence was found of any pre-existing medical condition which could have contributed to the accident.

Passenger injuries were mainly minor and the injured passengers were seated either in the forward cabin or on the right side in the rear cabin. No passengers seated on the left side of the rear cabin were hurt. Some passengers admitted to not having their seat belts fastened, and one cabin attendant did not fasten her seat belt.

The passenger seated in seat 4B, where the fuselage buckled inwards, suffered fatal injuries and died in hospital. It was not possible to determine whether he had been strapped in, but as the seat belt was intact and he was found forward, and out of, his seat by the rescue personnel, it seems likely that he may not have been. The autopsy showed that he suffered numerous fractures of bones on the left side of his body and these were probably caused by the fuselage structure that protruded into the cabin.

1.14 Fire

The accident was attended on the landside by three Foam Tenders and seven other appliances including Rapid Intervention Vehicles, Foam Carrier/Hose Layers and Personnel Carriers. Water-borne appliances consisted of a rescue launch and two inflatable craft. A total of 41 Airport Fire Contingent personnel (including five divers) were involved in the fire fighting and rescue operations.

The first Rapid Intervention Vehicle (RIV) arrived at the aircraft within a minute of the alarm being given. A small fire had started in the centre (No2) engine intake duct - the engine had detached from the airframe and lay on the stone ledge adjacent and to the right of the engine bay - and a layer of fuel spread over the surface of the surrounding water.

Foam was immediately applied to the rear of the aircraft and over the fuel leakage by the RIV and a Foam Tender. However, due to the direction the aircraft was facing these appliances were unable to direct foam into the engine intake and the fire inside it continued to burn. Attempts by the rescue launch (Catamaran) to bring its foam monitor to bear were hampered by the strong water current and the awkward angle of attack. Two firemen then swam to the rear left side of the aircraft from the runway promontory with a sideline connected to the water tank of a Foam Tender and managed to clamber onto the left (No.1) engine nacelle. However from there they were unable to reach the centre engine intake. They were then joined by a third fireman and with some difficulty one of them succeeded in climbing onto the roof of the passenger cabin, the others passed the sideline up to him and he extinguished the fire by spraying water directly into the engine intake.

1.15 Survival aspects

1.15.1 General

At the end of the accident sequence the aircraft came to rest in the water in a nose high attitude and slightly left wing low. The left sidewall of the fuselage near passenger seat rows 3 and 4 was severely buckled inward, whilst the roof and the opposite fuselage sidewall had failed in tension. Forward of this area the front of the aircraft remained attached only by secondary structure at, and below, cabin floor level and drooped down in to the water at a steep angle. A diver reported that the extremity of the nose rested in contact with the sea bed approximately 12 ft below the surface. The water was foul with almost zero visibility underwater.

Deceleration forces were not high and there was no major post impact fire. Minimal structural distortion was caused to the rear passenger cabin where 70 of the 89 persons on board were seated.

There was a strong current flowing in Kowloon Bay and this caused the wreck to rotate slowly clockwise, as it turned the right wing remained above water and provided a convenient platform for the passengers who exited the aircraft via the right hand overwing escape hatch. Eventually the right wing tip contacted, and lodged upon, a ledge of stones at the base of the promontory. Passengers reported that the rear of the passenger cabin was under water to a depth of approximately three feet.

It rained heavily and continuously throughout the rescue phase.

1.15.2 Rescue services

Although the fire and rescue services were rapidly on the scene, both from the land and water, by the time they arrived many passengers had already escaped from the passenger cabin. Most were standing on the right wing, some were in the water, and a few had already scrambled ashore. Ladders and ropes were lowered down the sea wall and two inflated life rafts thrown into the sea from the rescue launch. After the small fire in No.2 engine intake duct had been extinguished, the wreck, which seemed in danger of moving away from the promontory in the current, was secured to the shore with lines.

Forty one survivors were taken on board the rescue launch and five on to a nearby junk. These 46 survivors were then transferred to a Marine Police launch and taken to the airport sub fire station pier. At the same time 35 passengers were rescued to the shore by the landside rescue personnel. All injured survivors were then conveyed to a First Aid Point, and seriously injured survivors were airlifted to hospital by helicopter. The uninjured were taken to an assembly area in the Passenger Terminal Building for customs and immigration formalities.

When the rescue personnel boarded the aircraft to check whether it was clear of survivors they found two passengers trapped in the left side of the forward cabin at the point where the fuselage had buckled. One, who appeared to have a broken arm, was entangled with seat wreckage and collapsed cabin furnishings. The other, similarly ensnared, had only his head above water. Both were quickly released and removed from the aircraft. Efforts by the rescue personnel to approach the flight compartment from the passenger cabin were unsuccessful due to the tangle of wreckage blocking the way.

Attempts were then made by fireman divers to gain access to the flight deck but these were severely hampered by the strong current and poor underwater visibility. To add to the difficulties all approaches to the submerged part of the forward fuselage were obstructed by broken pieces of aircraft structure and a tangle of wires and loose aircraft furnishing. After considerable difficulty a diver gained entrance to the submerged fuselage from the rear, and found a way through it to the forward vestibule which he cleared of obstructions and then exited the aircraft by the forward passenger door. Using this door divers then entered the aircraft and gained access to the flight compartment.

Meantime Royal Navy divers had arrived on the scene and attempted, without success, to gain access to the flight compartment from outside the aircraft.

1.15.3 Flight compartment

The following is contained in ICAO Annex 6, Operation of Aircraft - Part 1, International Commercial Air Transport - Aeroplanes.

Quote -

"6.2.2 An aeroplane shall

6.2.2.1 be equipped with:

a)...
b)...
c) 1) a seat or berth for each person over an age to be determined by the State of the Operator.

2) a seat belt for each seat and restraining belts for each berth;

3) a safety harness for each flight crew seat. The safety harness for each pilot shall incorporate a device which will automatically restrain the occupants torso in the event of rapid deceleration."

and also:

"4.4.4.4 Safety harness. Each flight crew member occupying a pilot's seat shall keep his safety harness fastened during the take-off and landing phases ; each other flight crew member shall keep his safety harness fastened during the take-off and landing phases unless the shoulder straps interfere with the performance of his duties.

Note.- Safety harness includes shoulder straps and a seat belt which may be used independently."

Unquote.

The flight compartment on this aircraft was fitted with five crew stations for two pilots, a flight engineer, a radio operator and a navigator. All stations were fitted with a standard crew seat equipped with an inertia reel shoulder harness and lap straps with a quick release buckle. The shoulder harness on all five seats was covered over by a loose seat cover fitted to each seat and was therefore not readily available for use. On some seats the shoulder harness straps had been tied together under the seat pan. The lack of wear on the lugs at the end of each shoulder harness strap, compared with that on the lap strap, showed that the shoulder harnesses had been used only a few times since they were installed.

The aircraft was not designed or equipped to accommodate more than five flight deck crew. Nevertheless, a sixth flight crew member, a Radio Operator under training, was carried and accommodated in the flight compartment throughout the flight (including the take-off and landing) on a loose metal stool. No provision was made to restrain either the stool or the crew member using it.

The entrance door to the flight compartment was hinged so that it opened into the flight deck. The original door was constructed from frangible material to permit its use as an emergency exit but on this aircraft was replaced by a heavy armour-plated door.

1.15.4 Passenger compartment

A layout of the passenger accomodation is at Appendix 12.

The aircraft had two passenger entry doors on the left side of the fuselage forward of the wing, referred to as the front and midship passenger doors. Located opposite the front passenger entry door was a smaller service door, referred to as the front emergency exit door. Opposite the midship passenger door there was a galley area.

There were two inward opening escape hatches on each side of the aircraft, located over the wings, at seat rows 10 and 11.

The cabin configuration divided the passenger compartment into two, with six seat rows forward of the midship passenger door/galley area and 12 behind it. With the exception of the last row the seat units were all of the triple type allowing for six abreast seating about a central aisle. Because of the narrowing of the fuselage the last row (18) was only four abreast.

Stowage in the passenger cabins for hand baggage was provided by overhead open shelving (hatracks). Forty-eight pieces of hand baggage were recovered from both passenger cabins.

Emergency exits for the the front cabin comprised the front and midship passenger doors at each end of the cabin on the left side, and the front emergency exit door on the right side of the aircraft opposite the front passenger door. Both of the front doors were forward of the break in the fuselage, and were submerged beneath the water when the aircraft came to rest.

The emergency exits for the rear cabin were the midship passenger door at the front of the cabin and the two overwing inward opening hatches on each side of the aircraft located approximately half way along the cabin at seat rows 10 and 11. Seat row pitching in this cabin was such that none of these hatches had a clear path to them from the aisle.

Passenger entry doors on this aircraft were of the inward opening plug type with an "up and over" action, stowing into the roof. After the accident both the front and midship passenger doors were found open, with the midship door undamaged and in the stowed position. The front passenger door was missing and has not been recovered. It is believed to have been lost during the transit of the sea wall when the forward fuselage suffered considerable distortion. The front emergency exit door was found secured closed and could not be operated, however this was not surprising as this part of the fuselage had suffered major damage and distortion. The forward right escape hatch and the rear left hatch were found open. The other two escape hatches were found closed but operated without difficulty several days later during examination of the wreckage.

Examination of the passenger seats showed none to have failed structurally as a result of the impact forces, although several units from the front cabin were distorted as a result of the fuselage failure. All passenger seats except one were equipped with friction-lock seat belts, in which the free end of one strap is inserted through the buckle on the other and clamped tight as a lever on the buckle is operated. At most seat positions, the buckle was attached to the left strap, but at 12 positions the buckle was on the right strap. All buckles appeared to operate but, as all had corroded to some extent due to water immersion, it could not be established if each one had been capable of locking its respective strap. At one seat position the seat belt to which the buckle was attached was fitted to the seat in such a way that it was necessary to twist the belt in order to bring the operating lever uppermost. At the remaining seat position the more usual type of seat belt with a metal-to-metal latching device was fitted. No seat belts had failed.

The following is contained in ICAO Annex 6, Operation of Aircraft - Part 1, International Commercial Air Transport - Aeroplanes.

Quote -

> 6.5.2.1 Landplanes shall carry the equipment prescribed in 6.5.2.2:
>
> a)...
> b)...
> c) When taking off or landing at an aerodrome where, in the opinion of the State of the Operator, the take-off or approach path is so disposed over water that in the event of a mishap there would be a likelihood of a ditching.
>
> 6.5.2.2 The equipment referred to in 6.5.2.1 shall comprise one life jacket or equivalent individual floatation device for each person on board, stowed in a position easily accessible from the seat or berth of the person for whose use it is provided.

Unquote.

Examination of the passenger cabins failed to reveal any passenger lifejackets. Two lifejackets were found on board (both with live inflation bottles), one in a cupboard close to the centre galley, the other in the flight compartment.

1.15.5 Passenger safety briefing

The following is contained in ICAO Annex 6, Operation of Aircraft - Part 1, International Commercial Air Transport - Aeroplanes.
Quote -

"4.2.10.1 An operator shall ensure that passengers are made familiar with the location and use of:

(a) seat belts;

(b) emergency exits;

(c) life jackets, if the carriage of life jackets is prescribed;

(d) oxygen dispensing equipment, if the provision of oxygen for the use of passengers is prescribed; and

(e) other emergency equipment provided for individual use.

4.2.10.2 The operator shall inform the passengers of the location and general manner of use of the principal emergency equipment carried for collective use.

4.2.10.3 In an emergency during flight, passengers shall be instructed in such emergency action as may be appropriate to the circumstances.

4.2.10.4 The operator shall ensure that during take-off and landing and whenever, by reason of turbulence or any emergency occurring during flight, the precaution is considered necessary, all passengers on board an aeroplane shall be secured in their seats by means of the seat belts or harnesses provided."

Unquote.

There were no passenger safety briefing cards on the aircraft.

Passengers reported that the cabin attendants did not make a safety briefing, and that the methods of fixing and releasing seat belts were not demonstrated. Neither were the locations and method of use of the emergency exits pointed out to them.

The seat back in front of each passenger carried a placard saying that there was a lifejacket under each seat. There were no passenger lifejackets on the aircraft.

The Fasten Seat Belt/No Smoking signs were illuminated for take-off and an announcement made requesting passengers to fasten their seat belts. Passengers reported that a cabin attendant checked the passenger cabins before departure.

The Fasten Seat Belt/No Smoking Signs were illuminated on the approach to HKIA and an announcement was made drawing passengers attention to them. However, no physical check was carried out to ensure that passengers were secured in their seats.

1.15.6 Passenger escape routes

When the aircraft came to rest the midship passenger door was opened by one of the cabin attendants seated alongside it. This exit led straight to the open water. Some passengers jumped from this exit into the water and swam ashore, and five were rescued from it on to a passing junk. Approximately 10 passengers in total used this escape route.

During the ground slide the forward right overwing escape hatch (at seat row 10) partially opened. When the aircraft came to a halt a passenger, seeing daylight through the gap and thinking it to be a hole in the fuselage, kicked at it to enlarge it and the hatch sprang open. This exit had a relatively clear path to it from the aisle, and those passengers that did not use the midship door escaped through it on to the right wing.

The rear left escape hatch also sprang open during the ground slide and lodged itself against an adjacent seat back. No attempt was made by the passengers to further open this hatch and it was not used as an escape route.

The left forward and right rear escape hatches remained closed and no attempt was made to open them.

Two passengers were seated in row 4 in the forward passenger cabin, left side, where the fuselage buckled, and both were trapped by deformed aircraft fittings and structure. They were found by the rescue personnel, released and taken out of the aircraft through the midship passenger door. One later died in hospital.

1.15.7 Cabin attendants

Of the three cabin attendants, two were seated in cabin crew seats at the midship passenger door and one in the forward passenger cabin in a passenger seat in row 2. The two security officers were seated in seats in row 1.

The cabin attendant seated in row 2, together with the two security officers, were therefore forward of the break in the fuselage and were cut off by it from the main passenger cabin. All three escaped into the water through the break in the right side of the fuselage wall and were unable to assist with the evacuation of the passengers.

One of the cabin attendants seated on a cabin crew seat at the midships door had not fastened her seat belt for landing and was rendered unconscious during the accident sequence. She regained consciousness in the water, clinging to some wreckage, and was rescued by fire services personnel. It is presumed that she exited the aircraft through the midship door, but she has no recollection of having done so.

The remaining cabin attendant opened the midship door and directed the passengers to exit the aircraft through the door and right forward escape hatch. After checking that the passenger cabin was clear she left the aircraft through the midship door.

1.16 <u>Tests and research</u>

1.16.1 Flight crew procedures

Members of the investigating team were invited, by CAAC, to fly as observers on flight CCA301 on 17 September 1988 between Guangzhou and Hong Kong.

The flight deck crew consisted of Commander, First Officer, Flight Engineer, Flight Navigator and Radio Operator. Communication between the flight crew was vocal, and consequently the only crew member to wear a headset was the Radio Operator. The flight deck loudspeakers were selected on.

The following points of flight procedure were noted;

(a) All radio communication was carried out by the Radio Operator and monitored by the crew over the loudspeaker.

(b) Instructions received by RTF in English were translated to the crew by the Radio Operator.

(c) The Take-off/Landing Data card was prepared by the Navigator.

(d) VHF communication and navigation aids were tuned and, where appropriate, identified by the Navigator. They were then confirmed to the Commander by the aid being selected to the loudspeaker.

(e) Before taxying the challenge-and-response checklist was read by the First Officer, responses being elicited from the various crew members. Subsequently it was read by the Flight Engineer, the First Officer actioning the pilot orientated checks, leaving the Commander free to handle the aircraft.

(f) After the initiation of take-off power by the Commander, all subsequent power adjustments were made by the First Officer at the Commander's request.

On the approach to runway 13 at Hong Kong, the aircraft configuration was landing gear down, spoiler extended and 23 degrees of flap. The initial approach speed was noted to be between 165 and 171 kt. The threshold speed had been calculated as 136 kt plus a 15 kt allowance for surface wind gusts. Land flap was selected at about 1000 ft amsl when the speed reduced to 150 to 155 kt. A normal landing was made on runway 13.

1.16.2 Flight simulation

The design simulator at British Aerospace, Hatfield, UK was programmed with Trident 2E aerodynamic data and a mathematical model of the weather situation pertaining at the time of the accident. The simulator was fixed base and had only a rudimentary flight deck and visual system. Both computer generated and pilot flown runs were made which attempted to match the approach profile constructed from data retrieved from the UFDR.

The computer generated runs included the use of thrust to match speed and stick to match altitude, wind along the body axis to match speed whilst maintaining thrust at the initial zero acceleration level and vertical wind to match 'g' and horizontal wind to match speed.

Pilot flown approaches included a normal manual ILS using wind from the mathematical model and re-runs of the computer matching runs.

The diagram at Appendix 9 shows outputs from the simulations. The column alongside the flight path plot shows tailplane angle, thrust and EAS. The main values are from the computer run which matched speed with thrust, and altitude with stick, to follow the UFDR profile. The values in brackets are from a pilot flown normal ILS profile using wind from the mathematical model.

From just above 800 feet to 600 feet the aircraft is recovering from an excursion above the glideslope. It seems reasonable in these circumstances to expect an initial reduction in power followed by an increase in power just before the glideslope is regained, the airspeed remaining approximately constant throughout. However, there was a large speed increase - and to match this and the UFDR profile required the application of a considerable amount of power. When the next excursion occurs, just above 500 feet, recovery is from a situation where the aircraft is high on the profile, with high airspeed and high power. When that is considered, the remainder of the profile looks reasonable and the speed appears to be decaying at the right rate for the flight path angle, assuming land flap and a low power setting.

1.17 Additional information

1.17.1 Air traffic control procedures and instructions

The operating procedures for approach and aerodrome control at Hong Kong International Airport are laid down in the Manual of Air Traffic Control (MATC) issued by the Air Traffic General Manager and supplemented by Temporary Instructions and Operations Memoranda. The manual comprises eight consecutively numbered sections each of which is called an Air Traffic Control Instruction (ATCI).

Reproduced below are ATCI's relevant to the circumstances surrounding this accident. ATCI Nr.3, from which all except the last extract are taken, is divided into Chapters. Chapter 2 addresses Aerodrome Control Procedures and Chapter 3 addresses Approach Control Procedures. The last extract is from ATCI Nr.5 which deals with Radar Procedures.

The citing of these ATCI's in this context should not be taken as an appraisal of the events leading up to the accident.

Automatic Terminal Information Service In Chapter 2 of ATCI Nr.3 the following instruction can be found:

"2.8.3 The purpose of this broadcast is to reduce R/T workload and congestion on Aerodrome Control and Approach Control by eliminating the necessity of repeating routine information to each arriving or departing aircraft.

The broadcast will be continuous until the data changes, when a new broadcast will be made. Each broadcast will have an identification code and pilots are required to acknowledge receipt of this information on ATS frequency.

For example : "Received information (ALPHA) (BRAVO) (CHARLIE) etc."

Aerodrome Controllers (normally GMC) and Approach Controllers must ensure that all pilots acknowledge receipt of the current ATIS broadcast. The acknowledgment should be recorded by entering the ATIS message identification alphabet in BOX A of the Aerodrome Control outbound flight progress strip, local flight progress strip or BOX K (bottom half) of the Approach Control inbound flight progress strip of the aircraft concerned.

2.8.4...

2.8.5...

2.8.6. Whenever there are rapid and marked changes of surface wind, visibility or cloud base, it is not necessary to attempt to keep the ATIS broadcast up-to-date.

Instead, the broadcast must be made stating that one or more of the above items are varying rapidly and why, and that up-to-date information will be passed on control frequencies.

The broadcast will be made in the standard way except that the item that is varying will be passed as:-

'Visibility - varying rapidly due passing showers. Up-to-date information will be passed on control frequencies.'"

<u>Runway Visual Range</u> In Chapter 2 of ATCI Nr.3 of the Manual of Air Traffic Control the following instruction can be found:

"2.11. Runway Visual Range (RVR)

2.11.1 The AMC controller shall alert Approach Control and PAR Control (when manned) whenever visibility decreases to the extent that RVR readings fall below 2000 m.

2.11.2 AIP RAC Section provides details of RVR together with the method of passing RVR values to pilots. The system is designed so that accurate values can only be obtained when the high intensity lights are in operation on settings of 10%, 30% or 100%. Accordingly, RVR values will only be given to pilots in these circumstances, both by day and night.

2.11.3 It should be noted that the value of the RVR depends on the intensity setting of the runway lights. If the intensity of the lights is increased, then the value of the RVR also increases. When the RVR value is marginal, a change in the intensity setting of the runway lights may possibly alter the RVR from below to above limits (or vice versa). The RVR value passed to the pilot by the controller should therefore correspond to the light intensity setting intended for landing or take-off.

2.11.4 The maximum value on the RVR display has been pre-set to 2000 m. Whenever the display unit shows "2000", it indicates that the RVR is equal to or more than 2000 m.

2.11.5 The master display unit is situated at the Airport Met. Office. A display of "0000" or "--00" indicates that :-
(a) the RVR system is unserviceable; or

(b) the RVR is zero.

Any faults are to be reported to Airport Met. Office.

2.11.6 When the last digit is flashing or when all four digits are updating continuously, this indicates that the system is on test or maintenance."

Arriving Aircraft In Chapter 3 of ATCI Nr.3 of the Manual of Air Traffic Control the following instruction can be found:

"3.4.1 Weather Information
3.4.1.1 Weather information is disseminated by VOLMET and ATIS broadcasts (see AIP MET 3-1 & RAC 14-2). Controllers are to ensure that the latest ATIS broadcast is received and acknowledged."

Precision Approach Radar In ATCI Nr.5 of the MATC the following is included under the heading of Duties of the PAR Controller during an ILS approach monitored by PAR:

"7.12.2 (g) To notify pilots of significant changes in weather conditions as advised by aerodrome control."

1.17.2 Aerodrome operating minima

State aerodrome operating minima (AOM) were not imposed at HKIA.

The legislation in force in HK governing the use of aerodrome operating minima (AOM) at HKIA was the Air Navigation (Overseas Territories) Order 1977. This Order required operators of foreign registered aircraft to furnish the HK authorities with details of the AOM to be used together with any associated instructions. In this context AOM for landing meant decision height (DH), runway visual range (RVR) and visual reference. The Order also prohibited an aircraft from commencing an approach when the RVR was below the specified company minimum, or continuing an approach to DH if during an approach the RVR fell below it. These requirements were also spelled out in detail in the FAL section of the HK AIP.

In accordance with these requirements the CAAC had lodged their AOM and associated instructions with the HK CAD. The AOM specified for Trident aircraft for a RW31 ILS approach with, or without, precision approach radar monitoring was:

Decision Altitude	405 ft
Visibility	1600 m
RVR	1500 m

Scrutiny of the 'associated instructions' showed that no visual reference was specified in them by CAAC, and that an approach could be continued to DH if the RVR fell below company minimum after the aircraft had crossed the outer marker.

1.17.3 Ground proximity warning system

The relevant ICAO Standard included in Annex 6 Part 1 requires turbine engine aeroplanes of maximum certificated take-off weight in excess of 15000 kg, or authorised to carry more than 30 passengers, to be equipped with a Ground Proximity Warning System (GPWS) if the individual aircraft's certificate of airworthiness was first issued on or after 1 July 1979. Carriage of GPWS by aircraft certificated prior to this date is included in the Annex as a Recommended Practice only.

The accident aircraft was not equipped with a GPWS, and as the aircraft's certificate of airworthiness was first issued in 1973 it was not required to be equipped with it.

Scrutiny of the UFDR trace showed achieved rates of descent in the final stages of the approach that were unlikely to have triggered a Mode 1 warning had the equipment been fitted.

1.18 New investigation techniques

Nil

2. ANALYSIS

2.1 General

There were no surviving flight deck crew and the lack of a CVR, coupled with the small number of parameters recorded by the UFDR, severely hampered the ability of the investigation to determine the sequence of events on the final approach. Neither was it possible to determine if anything happened on the flight deck to distract the pilots from their normal cross monitoring function. A CVR would doubtless have been able to provide valuable clues to the cause or causes of this accident, as would the recording by the UFDR of additional parameters such as pitch, roll, flap position and engine thrust.

2.2 Flight deck indications and controls

2.2.1 Left altimeter and vertical speed indicator

These instruments showed +200 ft and in excess of 6000 fpm down respectively, whereas the corresponding right instruments displayed -30 ft and no climb/descent. Both altimeters were set to the same sub-scale setting.

Post accident examination of the altimeters and the associated ADC by the manufacturers failed to reveal any defects not attributable to immersion in sea water. Tests carried out showed a satisfactory correlation between the instrument readings and the associated ADC and that both altimeters were functioning correctly at the point of electrical power failure. The possibility that heavy rain affected the static port supplying the feed to this ADC was considered, but as a small decrease in the static pressure would be required to produce the discrepancy between the altimeters, and as water entering the static port would be likely to cause an increase rather than a decrease, this was considered to be a remote possibility. The most likely explanation therefore is that the discrepancy resulted from a false pressure signal generated in the pitot static system when the fuselage was damaged during the ground slide.

The indication of maximum rate dive on the left VSI is not considered to be significant. This was a straightforward manometric instrument and the pointer would have returned to the zero position regardless of the disruption of the pitot static system during the ground slide, or of any false pressure signals that may have been generated. There is little doubt that the indication of maximum rate of dive was entirely due to water pressure, with the subsequent corrosion of the pointer mechanism causing the reading to be retained.

The SDAU data base of the UK CAA records that over the life of the British Airways fleet of Trident aircraft there were occasions when the primary flight instruments presented erroneous information to the crew. In most of these cases the fault was readily identified by the crew and, again, in most cases a defect was later discovered. However, the results of the examinations of the flight instruments and air data computers by Smiths Industries, Honeywell and British Aerospace failed to reveal any pre-accident defects in these units which could have misled the crew. The effects of salt water immersion did, of course, lead to corrosion of the mechanisms and electronics within most of the units and precluded full functional testing and hence a full assessment of their serviceability state. The correlation, however, between the output of the ADC's and the information presented on the flight displays would seem to support the view that they were serviceable.

2.2.2 Throttle positions

The left throttle (No.1 engine) was found fully closed with the reverse thrust lever deployed. Both the centre (No.2 engine) and right (No.3 engine) throttles were well into the forward thrust range with the right (No.3) engine reverse thrust lever stowed. Examination of the engines showed that the clamshell doors of the left (No.1) engine were closed, in conformity with the reverse thrust lever position. On the right (No.3) engine the clamshell doors were open, in conformity with the forward thrust position of the associated throttle.

Shortly after the ground slide began the aircraft started to yaw to the right. It seems reasonable to assume that the pilot at this time, or possibly earlier, selected reverse thrust on the left engine in an effort to counteract this yaw. The positions of the other two throttles are not considered to be significant as they were probably kicked and moved by the flight deck crew during their efforts to escape, and possibly also by the divers during the retrieval of the crew member's bodies.

2.2.3 Flap selector lever position

The flap selector lever positions are UP - 10 degrees - 16 degrees - 23 degrees - LAND. The flap selector lever was found out of, and just below, the 23 degree gate and bent to the left. However the flaps had not moved and were still in the LAND position. This points to the lever having been moved after hydraulic power was lost, that is, after impact. The distortion of the lever, and corresponding bruises on the left thigh of the pilot in the right seat, suggest that the lever was struck and bent during the crash sequence. It therefore appears likely that it was dislodged from the LAND gate at some time during the crash sequence rather than deliberately selected. (See also 1.12.3 Wreckage examination - Flaps)

2.2.4 ILS frequency selection

The runway 31 ILS frequency is 109.9 MHz. The left radio navigation receiver was found selected to this frequency but the right radio navigation receiver was found selected to 109.8 MHz - that is 0.1 MHz adrift.

On the Trident when an ILS frequency is selected the blind of the associated Flight Compass changes to a yellow/blue display. Selection of a VOR frequency causes the blind to show a distinctive black and white VOR to/from arrow. On the crashed aircraft the right hand instrument display was selected to the right radio navigation receiver (Nav 2) which was tuned to 109.8 MHz. However an ILS yellow/blue display was showing on the right flight compass, which indicated that the move off frequency occurred after power was lost. The frequency selectors were of the conventional concentric knob type and the most likely explanation is that the selector was knocked or kicked by a crew member when attempting to escape from the flight deck. It should be borne in mind that when the aircraft came to rest the flight deck floor was almost vertical.

2.3 Technical defect

The crashed aircraft was recovered to dry land relatively intact and its systems subjected to engineering scrutiny on site or removed to the UK for functional testing. It was established that the aircraft was structurally complete prior to the crash. The aircraft's engines, systems and their components revealed no evidence of pre-impact failures or malfunctions and each system was found configured in a manner that was consistent with the approach phase. The damage to components found was attributed to the impact sequence, or corrosion due to post accident immersion in the corrosive waters of Kowloon Bay, or both.

Unless an obscure defect existed, which is thought to be highly unlikely, it must be concluded that up to the moment of impact the aircraft was generally serviceable, and that the accident was not caused by a technical defect.

2.4 Weather

2.4.1 Meteorological information available to China 301

General

ICAO Annex 11 - Air Traffic Services - states that the objectives of the air traffic services shall be to:

"1) ...

2) ...

3) ...

4) provide advice and information useful for the safe and efficient conduct of flights."

5) ..."

These objectives are also included in ATCI Nr.2 in the MATC.

ICAO Document 4444 - Rules of the Air and Air Traffic Sevices - specifies in greater detail than Annex 11 the actual procedures to be applied by air traffic services and includes the following under the heading of Information for Arriving Aircraft:

"At the commencement of final approach, the following information shall be transmitted to aircraft:

(a) significant changes in the mean surface wind direction and speed;

(b) the latest information, if any, on wind shear and/or turbulence in the final approach area;

(c) the current visibility representative of the direction of approach and landing or, when provided, the current runway visual range value(s) and the trend, if practicable, supplemented by slant visual range value(s), if provided.

During final approach, the following information shall be transmitted without delay:

(a) the sudden occurrence of hazards (e.g. unauthorized traffic on the runway);

(b) significant variations in the current surface wind, expressed in terms of minimum and maximum values;

(c) significant changes in runway surface conditions;

(d) changes in the operational status of required visual or non-visual aids;

(e) changes in observed RVR value(s), in accordance with the reported scale in use, or changes in the visibility representative of the direction of approach and landing."

The aircraft crashed at 0119 hr in heavy rain, with an RVR of 1000 m, and the investigation was concerned to determine whether sufficient advice and information was given, or made available, to the commander of China 301 to enable him to form a reasonable assessment of the landing conditions at HKIA.

The flight took place at the relatively low cruising altitude of 10000 feet and whilst still in the Guangzhou FIR the first deviation due to weather was made. After entering the Hong Kong FIR China 301 made several requests to change, or to maintain, heading to avoid weather. The chart at Appendix 10 shows an approximation of the track-made-good from the FIR boundary to HKIA and serves to indicate the extent of the track deviations. No radar recording facilities were available at HKIA and the chart was constructed using UFDR data, the RTF transcript and controller recollection.

On first contact with HK approach China 301 acknowledged receipt of HK ATIS information DELTA -

"This is Hong Kong International Airport..information DELTA at time 0035..runway in use 13 expect IGS Approach..runway surface is wet..ILS departure will be monitored by precision approach radar.. surface wind 090 to 150 degrees 10 knots..visibility 5000 metres in rain..cloud 1 okta at 500 feet..3 oktas at 1800 feet..temperature 25..QNH 1010 hectopascals..tempo visibility 3000 metres. Acknowledge information DELTA on frequencies 119.1 for arrival..121.6 for departure."

At 0047:52 hr China 301 was informed by the approach controller that..

"...on my radar there is weather between Charlie Hotel and the two seven zero radial up to Lima Tango..if you prefer you can have runway 31 monitored ILS Approach..the surface wind is between zero nine zero to one four zero degrees at one zero knots..it's heavy shower over the airfield the visibility on runway 31 is five thousand metres.. on the IGS is three thousand metres..advise".

This was acknowledged by China 301 with the decision to make a PAR monitored ILS approach to runway 31.

At 0100 hr the ATIS changed to Information ECHO. As this change was not brought to the attention of aircraft on the approach frequency there is no way of knowing whether it was received by China 301. However, in view of the weather experienced by the flight up to that point, and the actual weather reports already passed to the aircraft, it is reasonable to assume that the commander was alert to the meteorological situation and had ordered a watch to be kept on the weather broadcasts. The change in weather between the two broadcasts was, in any case, not particularly significant.

At 0113 hr the ATIS information was updated to FOXTROT. The update was not brought to the attention of approaching aircraft by the approach controller.

At 0112:41 hr the approach controller broadcast the weather passed to him by the COO, which comprised some of the information contained in FOXTROT, namely -

"Wind 120 - 150 / 5 - 10 kt, runway surface wet, visibility 4500 m in rain."

- however the approach controller was not aware that a meteorological warning had been added to FOXTROT "... expect significant windshear and moderate to severe turbulence in the vicinity of cumulonimbus.." and therefore he did not relay this information to the aircraft.

At 0116:01 hr, whilst China 301 was on the PAR frequency and flying the ILS approach, the visibility fell from 4500 m to 3000 m but China 301 was not told of this by the PAR controller.

During the ILS approach the touchdown zone RVR RW 31 fell sharply from above 2000 m to 1000m at the time of the accident - but no RVR's were passed to China 301.

In summary and in sequence, the following surface weather conditions are those known to have been received by China 301:-

0035 - 0043 hr - ATIS Information Delta:

090 - 150 / 10 kt
1/8 at 500ft 3/8 at 1800ft
Visibility 5000 metres in rain; tempo 3000 metres

0047:52 hr - from HK approach control:

090 - 140 / 10kt
Heavy Shower
Visibility 5000 metres on RW31; 3000 metres on the IGS

0112:41 hr - from HK approach control:

120 - 150 / 5 - 10 kt
Runway surface wet
Visibility 4500 metres in rain

0116:46 hr - from the PAR controller together with landing clearance:

Surface wind 090 / 07 kt

ATIS Information

The AMC was responsible for updating the ATIS information whenever one or more of the following occurred:

i) the Met CCTV information changed;

ii) the QNH changed;

iii) a significant change of surface visibility and/or wind velocity;

iv) a change of weather e.g. cloud type and amount, existence of Cb, precipitation ... etc;

v) an outage of navigation and/or approach aids;

vi) a change of departure or arrival runway and/or approach and departure procedures.

The change of ATIS information from DELTA to ECHO at 0100 hr was not prompted by a change of weather conditions but by the change to runway 31 for landing and 13 for departure. The content of ECHO was prepared by the AMC (Tower Controller) at 0058 hr (i.e. before the Met CCTV update at 0100 hr) and was on air at 0100 hr before the Met CCTV was amended. The weather content of ATIS ECHO was therefore based on the weather observation made at 0030 hr and the observed changes in visibility and wind velocity by the Tower Controller.

It was not possible to ascertain the exact time the Met CCTV was updated. However, the transmission made by the Approach Controller at 0102:42 hr to CCA 319, shows that the QNH was 1010 hPa, and that made at 0103:53 hr to CCA 301 shows the QNH was 1011 hPa. It is therefore reasonable to conclude that the CCTV was updated between time 0102:42 and 0103:53hr. The next change of the ATIS information from ECHO to FOXTROT was prompted by this Met CCTV update. ATIS FOXTROT was prepared by the Tower Controller at 0111 hr and was on air at 0113 hr.

The essential differences between ECHO and FOXTROT were the change of QNH from 1010 hPa to 1011 hPa and the addition of the statement concerning the possibility of significant windshear and moderate to severe turbulence in the vicinity of Cb.

At 0110:33 hr, before ATIS information FOXTROT was on air, the Tower Controller passed the following to the Approach Coordinator, who was seated next to the Approach Controller:

> "Latest FOXTROT is opposite runway and the wind is 120 to 150..5 to 10..runway wet and the visibility 4500 metres ... (cross talking)..."

At 0112:41 hr the Approach Controller transmitted on his control frequency:

> "China ... correction all stations..latest weather.. wind 120 to 150 degrees 5 to 10 knots..runway surface wet.. visibility 4500 metres in rain."

This was an abbreviated form of the weather information included in FOXTROT and passed by the AMC at 0110:33 hr to the COO. However the Approach Controller, having broadcast the surface conditions, did not broadcast, or tell China 301, that the latest ATIS Information was FOXTROT. It was therefore not possible to determine whether China 301 received the caution of significant windshear in the vicinity of Cb contained in Information FOXTROT.

The same prediction of windshear was in the 0100 hr Met Report used for the HK VOLMET broadcasts on HF, the timing of the relevant transmissions being h + 15 to h + 20. As China 301 was established on the ILS at 0114:33 hr it is unlikely, being already on the approach and working the approach frequency, that the crew would be monitoring the VOLMET. Post accident both HF sets were found selected OFF and neither were tuned to a HK VOLMET frequency.

Throughout the approach of China 301 approach control at HKIA was being effected by an Air Traffic Control Officer undergoing Approach Control Rating training by an approach control instructor. Both student and instructor stated that the changes of the ATIS broadcast from DELTA to ECHO and from ECHO to FOXTROT were deliberately not passed to the approaching aircraft. One reason given by the instructor (with whom the responsibility rested) was that the weather was changing rapidly and in the circumstances the ATIS information was never up-to-date. However, examination of the reported weather shows no rapid changes evident until 0114 hr. Another reason given was that MATC ATCI Nr.3 para 2.8.6 - (see 1.17.1) - was applicable in the circumstances. But the MATC showed that this ATCI set out the procedure to be adopted by the AMC in composing the contents of the ATIS broadcast when the weather conditions fluctuated rapidly, and did not address the Approach Controller. The third reason given was that almost immediately ECHO was on the air the Met CCTV was up-dated with a later actual and a revised QNH, and that there was no merit in directing pilot's attention to information that had already been superseded. This is a perfectly valid point with repect to the change from DELTA to ECHO. The approach controller would have been well aware that with the up-dating of the Met CCTV the ATIS information would shortly be changed. His not directing China 301's attention to the change from DELTA to ECHO was therefore not significant.

Both the approach control officer under instruction and the instructor were of the opinion that with the passing of the weather obtained from the AMC at 0110:33 hr to China 301 there was no need to direct the pilot's attention to Information FOXTROT. They were not aware of the complete content of FOXTROT, and that it contained information on windshear, as this was not passed to them by the AMC along with the surface conditions. It was not the working practice at the time for the AMC to pass to other control positions supplementary information from the ATIS broadcast which was included in the routine half-hourly Met report, and available to controllers on their Met CCTV. The approach controllers stated that it was not the usual practice, in their opinion, to draw pilot's attention to changes in ATIS if they had already passed the aircraft a later actual weather report, or a later QNH. Air traffic management's opinion was that the requirement of ATCI Nr.3 with respect to the receipt and acknowledgement of the latest ATIS broadcast by arriving aircraft (see 1.17.1) could be met by the Approach Controller ensuring receipt of the latest ATIS on initial contact only.

Visibility and RVR

At 0116 hr when China 301 commenced its final approach the visibility was estimated by the AMC in the control tower (a certified Meteorological Observer) to be approximately 3000 m and although this was passed to, and acknowledged by, the PAR controller it was not passed on by him to the aircraft. The reason for this could not be determined. When he received the visibility over the intercom the PAR controller was engrossed in attempting to gain radar contact with the aircraft. However the workload was not unduly high and this alone seems an unlikely reason for an experienced controller failing to pass important information on to the aircraft. It may be that the phrasing of the message by the AMC, with the inclusion of a doubt about the RVR readings, could have led a mind preoccupied with the PAR controls into subconsciously disregarding it.

> "Visibility is around three thousand metres - I don't know what's wrong with the RVR".

The visibility element of CAAC's aerodrome operating minima for an ILS approach to RW 31 was 1600 m. Therefore, although the reduction in visibility from 4500 m to 3000 m was not made known to China 301 it is unlikely, being well above the company minimum, that had it been passed to the aircraft it would have caused the pilot to discontinue the approach. Although a knowledge of the fall in the visibility would have given the pilot a better idea of the visual picture to expect when he broke cloud, the fact that he was not told of it is not considered to have had any bearing upon the outcome of the approach. When weather conditions are such that no approach ban is imposed by company or national requirements, and none existed in this case, the pilot is responsible for evaluating the adequacy of his visual reference at Decision Height regardless of the visibility passed by ATC. And based on this appraisal it is for the pilot to then choose the most appropriate course of action.

Approximately 10 to 15 minutes before the accident occurred the AMC on duty in the tower noticed that the north RVR reading on the digital display was showing "-0000" with sensible (but unrecollected) readings displayed for the centre and south sites. In such circumstances controllers are instructed (see 1.17.1) to consider the system unserviceable and to report the fault to the AMO - and at 0112 hr this was done; and there the matter rested. There is no requirement in the ATCI to inform approaching aircraft that RVR's are temporarily unavailable, and China 301 was not informed. Soon after reporting the fault the centre and south readings also fell to "-0000" and stayed there for a short while. The centre and south readings then began to display again but the north reading stayed at "-0000". Still uncertain of the integrity of the centre and south displays the AMC did not pass the readings to the PAR controller but did say to him "... I don't know what's wrong with the RVR". The decision by the AMC to disregard the RVR readings, in the circumstances, is considered to have been correct. It was subsequently determined that the values displayed for the south and centre sites were, in fact, valid.

The computer print-out of the south site (RW 31 touchdown zone) RVR showed that it fell briefly below 1500 m from 0043:16 to 0044:28 hr, and that the next RVR reading below 1500 m recorded for the south site occurred at 0117:57 hr. Two minutes later (at 0119:55 hr) it was back up to 1500 m, having bottomed out at 1000 m at 0118:36 hr. As previously explained (1.7.1) these recorded readings were not necessarily the same as those that would be shown at the same time on the displays in ATC, and in any case, no RVR was passed to the approaching aircraft. But they do serve to show the order of the values at the time of the accident and the rapidity with which they were changing.

Had the RVR display been considered serviceable and the values passed to China 301, the commander would have been required with the aircraft at or above decision height, by Hong Kong legislation (but not his company regulations), to have carried out a missed approach when the touchdown zone (south) RVR fell below his company minima of 1500 m. At or below decision height, provided there was adequate visual reference, the approach could be continued. The crash occurred shortly after 0119 hr and the UFDR trace shows the aircraft approaching decision height (405 ft) approximately 25 seconds earlier. Given that the earliest the display in ATC could have registered an RVR of less than 1500 m was 0117:57 hr, and with the system 15 second display up-date interval it could have been as late as 0118:12 hr, it is unlikely that in any event the RVR would, or could, have been passed to the aircraft in time to affect the commander's decision to continue the approach.

Advice and information provided to arriving aircraft

Whilst the commander of China 301 had acknowledged receipt of ATIS Information DELTA and was therefore aware of the trend forecast "...tempo visibility 3000 m..." he was not advised when, during the approach, the visibility actually fell from 4500 m to 3000 m. However, the visibility element of the CAAC Trident AOM for HKIA was 1600 m and therefore, even if the fall in visibility had been passed to the commander, it is unlikely to have caused him to discontinue the approach.

No RVR was available during the period that China 301 was approaching HKIA but this information was not passed to the aircraft. It is thought unlikely, even if it had been passed, that it would have caused the commander to discontinue the approach. And if the RVR had been available, given the timing of the deterioration of the value to below 1500 m, the possibility of it being passed to the accident aircraft in time to influence events was extremely remote.

A warning to expect significant windshear in the vicinity of Cb "in approach" was included in the half-hourly Met Report that went on display at 0103 hr on the Met CCTV in ATC at the tower, approach control and PAR positions. This information was also included, without the qualifier "in approach", in ATIS Information FOXTROT. As the windshear advisory was general in nature, and the ATIS broadcast specified the runway in use for landing, the AMC believed the inclusion of the words "in approach" would only serve to confuse, and therefore left them out. In the event, the change to FOXTROT was not brought to the attention of the pilot of China 301, nor was the information on windshear otherwise passed to him.

From the foregoing it is concluded that sufficient advice and information was available to the commander of China 301 to enable him to assess the general weather conditions affecting HKIA.

However, with China 301 not being advised of the deterioration in the visibility whilst on the approach, and that RVR was temporarily unavailable, and that the ATIS Information had changed from ECHO to FOXTROT, or of the possibility of significant windshear in the vicinity of Cb in [the] approach, there must arise some doubt as to whether the level of information and advice provided by ATC in this instance fully met the objectives of ICAO Annex 11 and Doc.4444. Whilst this may or may not be the case, none of these items of information, either singly or taken in conjunction, are considered to have been of such weight that knowledge of them would have caused the commander to abandon the approach. And whilst knowledge of them would have aided the commander in the planning of the approach, it is not considered that lack of knowledge of them contributed to cause the accident.

2.4.2 Windshear

Examination of the meteorological records showed the absence of any strong horizontal winds at low levels. There were however variations, even reversals, in the wind directions. From the data available, the Meteorological Office, Bracknell, UK, aftercasted the following wind profile along the approach path -

Time UTC (HHMMSS)	Altitude ft	Velocity true/knots	Components(kt) From the Head (310)	From the Right (040)
011700	2000	200/07	-2	-7
011730	1500	190/05	-2.5	-4
011800	1000	170/02	-1.5	-1
011830	500	240/02	0	-2
011845	300	030/04	+1	+4
011850	200	060/08	-3	+7.5
011855	100	080/09	-6	+7
011900	50	100/10	-9	+5

The timings are approximate, and the change in direction from SSE to NE to E may have been more abrupt than shown, but nevertheless it was deduced that during the period 0117 - 0119 hr the light southerly wind became variable and then changed to easterly at 10 kt. The effect of this would have been to noticeably increase the tailwind, and crosswind from the right, in the last 200 ft of the approach. (The preceding aircraft reported experiencing a left quartering tailwind of 10 kt at 2000 ft, shifting to 5 kt on the tail at 500 ft, some heavy rain and turbulence but no windshear.)

The backing of the wind after the accident was quite pronounced, but the wind variations beforehand, even in the heavy rain, were not exceptional. Other records (not included in this report) show a southerly wind of about 5 kt at 0110 hr, and a north-easterly wind of 4 kt just after the accident. These could indicate the directions of rain cells but with such low speeds this cannot be certain.

From the meteorological data it is reasonable to assume that some windshear was present at the time of the accident, and that there was a tailwind of the order of 9 kt in the lowest 200 ft. But the horizontal winds were generally light, and would not by themselves have been a major threat to the safe approach of a large aircraft. Strong vertical winds, as might occur in a microburst, also seem unlikely, because they would have been associated with strong horizontal gusts in places, and these were not observed. However, there was probably some downward motion of air in the heavier rain, but no more than a few knots and not of sufficient magnitude to cause the accident.

The low level windshear warning system at HKIA was serviceable throughout the accident period and did not record any significant windshear until three minutes after the accident. The system utilizes only longitudinal wind components in its computations and it therefore cannot detect the vertical air currents that occur in a microburst. With the relatively wide spacing of the anemometers, the investigation considered the possibility of the horizontal gusts associated with a microburst going unrecorded as a microburst slipped through the system. Much time and effort was spent during the investigation in attempting to determine whether this could have been the case but the results were inconclusive, and although the possibility of such an event could not be completely ruled out, the likelihood was judged to be low.

The approach profile (at Appendix 7) from 500 ft down has the look of a windshear encounter - with the aircraft first going above the glideslope followed by decreasing airspeed, a reduction in pitch attitude and the aircraft subsequently dropping below the target glideslope. The recovery from this excursion was from a position where the aircraft was high on the profile at a relatively high speed. The flight simulation (Appendix 9) shows that power was probably high too. Taking this as the starting point, the remainder of the flight simulation profile looks reasonable, with the speed decaying at a realistic rate for the flight path angle and assuming the computed power settings with land flap. The initial excursion therefore may well have been due to application of power out of phase with the profile requirements and not windshear. It should be noted from the UFDR derived profile that glidepath tracking does not appear to have been particularly steady throughout the approach. If the deviation below the normal approach path during the latter stages of the approach was caused by significant windshear it would be reasonable to expect the pilot(s) to have made a large application of power. None of the survivors, passengers or crew, recalled this occurring. In view of this, and of the absence of any positive meteorological evidence of significant shear, the shape of the reconstructed approach profile is not considered, on its own, to be sufficient grounds to conclude that significant windshear was encountered on the final approach.

Neither of the pilots of China 301 had received practical training in windshear recovery techniques, and had not flown windshear recovery profiles in a flight simulator. They had, nevertheless, received a considerable amount of classroom instruction in the subject. Therefore the possibility that windshear was encountered, but was not recognized and reacted to by the pilot(s), was considered. However, in view of the flight crew's level of experience, and the meteorological conditions of the flight, it seems reasonable to assume that they would have been highly alert to the possibility of a windshear encounter and the probability of an encounter going unrecognised was therefore low.

The investigation concludes that there is no firm evidence to show that significant windshear was encountered during the final approach, but believes that a degree of shear did exist, and that it may have contributed to destabilising the approach.

2.4.3 Effects of heavy rain

In-flight visibility

There are mathematical formulae by which it is possible to determine visibility from rainfall rate. The mathematical relationship is not precise and the results obtained depend upon the particular formula used. Using these formulae, the lowest visibility obtained from the highest instantaneous rainfall rate recorded at HKIA around the time of the accident, was approximately 400 m. As a meteorological optical range of 517 m (RVR 1000 m) was measured at the south site at the time of the accident, it is reasonable to assume that the visibility in rain on the approach was in the order of 400-500m.

No defects were found in the windshield wiper system of the crashed aircraft, the wiper blades were in a serviceable condition and both pilot's wiper speed selectors were found positioned at maximum. The aircraft was also fitted with a rain repellant system designed to be used in conjunction with the wipers to improve visibility in heavy rain. Examination of the system revealed sufficient evidence to suggest that, should it have been triggered, it was unlikely that much, if any, fluid would have reached the windshields due to the presence of paint in most of the spray nozzles.

The expert opinion of a number of experienced pilots is, that under conditions of extremely heavy rain, windshield wipers are of relatively limited use in providing an area of clear vision. Furthermore, it is known that rain on an aircraft's windshield may act as a crude prism, and that the effect is proportional to the rate of the rainfall. This refraction effect may cause objects to appear further away than they really are and hence lead to the overestimation of height by the pilot. It is therefore possible that, while attempting to rationalize a limited visual picture through a rain covered screen, the pilots of the accident aircraft thought the aircraft higher than it was, and may not have appreciated the high descent rate and steep approach angle in time to take corrective action.

Engine performance

There is no doubt that the final stage of the approach was made in heavy rain (all engine relight switches were ON) and a possibility considered was that a go-around was attempted, but that rain ingestion adversely affected engine performance. Rolls Royce conducted water ingestion trials some years ago on a similar Mark of Spey engine and were able to demonstrate surge free slam accelerations, from flight idle to full power, in levels of simulated rainfall with a water to air ingestion of 6% by weight. Therefore, unless the rain content of the atmosphere at the time of the accident approached the 6% value achieved in the tests, the possibility that a power loss occurred during an attempted go-around is unlikely. Using mathematical formulae that relate visibility to rainfall intensity, and one that relates rainfall intensity and liquid water content, the liquid water content by weight for visibilities in the order of 400-500 m is less than one half of one percent. Even allowing massive margins for possibly imprecise mathematical relationships, this figure is so far below the maximum at which surge free slam accelerations were demonstrated, that the possibility of a power loss due to water ingestion is considered to have been extremely remote.

Aerodynamic performance

The work that has been done to date on the effect of heavy rain on aircraft aerodynamic performance is inconclusive. However it is reasonable to assume that some performance decrement could occur due to the basic aerodynamic effect of the roughening of the airfoil and momentum losses arising from raindrop impact. In this accident the sequence that led up to the final impact started with the aircraft climbing above the glideslope with increasing airspeed, an event which indicates a performance increment rather than a decrement and is unlikely therefore to be attributable to the adverse aerodynamic effect of heavy rain. Also research suggests that the worst effects of heavy rain may be expected close to the stall, and taking into account the relatively high speed of the aircraft the effects of the rain on the aircraft's performance are likely to have been small.

2.5 Final stages of the approach

Appendix 7A is a reconstruction of the final approach path using UFDR data and an estimated wind derived from recorded meteorological data.

The reconstructions show two significant excursions above the glideslope in the final stages of the approach, and it is clear that the approach started to become unstable with the first of these. Possible reasons for the excursions were therefore considered. A postulation was that one, or other, of the excursions may have been associated with the lowering of land flap. However CAAC procedures call for land flap to be taken earlier in the approach (at 1000 ft) and there is no reason to believe that the handling pilot on this flight adopted nonstandard procedures, and it seems unlikely that he would have done so in adverse approach conditions and in the presence of a training Captain.

The first excursion took place at approximately 850 ft. At this point the aircraft should have been passing through the Lei Yue Mun Gap. Pilots familiar with HKIA report that with an easterly wind it is not uncommon to experience a brief period of turbulence at this stage on the approach, and therefore it is possible the excursion shown on the UFDR trace at this point was due to this. And, as previously mentioned, another possibility is that land flap was lowered at this point and the aircraft allowed to "balloon". From Appendix 9 it can be seem that the thrust levels required by the computer (un-bracketed values) to follow the UFDR derived profile both before and after this event were similar. If it is accepted that there was no significant windshear, this excursion may have been brought about by an application of power out of phase with the profile requirements.

At 600 feet the aircraft was briefly back on the glideslope with the speed having risen to approximately 165 kt. Almost immediately the speed rose further to the full flap limit speed of 170 kt, and then slightly exceeded this value until just above 500 ft when the aircraft started to go above the glideslope again. This second excursion was significant, possibly equivalent to two dots. With the decreased rate of descent, and with the aircraft now well above the glideslope, the speed began to bleed off. The approach path then steepened, and a steep decent ensued until at 300 ft the aircraft went through the glideslope, with no apparent attempt being made to maintain it, and continued on down until it hit the approach light.

This second excursion is difficult to explain. Just before it occurred the speed was fluctuating around 170 kt and one possibility is that the pilot raised the nose in order to avoid exceeding the land flap limiting speed (170 kt) and in doing so caused the aircraft to go above the glideslope. Another possibility is an encounter with an increasing headwind associated with a windshear, or the application of power. Or possibly it came about as a result of the temporary loss of external visual references. A stabilized approach is an essential aid in the recognition of unacceptable flight path trends and there can be no doubt that it was with this excursion above the glideslope, and the resulting destabilization of the approach, that the accident sequence started.

From passengers recognition of the buildings they saw when the aircraft broke cloud it was possible to establish the main cloud base at 700 - 800 feet. Also observations from the coxswain of a police launch under the approach path confirmed that the aircraft was not in cloud for much of the latter portion of the approach, but that it was raining heavily toward the runway promontory. In these circumstances it seems possible that the transition from instruments to visual flight was made above the DH (405 ft), and that the pilot's concentration on the maintenance of visual reference, in what were certainly very difficult approach conditions, detracted from the instrument scan. For if either pilot had been monitoring their instruments they would have reacted positively to correct the unstable approach and the final transit through the ILS glideslope. They apparently did not do so, and the most likely explanation is that as they neared the runway and entered the heavy rain, they were engrossed in seeking, or maintaining, visual reference in the rapidly deteriorating visibility.

As the aircraft neared the promontory and entered the heavy rain it is likely that the windscreen wipers were unable to cope and forward vision became blurred to the extent that the sea, sky and ground features became almost indistinguishable. The rain repellant system, with most of the holes in the spray heads clogged with paint, would have been of little use. The visibility in rain on the approach was probably down to 400-500 m for short periods and the RVR at the southern site at this time was between 1000 and 1200 m. Given this order of visibilities, and the effect on forward vision of the heavy rain on the screens, it is unlikely that the pilots would have seen the PAPI. For if they had seen the PAPI they would have been aware of their excursion below the glidepath. And although the time available was short they would, or should, have corrected it. Passenger and cabin crew statements gave no indication that the approach was other than normal up to the point where the aircraft struck the approach light, with no mention made of a noticeable increase in engine noise in the late stages.

2.6 Crew Procedures

Both pilots of China 301 held the rank of Captain. The Captain occupying the right control seat was the more experienced, a training Captain and the designated aircraft commander. In accordance with CAAC practice, and confirmed by the surviving crew members who visited the flight deck, the Captain occupying the left control seat was the handling pilot with the commander acting as non-handling pilot. No pilot training or checking was scheduled to take place on the flight. These circumstances, when both pilots are qualified as Captain, can lead to uncertainties and hesitation in the decision making process, and it is possible that a crew so constituted may not interact in the same manner as a crew composed of a Captain and First Officer.

CAAC procedures dictate that when two Captains occupy the control seats that the Captain who is the handling pilot decides at DH whether he has adequate visual reference to continue the approach, however, his decision is subject to the overriding authority of the commander. In this case, as the approach was continued past DH, it must be assumed that both the handling pilot and the commander considered the visual reference, although obviously limited, to have been sufficient to safely complete the approach and landing.

The decision whether to go-around for the pilot still flying on instruments at DH is not a difficult one to make. However, when a pilot has the runway in sight from well before DH he might make his decision to land at some arbitrary point before DH has been reached. The remaining visual approach phase may be quite long -

in this case probably commencing from somewhere around 700 to 800 feet. If the approach conditions now deteriorate the pilot, having already made a decision to land, may find it difficult to reverse that decision but attempt to carry on with the approach despite deterioration of his visual reference. It appears probable that the decision to continue the approach visually was made at some point before the aircraft reached DH and that the commander had concurred with it. It was after passing DH that the heavy rain caused a marked deterioration in the visual references which the crew had previously considered adequate.

It is standard practice in CAAC for the flight path to be monitored by the non-handling pilot. The purpose is to detect deviations from the normal and to bring them to the attention of the handling pilot, and to intervene if the deviation becomes unsafe.

In this accident the approach became progressively unstable from just above 850 ft. At DH (405 ft), after two major excursions above the glideslope, the aircraft was still significantly high in relation to the target approach path. It was not until just below 300 ft that the glideslope was regained, but when it was the aircraft was allowed to continue straight through and then well below it. As no attempt was made to discontinue the approach either before, or at DH, it must be presumed that neither pilot recognized that it was unstable. Or if the commander detected that it was, there was a failure on his part to communicate the fact to the handling pilot, or if it was communicated there was no attempt on the commander's part to take action when an appropriate response was not made by the handling pilot. This lack of any effective response to the progressive degradation of the flight path indicates the possibility of the pilots not having performed in a coordinated manner, and this may have been because of their similar rank. The handling pilot was flying alongside another Captain of higher status and greater experience, and may have been waiting for some intervention from him before taking the decision to discontinue the approach. On the other hand, the commander, out of deference for the other Captain may well have hesitated to intervene.

After the aircraft went through the glideslope at 300 ft very limited recognition and response time was available. Any remedial action would have had to be timely and positive. None appears to have been taken.

2.7 Fuel reserves

The aircraft technical log recorded 22000 (lb) of fuel on board at the start of the flight. From manufacturer's data a flight of 200 nm at 10000 ft would burn off 7450 lb and leave 14550 lb remaining at HK. The fuel quantity consumed indicators on the flowmeters showed a total of 7143 lb was used on the flight. These indicators were of the drum counter type and can be considered accurate. The fuel contents gauges after the accident showed a total of 13000 lb remaining, but as electrical power to these gauges failed during the ground slide when the fuel was sloshing around in the tanks this figure cannot be considered entirely accurate. However the readings are considered sufficiently accurate to confirm that the commander had adequate fuel available to make a missed approach and to divert should this have been necessary. He was therefore under no pressure to complete the approach from this aspect.

2.8 Air Traffic Control

2.8.1 Manual of Air Traffic Control

The RTF transcript at Appendix 5 shows that notification of the changes to the ATIS information were not broadcast on the approach frequency or otherwise passed to approaching aircraft. The MATC instruction to ensure that approaching aircraft received the latest ATIS broadcast was therefore not complied with, however approaching aircraft were passed the latest surface weather conditions. The MATC requires the PAR controller to notify pilots of significant changes in weather conditions, but China 301 was not informed of a drop in visibility from 4500 m to 3000 m.

2.8.2 Precision approach radar (PAR)

The PAR return of China 301 was masked by heavy precipitation and this made radar monitoring of the approach impossible. The masking of returns from relatively small aircraft in this way is a known characteristic of the PAR equipment in use at HKIA, and there is very little, if anything, that the PAR controller can do about it.

Inspection of various operator's AOM on file with the CAD showed that some used lower minima for ILS approaches monitored by PAR than for approaches without PAR monitoring. Thus, a pilot using lower minima on a PAR monitored ILS approach, being told at a late stage of the approach that PAR monitoring was not available might have to hastily rearrange his DH. Or might even already be below the non-PAR monitored DH.

Similarly, some companies rely upon PAR monitoring on departure in poor weather from RW 13 for emergency terrain clearance turns in the event of engine failure on take-off. To suddenly lose radar monitoring on initial climb following an engine-out continued take-off could jeopardize the safety margins of the emergency turn procedure.

In view of the importance placed upon PAR monitoring by some operators in both the approach to RW 31 and departure from RW 13, it would be prudent for the CAD to promulgate the possibility of PAR monitoring being abruptly lost, particularly by relatively small aircraft, when approaching or departing in conditions of heavy precipitation.

2.9 Fire and Rescue

The fire was centered in the middle part of the intake duct of the centre (No.2) engine, an area where there are no fuel or oil pipes. As there was no external fire damage to the engine itself, and no evidence of flame break out, it seems probable that fuel for the fire came forward from the engine after it had flamed out and was slightly tail to wind during the latter part of the ground slide. This is supported by the comments of some of the passengers at the rear of the aircraft who stated that they were aware of the presence of fuel 'raining' upon them during the ground slide. Fuel entering the bleed air take-off ducts from No.2 engine and being discharged into the passenger compartment air supply ducts could produce such an effect. The timely arrival of the airport fire contingent and their prompt action in extinguishing the fire and covering the fuel slick with foam was a major factor in preventing any further loss of life.

The rescue operation, from both land and water, took place concurrently with the fire fighting operation and was mounted in a competent manner. Earlier access to the flight compartment by rescue personnel was not possible due to wreckage blocking the forward door and vestibule.

2.10 Survivability

2.10.1 General

The accident is considered to have been survivable. Deceleration forces were not high, minimal structural distortion was caused to the passenger compartment and there was no major post impact fire. Apart from the one passenger who suffered fatal injuries all the fatalities were flight crew, and all died by drowning.

2.10.2 Flight deck crew

The flight compartment on this aircraft was designed to be, and was, fitted with five crew seats all of which were equipped with lap straps and upper torso restraint. The CAAC requires pilots when seated at the controls for take off and landing to fasten their lap strap but there is no hard and fast requirement to wear the shoulder harness. Other flight crew members are required to have their lap straps fastened for take off and landing but may dispense with the shoulder harness if it hinders their work - which is a normally accepted proviso. However, the shoulder harness on all five crew seats was positioned in a way that precluded its use by the crew and the condition of the lugs confirmed it had been rarely used since being fitted. It is obvious therefore that it was standard procedure in CAAC for the Trident flight crews not to use the shoulder harness and that this practice was condoned by the operator. The safety benefits to flight crews of using upper torso restraint has long been recognized by the aviation community and needs no emphasizing in this report.

The sixth flight crew member, a Radio Operator under training, was seated in the flight compartment on a small metal stool which was not fixed to the flight deck floor and neither was he restrained in any way. For a flight crew member to be accommodated in such a manner throughout an international public transport flight is totally out of keeping with accepted safety standards.

There can be no doubt that during the initial impact, the ground slide, and the final impact that the five conventionally seated flight crew of China 301 were subjected to far more thrashing and flailing than would have been the case had they been wearing shoulder harness. And during the impact sequence the sixth crew member would almost certainly have been thrown about the flight compartment - together with the metal stool and the many other loose items found on the flight deck. Such circumstances could only have added to the confusion and disorientation of the crew; and would not have been conducive to a speedy evacuation if the aircraft had come to rest on land with the flight deck in a normal attitude. With the flight deck completely submerged in extremely dirty water and with the floor nearly vertical the chance of a successful evacuation was even further reduced. The crew were also faced with a door that was not only very heavy but opened into the flight deck against their direction of egress.

When the divers entered the flight deck they found all the flight crew with their seat belts unfastened, suggesting that at least five of them were conscious and had attempted to escape. Neither DV side window had been opened by the trapped crew although both were later successfully operated during examination of the wreckage.

2.10.3 Cabin attendants

The disposition of the cabin attendants in the passenger compartment was far from ideal. One sat in passenger seat row 2 and the other two sat at the midship door. This left the rear cabin which contained 12 seat rows (70 seats) and the 4 overwing emergency escape hatches virtually unattended. There was a cabin attendant seat at the rear of the cabin but this was not utilized.

With the cabin attendant sitting in seat row 2 cut off from the rest of the cabin, and with another seated at the midship passenger door knocked unconscious, only one cabin attendant was available to assist in the evacuation.

2.10.4 Passengers

Passenger safety leaflets were not provided. Passengers reported that there was no practical demonstration of the method of fastening and releasing seat belts nor were the positions and method of use of the emergency exits pointed out to them. An announcement was made requesting passengers to fasten their seat belts but no check was carried out by the cabin attendants prior to landing to see whether they had done so. In the circumstances it was indeed fortuitous that two of the overwing escape hatches came partly open during the ground slide, as the statement of the passenger who opened the right overwing escape hatch illustrates -

"Passengers were blocking the aisle and I heard people crying for help and screaming. The cabin was very dark and I climbed over the seats towards the front end of the aircraft because I saw a slit of light (later found out to be about 3 inches wide) at the front. When I reached there I pushed hard against the "wall" hoping to create a hole for escape. I did not know whether it was the emergency door. There was no movement, then I kicked hard (once) and that portion of the "wall" suddenly sprang open and I realized it was the emergency exit. I jumped out and discovered I was standing on the right wing."

The majority of the passengers escaped through this exit.

The approach and departure paths at HKIA are clearly so disposed over water that in the event of a mishap there is a likelihood of a ditching, but nevertheless no passenger lifejackets were carried on the accident aircraft. However placards on the seat backs in the aircraft still referred to lifejackets being available under the seats.

With a cruising altitude of 10000 ft there was no requirement to demonstrate the passenger oxygen equipment and no demonstration was given.

All but one of the seat belts on the crashed aircraft were of the type which comprise a strap fitted with a buckle through which the second strap is threaded - closure of a flap on the buckle then clamps the two straps together. This type of seat belt closure is no longer in common use and in the absence of any passenger safety leaflets, or practical demonstration of seat belt fastening and release by the cabin attendants, a person expecting the more usual metal-to-metal latch might mistakenly conclude that the metal fastening was missing from one of the straps. And particularly so if they happened to be sitting next to the one seat in the aircraft which was fitted with a seat belt with a metal-to-metal closure. Additionally, on this aircraft some seat belts were fitted with the buckle on the right strap and some with the buckle on the left strap. At one seat the belt to which the buckle was attached was installed in a way that required the belt to be twisted to bring the flap on the buckle uppermost. Such inconsistent installation only serves to confuse passengers and is therefore wholly undesirable. Seat belts, particularly those of the thread-through friction buckle type, are conventionally fitted with the buckle on the left strap so that the threading process is in the natural sense and the means of release operates from left to right.

None of the seat belts had failed, but because of corrosion following water immersion it was not possible to check whether all the buckles were capable of friction locking their respective threaded strap. However, as no passengers interviewed complained of seat belts coming loose during the impact sequence there was no evidence to suggest that the seat belt fastenings were other than serviceable.

3. CONCLUSIONS

3.1 Findings

(i) The aircraft commander was properly licensed and qualified to command the flight.

(ii) The captain and flight crew were properly licensed and qualified to carry out their duties.

(iii) Post mortem examination of both pilots revealed no preexisting disease or other medical condition that could have contributed to the accident.

(iv) The aircraft was being flown by the pilot in the left control seat.

(v) The cabin attendants were properly qualified and medically fit to carry out their duties.

(vi) The aircraft was correctly loaded and there were sufficient fuel reserves on board.

(vii) The aircraft was properly maintained.

(viii) With the exception of the partially clogged spray heads of the rain repellant system, there was no evidence of any defects or malfunctions in the aircraft, its engines or equipment that could have caused or contributed to the accident.

(ix) From the meteorological information available to him the commander should have been able to assess the general weather conditions affecting HKIA.

(x) The approach was not monitored by precision approach radar because the PAR controller was unable to gain radar contact with the aircraft due to heavy precipitation masking the return.

(xi) China 301 was not advised of the change of ATIS Information from ECHO to FOXTROT, nor of the warning to expect significant windshear in the vicinity of Cb. Had this information been passed to the aircraft it is unlikely to have influenced the course of events.

(xii) The aircraft was not informed by the PAR controller of significant change in the meteorological visibility during the approach. Whilst this ommission deprived the commander of the knowledge that the visibility was falling, it is unlikely to have influenced his continuance of the approach.

(xiii) RVR readings were not available to the aircraft whilst on the approach due to the equipment displays in ATC being considered unserviceable. Approaching aircraft were not advised that RVR was temporarily unavailable.

(xiv) The final approach became progressively unstable from 850 ft.

(xv) The possibility that windshear contributed to destablise the approach cannot be ruled out.

(xvi) During the final part of the approach the aircraft descended below the normal approach path with no apparent remedial action being taken.

(xvii) The aircraft suddenly encountered visibilities in the order of 400-500 m in heavy rain in the late stages of the final approach.

(xviii) The heavy rain on the forward windshields adversely affected the pilot's ability to maintain visual reference, and may have caused them difficulty in estimating the height of the aircraft above the runway, or the distance to it, or both.

(xix) The accident was survivable.

(xx) The flight deck crew were not wearing shoulder harness.

(xxi) A sixth crew member in the flight compartment sat on a small metal stool that was not secured in any way.

(xxii) There were no passenger safety leaflets on the aircraft, and no attempt was made to ensure that the passengers were familiar with the use of the seat belts and the location and use of the emergency exits.

(xxiii) The approach and departure paths at HKIA are substantially over water but no passenger lifejackets were carried on the aircraft.

(xxiv) The cabin attendants did not ensure that the passengers had fastened their seat belts for landing.

(xxv) One cabin attendant did not fasten her seat belt for landing.

3.2 Cause

There was insufficient evidence to determine the cause of the accident.

It appears probable that, having converted to visual references at some point prior to Decision Height, the commander elected to continue the approach despite the fact that heavy rain had caused a sudden marked deterioration in the visual references in the final stages.

There was no conclusive evidence that the aircraft encountered significant windshear on the approach, but given the meteorological conditions that existed at the time it cannot be ruled out, and therefore windshear may have been a contributory factor in destabilising the approach.

4. SAFETY RECOMMENDATIONS

(i) Friction fastening passenger seat belts should be replaced by a type with a metal-to-metal latching device.

(ii) Passenger seat belts should be fitted so that the means of closure operates in the natural sense and the release operates from left to right.

(iii) Passenger safety briefing leaflets should be provided.

(iv) Cabin attendant take-off and landing positions on Trident aircraft operated by CAAC should be reviewed.

(v) Flight deck crew should be required to wear shoulder harness for take-off and landing.

(vi) When the number of flight deck crew members carried exceeds the number of flight deck crew seats available the additional flight crew member should use a spare cabin attendant seat or a passenger seat, for take-off and landing and in turbulence.

(vii) The flight deck stool should be securely stowed outside the flight compartment for take-off, landing, in turbulence and when not in use.

(viii) Radar recording facilities should be available at terminal control areas handling significant volumes of international traffic.

(ix) A state-of-the-art low level windshear alert and warning system should be installed at HKIA.

(x) Air traffic management at HKIA should review the practices, procedures and instructions relating to the provision by air traffic services of advice and information to arriving aircraft.

(xi) The limitations of use of the PAR at HKIA in conditions of heavy precipitation should be notified in the AIP.

(xii) All aircraft engaged on international commercial air transport should be fitted with a cockpit voice recorder.

(xiii) All aircraft engaged on international commercial air transport should be fitted with a flight data recorder capable of recording the parameters required to determine the flight path, attitude, engine power and the configuration of lift and drag devices.

(xiv) Operators of flights to and from HKIA should provide lifejackets on the aircraft for the passengers and crew.

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.

Peter J BIRKETT
Deputy Chief Inspector of Accidents
Accidents Investigation Division
Civil Aviation Department
Hong Kong

June 1990

POSTSCRIPT

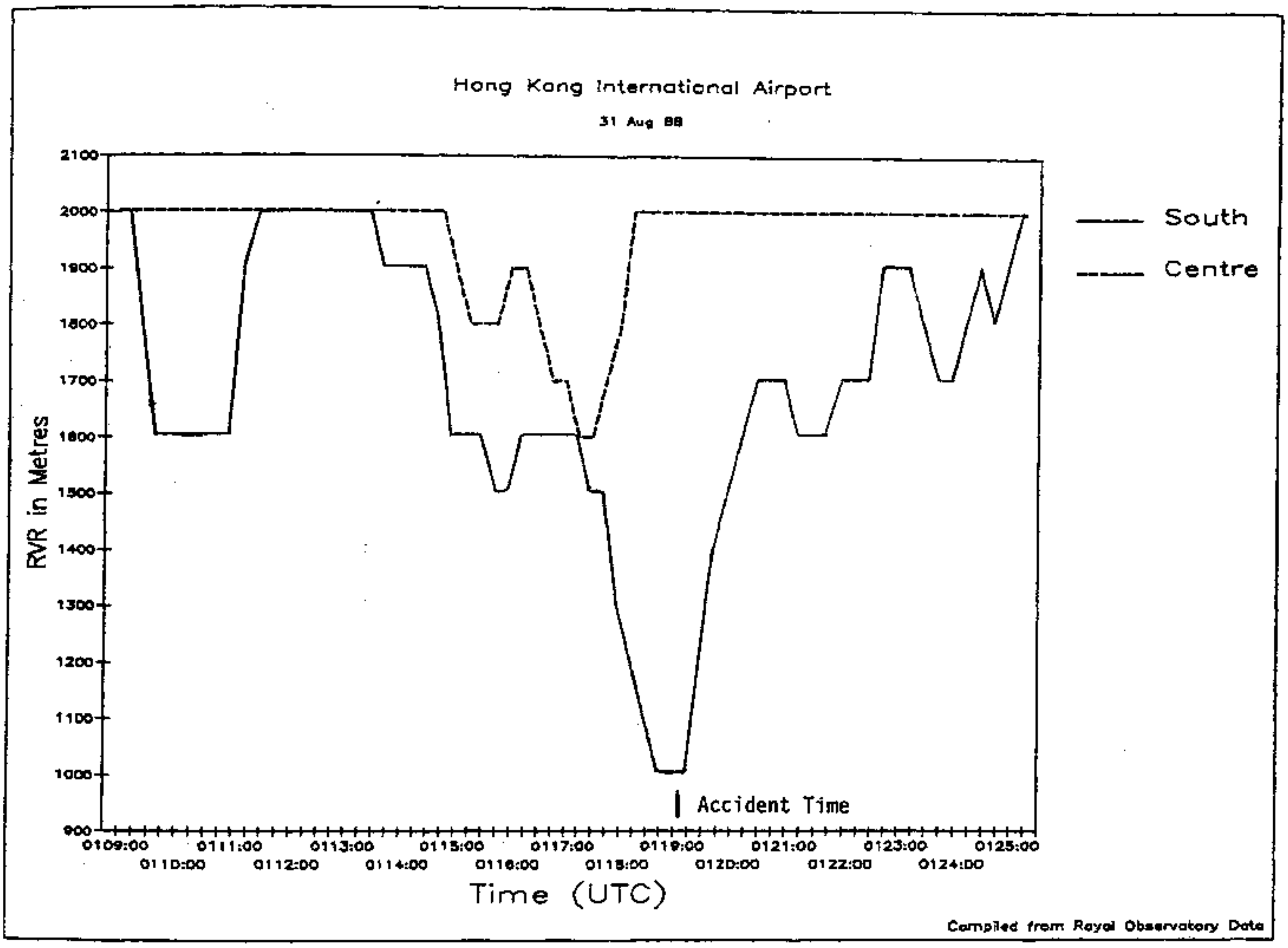
Since completion of this report information has been received from the Civil Aviation Administration of China that Safety Recommendations (i), (iii), (iv), (v), (vi) and (vii) have been implemented.

The Civil Aviation Department, Hong Kong, have stated that action has been taken with respect to Safety Recommendations (viii), (ix), (x) and (xi) and that Hong Kong commercial air transport operators already comply with Recommendations (xii), (xiii) and (xiv).

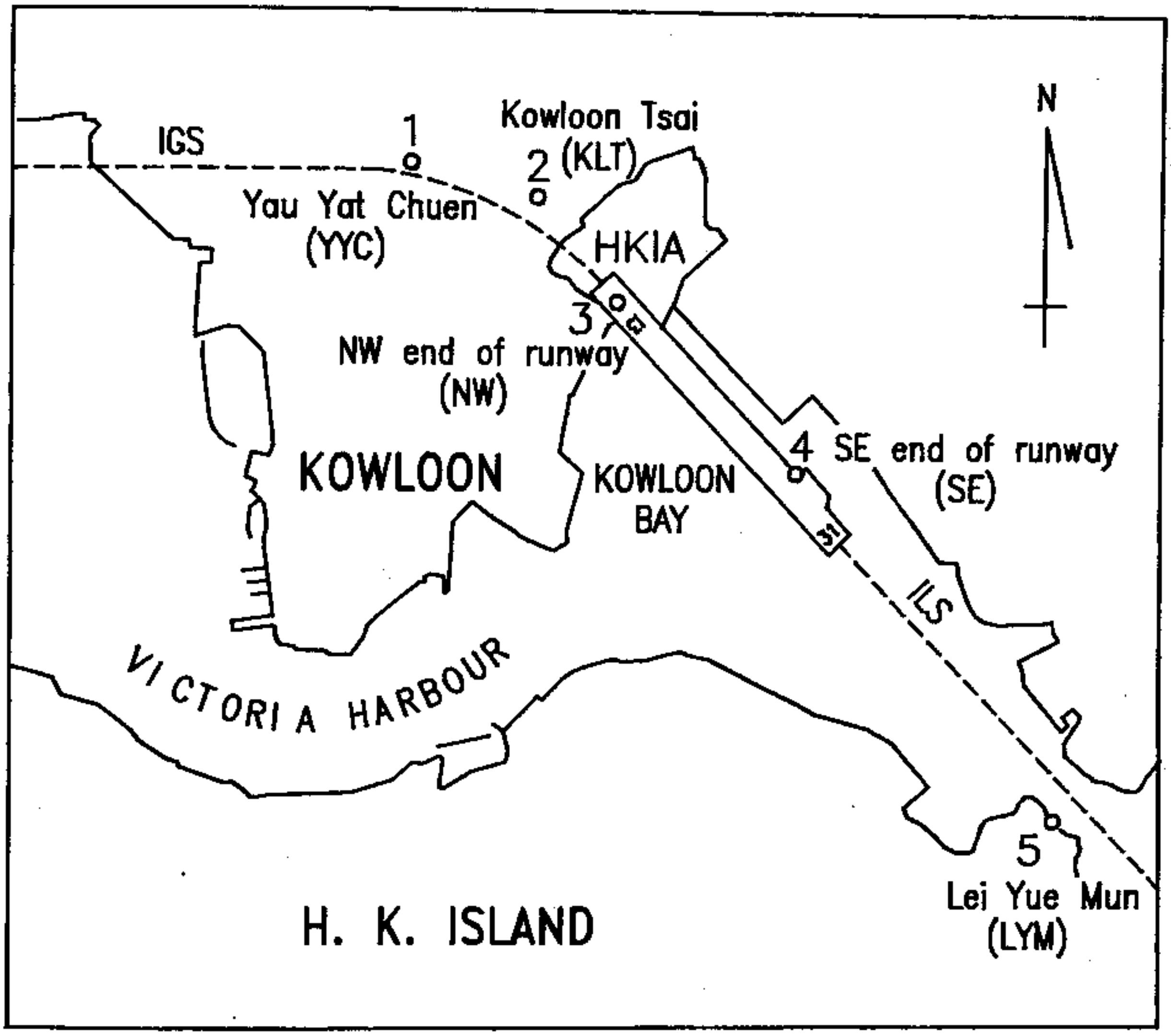
Runway Visual Range (readings)

Time	South	Centre	North
0100:00	>2000 m	>2000 m	>2000 m
0109:16	1800 m	>2000 m	>2000 m
0109:32	1600 m	>2000 m	>2000 m
0111:08	1900 m	>2000 m	>2000 m
0111:24	>2000 m	>2000 m	>2000 m
0113:00	>2000 m	>2000 m	1900 m
0113:18	>2000 m	>2000 m	>2000 m
0113:36	1900 m	>2000 m	>2000 m
0114:41	1800 m	>2000 m	>2000 m
0114:54	1600 m	>2000 m	>2000 m
0114:58	1600 m	1900 m	>2000 m
0115:11	1600 m	1800 m	>2000 m
0115:33	1500 m	1800 m	>2000 m
0115:50	1500 m	1900 m	>2000 m
0116:12	1600 m	1900 m	>2000 m
0116:16	1600 m	1800 m	>2000 m
0116:42	1600 m	1700 m	>2000 m
0117:08	1600 m	1600 m	>2000 m
0117:30	1500 m	1600 m	>2000 m
0117:34	1500 m	1700 m	>2000 m
0117:48	1500 m	1800 m	>2000 m
0117:57	1300 m	1800 m	>2000 m
0118:01	1300 m	>2000 m	>2000 m
0118:10	1200 m	>2000 m	>2000 m
0118:23	1100 m	>2000 m	>2000 m
0118:36	1000 m	>2000 m	>2000 m
0119:16	1200 m	>2000 m	>2000 m
0119:42	1400 m	>2000 m	>2000 m
0119:55	1500 m	>2000 m	>2000 m
0120:08	1600 m	>2000 m	>2000 m
0120:21	1700 m	>2000 m	>2000 m
0121:13	1600 m	>2000 m	>2000 m
0121:52	1700 m	>2000 m	>2000 m
0122:31	1800 m	>2000 m	>2000 m
0122:44	1900 m	>2000 m	>2000 m
0123:23	1800 m	>2000 m	>2000 m
0123:36	1700 m	>2000 m	>2000 m
0124:02	1800 m	>2000 m	>2000 m
0124:28	1900 m	>2000 m	>2000 m
0124:41	1800 m	>2000 m	>2000 m
0124:54	1900 m	>2000 m	>2000 m
0125:07	>2000 m	>2000 m	>2000 m

Runway Visual Range (plot)



Hong Kong Low-level Windshear Detection System
Location of Anemometers



Windshear Detection System (anemometer readings)

```
31-AUG-1988 WEDNESDAY 01:14:00
SE     A100/ 06 B100/ 07 C130/ 07 D080-160 E 00- 00 FR 04 L 04 GT 12 H 12
LYM    A080/ 09 B100/ 06 C070/ 01
NW     A100/ 01 B140/ 01 C110/ 02 D040-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A050/ 05 B060/ 05 C090/ 04
KLT    A100/ 02 B140/ 02 C120/ 02
SHEAR   31A/13D NO SHEAR     +00  13A/31D SINKING      -02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:14:30
SE     A100/ 05 B100/ 06 C130/ 07 D080-160 E 00- 00 FR 04 L 04 GT 12 H 12
LYM    A080/ 10 B090/ 08 C070/ 01
NW     A100/ 01 B120/ 01 C110/ 02 D040-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A040/ 04 B050/ 05 C090/ 04
KLT    A090/ 02 B120/ 02 C120/ 02
SHEAR   31A/13D LIFTING      +01  13A/31D SINKING      -02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:15:00
SE     A090/ 06 B090/ 06 C130/ 07 D080-160 E 00- 00 FR 04 L 04 GT 12 H 12
LYM    A080/ 11 B090/ 09 C070/ 01
NW     A110/ 01 B110/ 01 C110/ 02 D040-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A020/ 02 B040/ 04 C090/ 04
KLT    A100/ 08 B100/ 03 C120/ 02
SHEAR   31A/13D LIFTING      +01  13A/31D SINKING      -01   QNH XXXX

31-AUG-1988 WEDNESDAY 01:15:30
SE     A090/ 06 B090/ 06 C130/ 07 D080-160 E 00- 00 FR 04 L 04 GT 12 H 12
LYM    A070/ 11 B080/ 09 C070/ 01
NW     A110/ 01 B CALM   C110/ 02 D040-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A340/ 01 B030/ 03 C090/ 04
KLT    A100/ 08 B100/ 04 C120/ 02
SHEAR   31A/13D LIFTING      +01  13A/31D NO SHEAR     +00   QNH XXXX

31-AUG-1988 WEDNESDAY 01:16:00
SE     A090/ 06 B090/ 06 C120/ 08 D070-160 E 00- 00 FR 05 L 05 GT 12 H 12
LYM    A070/ 10 B080/ 10 C080/ 03
NW     A110/ 01 B CALM   C120/ 02 D060-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A300/ 04 B360/ 02 C080/ 04
KLT    A090/ 08 B090/ 05 C130/ 03
SHEAR   31A/13D LIFTING      +01  13A/31D LIFTING      +01   QNH XXXX

31-AUG-1988 WEDNESDAY 01:16:30
SE     A080/ 07 B090/ 06 C120/ 08 D070-160 E 00- 00 FR 05 L 05 GT 12 H 12
LYM    A070/ 09 B080/ 10 C080/ 03
NW     A130/ 01 B110/ 01 C120/ 02 D060-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A290/ 04 B330/ 02 C080/ 04
KLT    A100/ 06 B090/ 07 C130/ 03
SHEAR   31A/13D NO SHEAR     +00  13A/31D LIFTING      +02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:17:00
SE     A080/ 07 B090/ 06 C120/ 08 D070-160 E 00- 00 FR 05 L 05 GT 12 H 12
LYM    A070/ 09 B070/ 10 C080/ 03
NW     A130/ 01 B120/ 01 C120/ 02 D060-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A280/ 04 B300/ 02 C080/ 04
KLT    A070/ 06 B090/ 07 C130/ 03
SHEAR   31A/13D NO SHEAR     +00  13A/31D LIFTING      +02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:17:30
SE     A090/ 07 B090/ 07 C120/ 08 D070-160 E 00- 00 FR 05 L 05 GT 12 H 12
LYM    A060/ 11 B070/ 09 C080/ 03
NW     A140/ 01 B120/ 01 C120/ 02 D060-190 E 00- 00 FR 05 L 05 GT 06 H 06
YYC    A310/ 04 B290/ 03 C080/ 04
KLT    A100/ 04 B090/ 06 C130/ 03
SHEAR   31A/13D SINKING      -01  13A/31D LIFTING      +02   QNH XXXX
```

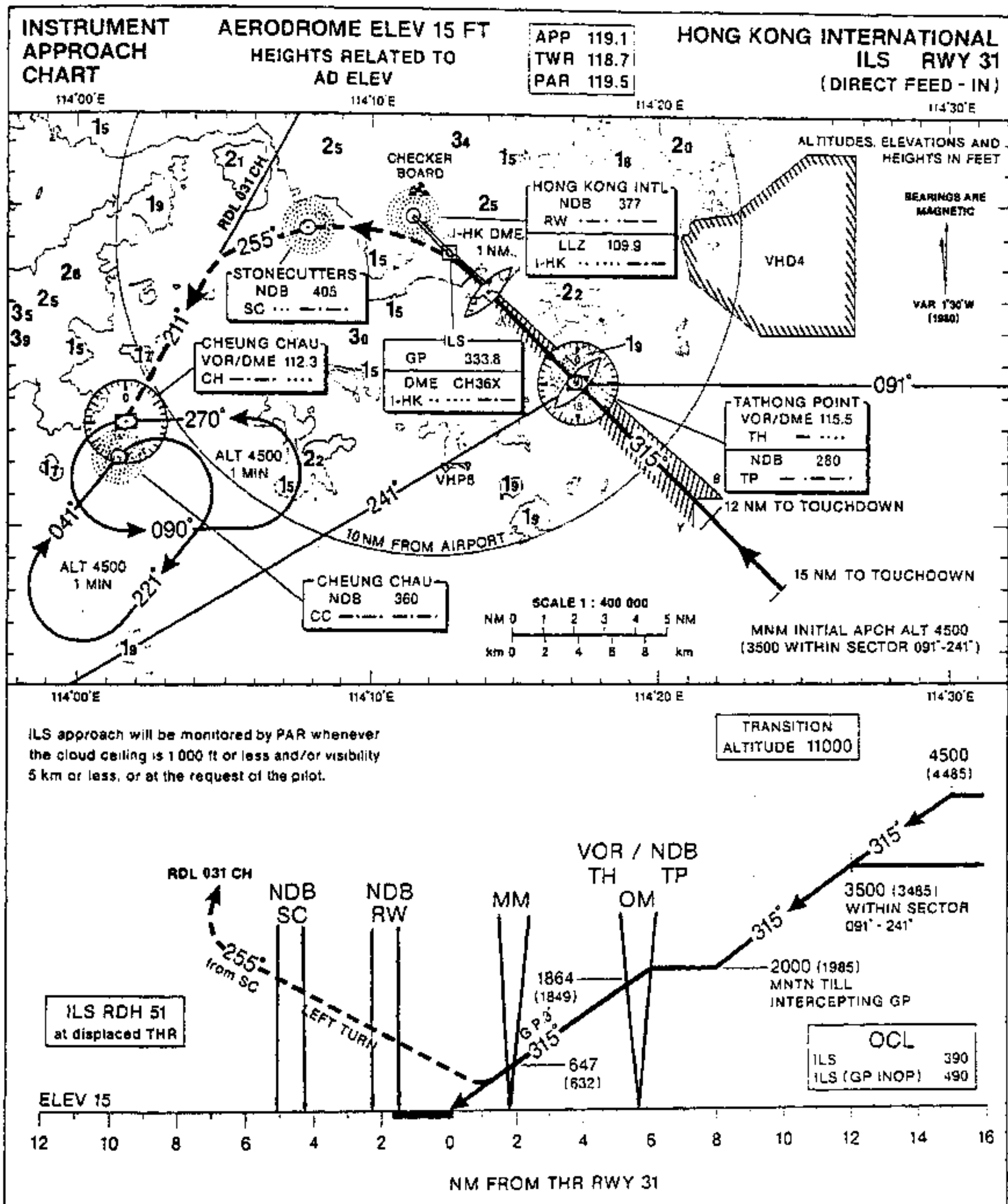
/continued

```
31-AUG-1988 WEDNESDAY 01:18:00
SE     A080/ 08 B090/ 07 C110/ 08 D070-160 E 00- 00 FR 06 L 06 GT 12 H 12
LYM    A040/ 08 B070/ 09 C090/ 05
NW     A140/ 07 B130/ 01 C130/ 01 D090-190 E 00- 00 FR 05 L 05 GT 08 H 08
YYC    A310/ 03 B290/ 04 C050/ 04
KLT    A060/ 02 B080/ 05 C130/ 03
SHEAR    31A/13D SINKING  .  -01  13A/31D LIFTING     +05   QNH XXXX

31-AUG-1988 WEDNESDAY 01:18:30
SE     A090/ 08 B090/ 07 C110/ 08 D070-160 E 00- 00 FR 06 L 06 GT 12 H 12
LYM    A050/ 09 B060/ 09 C090/ 05
NW     A140/ 07 B140/ 03 C130/ 01 D090-190 E 00- 00 FR 05 L 05 GT 08 H 08
YYC    A310/ 03 B300/ 03 C050/ 04
KLT    A300/ 02 B050/ 04 C130/ 03
SHEAR    31A/13D SINKING     -03  13A/31D LIFTING     +05   QNH XXXX

31-AUG-1988 WEDNESDAY 01:19:00
SE     A100/ 10 B090/ 07 C110/ 08 D070-160 E 00- 00 FR 06 L 06 GT 12 H 12
LYM    A030/ 08 B050/ 09 C090/ 05
NW     A140/ 06 B140/ 04 C130/ 01 D090-190 E 00- 00 FR 05 L 05 GT 08 H 08
YYC    A340/ 02 B310/ 03 C050/ 04
KLT    A290/ 06 B020/ 03 C130/ 03
SHEAR    31A/13D SINKING     -04  13A/31D LIFTING     +04   QNH XXXX

31-AUG-1988 WEDNESDAY 01:19:30
SE     A100/ 09 B090/ 08 C110/ 08 D070-160 E 00- 00 FR 06 L 06 GT 12 H 12
LYM    A360/ 05 B040/ 08 C090/ 05
NW     A130/ 04 B140/ 05 C130/ 01 D090-190 E 00- 00 FR 05 L 05 GT 08 H 08
YYC    A360/ 03 B330/ 03 C050/ 04
KLT    A290/ 06 B350/ 03 C130/ 03
SHEAR    31A/13D SINKING     -05  13A/31D LIFTING     +03   QNH XXXX

31-AUG-1988 WEDNESDAY 01:20:00
SE     A100/ 10 B090/ 08 C100/ 08 D070-140 E 00- 00 FR 07 L 07 GT 12 H 12
LYM    A300/ 06 B020/ 07 C070/ 06
NW     A120/ 04 B130/ 05 C130/ 02 D100-190 E 00- 00 FL 03 R 03 GT 08 H 08
YYC    A360/ 03 B340/ 02 C010/ 03
KLT    A270/ 06 B310/ 04 C160/ 04
SHEAR    31A/13D SINKING     -06  13A/31D LIFTING     +02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:20:30
SE     A100/ 12 B100/ 09 C100/ 08 D070-140 E 00- 00 FR 07 L 07 GT 12 H 12
LYM    A270/ 03 B350/ 05 C070/ 06
NW     A110/ 02 B120/ 04 C130/ 02 D100-190 E 00- 00 FL 03 R 03 GT 08 H 08
YYC    A010/ 03 B350/ 03 C010/ 03
KLT    A340/ 06 B310/ 05 C160/ 04
SHEAR    31A/13D SINKING     -07  13A/31D LIFTING     +01   QNH XXXX

31-AUG-1988 WEDNESDAY 01:21:00
SE     A100/ 11 B100/ 10 C100/ 08 D070-140 E 00- 00 FR 07 L 07 GT 12 H 12
LYM    A230/ 01 B310/ 04 C070/ 06
NW     A110/ 01 B120/ 03 C130/ 02 D100-190 E 00- 00 FL 03 R 03 GT 08 H 08
YYC    A020/ 03 B360/ 03 C010/ 03
KLT    A360/ 05 B320/ 05 C160/ 04
SHEAR    31A/13D SINKING     -05  13A/31D NO SHEAR    +00   QNH XXXX

31-AUG-1988 WEDNESDAY 01:21:30
SE     A110/ 10 B100/ 10 C100/ 08 D070-140 E 00- 00 FR 07 L 07 GT 12 H 12
LYM    A010/ 01 B280/ 02 C070/ 06
NW     A060/ 01 B110/ 02 C130/ 02 D100-190 E 00- 00 FL 03 R 03 GT 08 H 08
YYC    A010/ 02 B010/ 03 C010/ 03
KLT    A360/ 06 B340/ 05 C160/ 04
SHEAR    31A/13D SINKING     -04  13A/31D NO SHEAR    +00   QNH XXXX
```

/continued

```
31-AUG-1988 WEDNESDAY 01:22:00
SE     A110/ 12 B100/ 10 C090/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A360/ 03 B280/ 01 C040/ 07
NW     A090/ 01 B100/ 01 C120/ 01 D060-190 E 00- 00 FL 02 R 02 GT 08 H 08
YYC    A010/ 02 B010/ 03 C360/ 03
KLT    A360/ 06 B350/ 05 C050/ 04
SHEAR   31A/13D SINKING     -05  13A/31D NO SHEAR    +00   QNH XXXX

31-AUG-1988 WEDNESDAY 01:22:30
SE     A120/ 10 B110/ 10 C090/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A350/ 07 B300/ 02 C040/ 07
NW     A070/ 01 B090/ 01 C120/ 01 D060-190 E 00- 00 FL 02 R 02 GT 08 H 08
YYC    A350/ 03 B010/ 02 C360/ 03
KLT    A340/ 06 B350/ 06 C050/ 04
SHEAR   31A/13D SIG SINKING -08  13A/31D NO SHEAR    +00   QNH XXXX

31-AUG-1988 WEDNESDAY 01:23:00
SE     A120/ 10 B110/ 10 C090/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A340/ 09 B330/ 04 C040/ 07
NW     A090/ 01 B080/ 01 C120/ 01 D060-190 E 00- 00 FL 02 R 02 GT 08 H 08
YYC    A340/ 02 B360/ 02 C360/ 03
KLT    A360/ 04 B350/ 06 C050/ 04
SHEAR   31A/13D SIG SINKING -09  13A/31D NO SHEAR    +00   QNH XXXX

31-AUG-1988 WEDNESDAY 01:23:30
SE     A120/ 10 B120/ 10 C090/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A360/ 11 B350/ 06 C040/ 07
NW     A090/ 01 B080/ 01 C120/ 01 D060-190 E 00- 00 FL 02 R 02 GT 08 H 08
YYC    A320/ 03 B350/ 02 C360/ 03
KLT    A360/ 05 B350/ 05 C050/ 04
SHEAR   31A/13D SIG SINKING -09  13A/31D LIFTING     +01   QNH XXXX

31-AUG-1988 WEDNESDAY 01:24:00
SE     A120/ 10 B120/ 10 C100/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A010/ 12 B360/ 09 C020/ 07
NW     A100/ 04 B090/ 01 C110/ 02 D060-150 E 00- 00 FR 04 L 04 GT 08 H 08
YYC    A310/ 03 B330/ 02 C340/ 03
KLT    A350/ 06 B350/ 05 C020/ 05
SHEAR   31A/13D SIG SINKING -09  13A/31D LIFTING     +02   QNH XXXX

31-AUG-1988 WEDNESDAY 01:24:30
SE     A110/ 09 B120/ 09 C100/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A010/ 12 B360/ 10 C020/ 07
NW     A100/ 05 B090/ 02 C110/ 02 D060-150 E 00- 00 FR 04 L 04 GT 08 H 08
YYC    A330/ 04 B320/ 02 C340/ 03
KLT    A320/ 05 B350/ 05 C020/ 05
SHEAR   31A/13D SIG SINKING -08  13A/31D LIFTING     +03   QNH XXXX

31-AUG-1988 WEDNESDAY 01:25:00
SE     A110/ 09 B120/ 09 C100/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A020/ 10 B360/ 11 C020/ 07
NW     A090/ 04 B090/ 03 C110/ 02 D060-150 E 00- 00 FR 04 L 04 GT 08 H 08
YYC    A330/ 06 B320/ 03 C340/ 03
KLT    A340/ 05 B350/ 05 C020/ 05
SHEAR   31A/13D SINKING     -07  13A/31D LIFTING     +03   QNH XXXX

31-AUG-1988 WEDNESDAY 01:25:30
SE     A120/ 09 B120/ 09 C100/ 08 D000-000 E 00- 00 FR 08 L 08 GT 11 H 11
LYM    A020/ 09 B010/ 10 C020/ 07
NW     A070/ 01 B090/ 03 C110/ 02 D060-150 E 00- 00 FR 04 L 04 GT 08 H 08
YYC    A330/ 06 B320/ 04 C340/ 03
KLT    A330/ 08 B340/ 05 C020/ 05
SHEAR   31A/13D SINKING     -07  13A/31D LIFTING     +02   QNH XXXX
```

Runway 31 ILS Approach Chart



MISSED APPROACH: Climb to 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 3 NM 'I-HK' DME, then continue descend to decision height.

RTF Transcript

This transcription covers the time period from 31 August 1988, 0043 UTC, to 31 August 1988, 0119 UTC. It is a true transcription of the recorded conversation pertaining to the subject accident.

Agencies making transmissions	Abbreviations
China 301	CCA 301
Hong Kong Approach	APP
World 6188	WOA 6188
China 319	CCA 319
Hong Kong Precision	PAR
Hong Kong Tower	AMC
Korean 616	KAL 616
Approach Coordinator	COO

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0043:28	Approach China Three Zero One good morning
APP	119.1	0043:30	China Three Zero One Hong Kong Approach good morning
CCA301	119.1	0043:33	China Three Zero One Lima Quebec maintain ten thousand feet Information Delta squawk three one zero one
APP	119.1	0043:42	China Three Zero One radar contact call me again twenty miles before RUMET for instructions
CCA301	119.1	0043:48	China Three Zero One
CCA301	119.1	0045:34	Hong Kong Approach China Three Zero One deviate twelve miles to the left due to charlie bravo
APP	119.1	0045:43	China Three Zero One Hong Kong Approach no objections for your deviation call me again passing abeam RUMET
CCA301	119.1	0045:52	Say again please
APP	119.1	0045:54	China Three Zero One report passing abeam RUMET you can deviate I have no objection over
CCA301	119.1	0046:00	Roger report abeam RUMET China Three Zero One
APP	119.1	0047:44	China Three Zero One Hong Kong
CCA301	119.1	0047:50	Three Zero One go ahead please
APP	119.1	0047:52	China Three Zero One on my radar there is weather between Charlie Hotel and Two Seven Zero Radial up to Lima Tango if you prefer you can have Runway Three One monitored ILS Approach The surface wind is between zero nine zero to one four zero degrees at one zero knots It's heavy shower over the airfield the visibility on Runway Three One is five thousand metres on the IGS is three thousand metres advise

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0048:28	China Three Zero One make ..... ah ..... to make ILS Approach Runway Three One
APP	119.1	0048:37	China Three Zero One roger what is your present heading?
CCA301	119.1	0048:41	Heading..... ah ..... request Heading Zero Eight Zero
APP	119.1	0048:47	China Three Zero One Heading Zero Eight Zero is approved
CCA301	119.1	0048:51	Roger thank you
WOA6188	119.1	0049:53	Good morning Hong Kong ah World Six One Eight Eight is maintaining ah one five zero with request at pilot's discretion eight thousand
APP	119.1	0050:02	World Six One Eight Eight Hong Kong Approach good morning radar contact recleared one one thousand feet when you're ready for descent Information is Delta the QNH is one zero one zero and we get some weather on my radar between Charlie Hotel In fact it's from Charlie Hotel to Lima Tango to the south West of the IGS track So if you like we can give you Runway Three One ILS monitored approach and the surface wind is between zero nine zero and one four zero degrees one zero knots On the ILS and the Runway Three One the visibility is five thousand metres IGS is three thousand metres runway surface is wet and heavy shower over the airfield could you advise?
WOA6188	119.1	0050:51	Say again the wind please
APP	119.1	0050:54	The wind between zero nine zero and one four zero degrees ten knots
APP	119.1	0051:28	China Three Zero One Hong Kong
CCA301	119.1	0051:30	Go ahead please China Three Zero One

Station	Frequency	Time (UTC)	Communication
APP	119.1	0051:32	China Three Zero One in how many miles you can accept a right turn?
CCA301	119.1	0051:38	Er not right turn China Three Zero One
APP	119.1	0051:42	China Three Zero One roger turn right heading One Four Zero
CCA301	119.1	0051:46	Heading One four Zero China Three Zero One
CCA301	119.1	0051:52	China Three Zero One righting two minutes ..... ah ..... right
APP	119.1	0052:00	China Three Zero One say your message again?
CCA301	119.1	0052:03	Request in ..... two minutes right please
APP	119.1	0052:06	Confirm in two minutes you can turn right?
CCA301	119.1	0052:09	..... mative
APP	119.1	0052:10	Roger
WOA6188	119.1	0052:17	World Six One Eight Eight leaving ah one five zero for one one thousand
APP	119.1	0052:24	World Six One Eight Eight roger
APP	119.1	0052:43	World Six One Eight Eight ah do you prefer Runway One Three or Three One?
WOA6188	119.1	0052:50	Three One ma'm
APP	119.1	0052:52	World Six One Eight Eight roger
CCA301	119.1	0052:56	China Three Zero One starting right turn

Station	Frequency	Time (UTC)	Communication
APP	119.1	0052:59	Roger
WOA6188	119.1	0053:00	Erh which which Approach will we get on runway Three One?
APP	1119.1	0053:04	World Six One Eight Eight I understand ah Runway Three One turn right heading zero six zero
WOA6188	119.1	0053:10	And which Approach we're getting ma'm?
APP	119.1	0053:12	World Six One Eight Eight Runway Three One monitored by the ah Precision App ..... Approach Precision Radar
WOA6188	119.1	0053:18	Roger
APP	119.1	0053:46	Correct World Six One Eight Eight descend to four five zero zero feet
WOA6188	119.1	0053:53	Down to four thousand five hundred
APP	119.1	0053:56	Ah Six One Eight Eight ay firm Is three zero miles sufficient for you to lose altitude in time for the Approach?
WOA6188	119.1	0054:03	(Ro)ger affirmative
APP	119.1	0054:05	Roger
CCA301	119.1	0054:09	China Three Zero One maintaining Heading One Four Zero
APP	119.1	0054:13	China Three Zero One turn further right Heading One Nine zero

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0054:19	Right Heading One Nine Zero stand by
APP	119.1	0054:22	China Three Zero One correct
WOA6188	119.1	0054:26	World Six One Eight Eight is a little ..... going a little right of track to go round build up
APP	119.1	0054:32	Six One Eight Eight ay firm'd .....
APP	119.1	0055:00	China Three Zero One no delay for the approach keep high speed
CCA301	119.1	0055:04	Roger China Three Zero One
APP	119.1	0055:14	World Six One Eight Eight report passing altitude?
WOA6188	119.1	0055:17	Just comin' through ah one zero thousand
APP	119.1	0055:21	Ah roger
APP	119.1	0055:31	Ah World Six One Eight Eight can you accept heading zero six zero for base leg now?
WOA6188	119.1	0055:42	'firmative
APP	119.1	0055:43	Roger heading zero six zero for base leg
APP	119.1	0055:52	China Three Zero One can you accept a right turn now?
CCA301	119.1	0055:55	Ah .....Stand by stand by
CCA301	119.1	0056:29	Hong Kong Approach China Three Zero One main....ah maintain One Four Zero flying to .. route to abeam Tango Hotel and right turn
APP	119.1	0056:43	Can you accept a right turn now Three Zero One?

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0056:46	Negative negative maintaining One Four Zero maintain One Four Zero fly to abeam Tango Ho ... Tango Papa Tango Papa
APP	119.1	0056:57	Roger Three Zero One advise when you can accept a right turn
CCA301	119.1	0057:01	Roger
APP	119.1	0057:03	World Six One Eight Eight check passing altitude?
WOA6188	119.1	0057:06	Level at four thousand five hundred
APP	119.1	0057:11	World Six One Eight Eight confirm maintaining four five zero zero?
WOA6188	119.1	0057:14	That's affirmative Six One Eight Eight
APP	119.1	0057:16	Roger turn left heading three six zero to intercept Localizer when established cleared ILS Approach Runway Three One
WOA6188	119.1	0057:22	Three Six Zero's the Heading cleared to establish on Localizer World Six One Eight Eight
APP	119.1	0057:28	Six One Eight Eight latest information from Tower the surface wind mainly calm this time
WOA6188	119.1	0057:32	Wind mainly calm roger
APP	119.1	0057:37	China Three Zero One Tower reports the surface wind mainly calm this time

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0057:42	Roger China Three Zero One
CCA301	119.1	0059:02	Hong Kong China Three Zero One right Heading One Six Zero
APP	119.1	0059:07	Roger Three Zero One Heading One Six Zero is approved
CCA301	119.1	0059:10	(Ro)ger
APP	119.1	0059:11	And Three Zero One descend when ready to six thousand feet QNH one zero one zero report leaving one zero thousand
CCA301	119.1	0059:18	Roger China Three Zero One
CCA301	119.1	0059:25	China Three Zero One now leaving ten thousand feet for six thousand feet
APP	119.1	0059:30	Roger Three Zero One
APP	119.1	0101:01	World Six One Eight Eight contact Precision One One Niner Decimal Five for monitored approach
WOA6188	119.1	0101:06	One One Nine Five good day ....
APP	119.1	0101:08	Goodbye
CCA301	119.1	0101:09	Approach China Three Zero One right Heading Two Four Zero
APP	119.1	0101:12	China Three Zero One roger turn right Heading Two Four Zero
CCA301	119.1	0101:16	Roger
CCA301	119.1	0101:40	China Three Zero One reaching six thousand feet
APP	119.1	0101:45	China Three Zero One roger maintain six thousand feet

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0101:47	(Ro)ger maintain
CCA301	119.1	0101:56	China Three Zero One right Heading Two Eight Zero
CCA301	119.1	0102:04	Approach China Three Zero One right Heading Two Eight Zero
APP	119.1	0102:07	China Three Zero One can you erh maintain your present heading expect four zero miles to touch down I have one departure to depart Runway One Three ahead of you
CCA301	119.1	0102:16	Roger maintain present heading
APP	119.1	0102:18	Thank you
CCA319	119.1	0102:35	Hong Kong Approach China Three One Nine good morning I'll.... will be one zero thousand feet Rumet Information Delta
APP	119.1	0102:42	China Three One Nine good morning Information now is Echo QNH is One Zero One Zero Expect radar vectors for ILS Runway Three One and squawk ident please
CCA319	119.1	0102:55	Squawk Three One One One radar vectors for ILS Runway Three One QNH one zero one zero Information Echo China Three One Nine
APP	119.1	0103:13	China Three One Nine identified
CCA319	119.1	0103:15	Three One Nine roger
CCA301	119.1	0103:39	China Three Zero One can.... can I right Heading Two Eight Zero?
APP	119.1	0103:46	China Three Zero One confirm that is due to weather?

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0103:50	(Af)firmative erh
APP	119.1	0103:53	Roger China Three Zero One turn right Heading Two Seven Zero and check QNH now one zero one one expect three five miles to touch down
CCA301	119.1	0104:02	Roger cleared right turn Two Seven Zero China Three Zero One
APP	119.1	0104:23	China Three One Niner Approach
CCA319	119.1	0104:26	Hong Kong China Three One Nine please go ahead
APP	119.1	0104:28	Ah roger check lastest QNH ah One Zero One One
CCA319	119.1	0104:33	Roger QNH One Zero One One China Three One Nine
APP	119.1	0105:15	China Three Zero One reduce to normal approach speed now
CCA301	119.1	0105:20	Ah say again?
APP	119.1	0105:22	China Three Zero One cleared to reduce normal approach speed
CCA301	119.1	0105:26	Roger China Three Zero One
CCA319	119.1	0106:02	Hong Kong Approach China Three One Nine due to bad weather ahead of the Rumet Heading One Two Zero if available
APP	119.1	0106:10	China Three One Nine roger Heading One Two Zero is approved and a check with Guangzhou please
CCA319	119.1	0106:16	(Ro)ger approved
CCA319	119.1	0106:21	And ah we ah make Heading One One Zero Guangzhou is approved

Station	Frequency	Time (UTC)	Communication
APP	119.1	0106:27	China Three One Nine roger Hong Kong no objections
CCA319	119.1	0106:29	Roger thank you sir
APP	119.1	0106:33	China Three Zero One expect ah continue this heading to cross the Localizer rejoin from the west descend to five thousand feet
CCA301	119.1	0106:42	Roger descend five thousand feet maintain to present heading China Three Zero One
CCA301	119.1	0107:33	Radar Three Zero One reaching five thousand feet
APP	119.1	0107:36	China Three Zero One roger maintain five thousand feet I'll call you back for descent
CCA301	119.1	0107:40	Roger China Three Zero One
CCA319	119.1	0108:29	Ah Three One Nine abeam Rumet one zero thousand feet
APP	119.1	0108:35	China Three One Nine roger can you accept the .... Heading of One Three Zero?
CCA319	119.1	0108:45	Negative we would maintain this Heading One One Zero if available
APP	119.1	0108:49	China Three One Nine affirm maintain ah one zero thousand feet and advise if you can accept a right turn
CCA319	119.1	0108:56	Roger China Three One Nine
APP	119.1	0109:40	China Three Zero One turn right now Heading Three Six Zero to intercept the Localizer stand by for the approach

Station	Frequency	Time (UTC)	Communication
CCA301	119.1	0109:48	Roger right turn Three Six Zero?
APP	119.1	0109:51	Correct right Heading Three Six Zero to intercept the Localizer stand by for the approach
CCA301	119.1	0109:57	Request left..request left ah
APP	119.1	0110:02	China Three Zero One can you accept a right turn Heading Three Six Zero now?
CCA301	119.1	0110:06	Negative negative request left turn request left turn due to charlie bravo
APP	119.1	0110:11	China Three Zero One roger left turn long way round Heading Three Six Zero
			(Crossed transmissions)
KAL616	119.1	0110:18	Departure Korean Six One Six maintain three thousand
APP	119.1	0110:20	Korean Six One Six roger turn left now Heading Zero Nine Zero climb to five thousand feet
KAL616	119.1	0110:29	Roger climb five thousand feet zero nine zero Six One Six
APP	119.1	0110:33	China Three Zero One descend to four thousand five hundred feet

Station	Frequency	Time (UTC)	Communication
AMC/COO	Intercom	0110:33	COO : Go ahead
			AMC : Latest Foxtrot is opposite runway and the wind is One Two Zero to One Five Zero Five to Ten, runway wet and the visibility Four Five Zero Zero meters .... (cross talking)
			COO : Hang on I need to copy down One Two Zero One Five Zero degree Five to ten runway surface wet
			AMC : Yah and the visibility is Four Five Zero Zero meters in rain
			COO : Four Five Zero Zero meters in rain
			AMC : Yah
			COO : Okay
CCA301	119.1	0110:37	Descend four five zero zero feet China Three Zero One
APP	119.1	0111:12	Korean Six One Six continue climb to seven thousand feet report passing five thousand
KAL616	119.1	0111:18	Roger Korean Six One Six continue climb to seven thousand feet report five thousand
APP	119.1	0111:24	Correct
KAL616	119.1	0111:42	Korean Six One Six passing five thousand
APP	119.1	0111:45	Korean Six One Six roger can you accept a right turn Heading One Two Zero for the One Zero four Radial?
KAL616	119.1	0111:52	Roger Heading One Two Zero for Radial One Zero Four

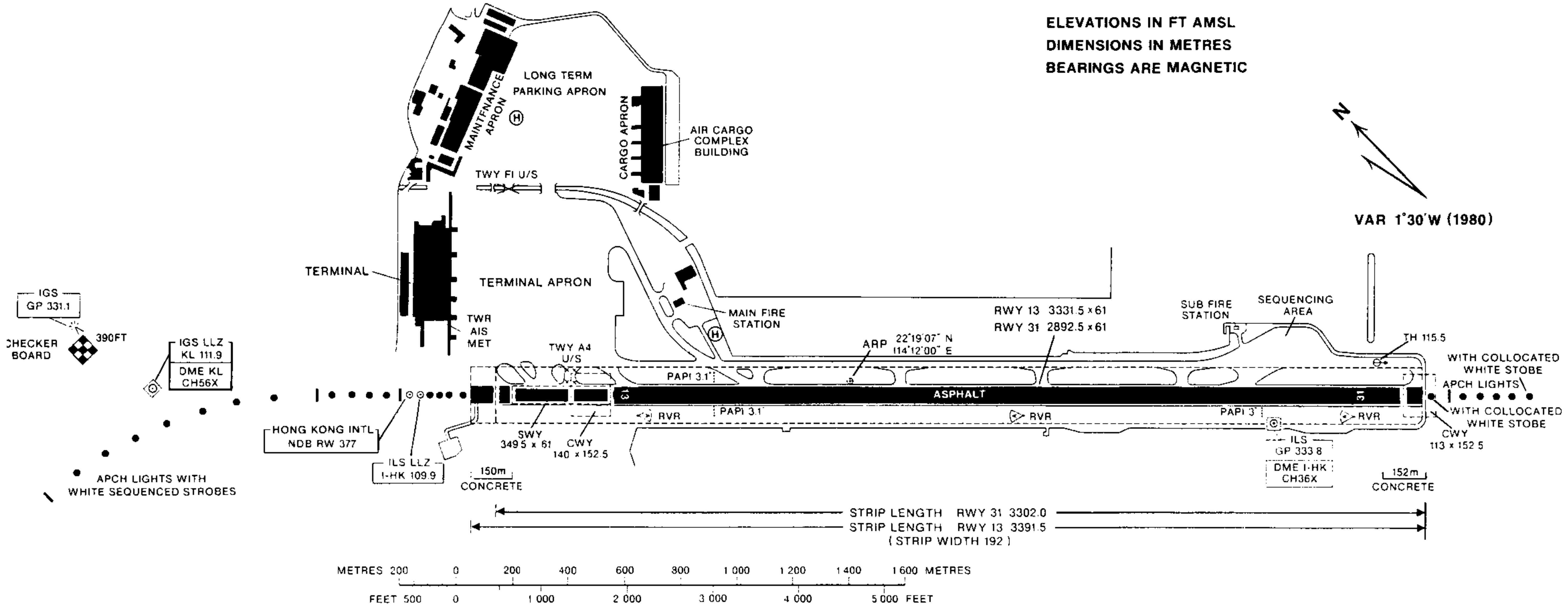
Station	Frequency	Time (UTC)	Communication
APP	119.1	0112:21	China Three Zero One your passing level?
CCA301	119.1	0112:23	Three Zero One four five zero-o feet Heading Three Six Zero
APP	119.1	0112:28	China Three Zero One roger Heading Three Six Zero to intercept the Localizer you are cleared for the ILS Approach
CCA301	119.1	0112:34	(Ro)ger intercept the Localizer cleared for ILS Approach China Three Zero One
APP	119.1	0112:41	China ..correction all stations latest weather wind one two zero to one five zero degrees five to one zero knots runway surface wet visibility four thousand five hundred metres in rain
CCA301	119.1	0112:58	(Ro)ger China Three Zero One
APP	119.1	0113:00	China Three Zero One confirm you accept Runway Three One Approach?
CCA301	119.1	0113:04	Affirmative Runway Three One
APP	119.1	0113:07	China Three Zero One roger closing the Localizer from the left report established
CCA301	119.1	0113:11	Roger report established China Three Zero One
APP	119.1	0113:14	Korean Six One Six climb now to Flight Level Three Three Zero present heading to intercept Charlie Hotel Radial One Zero Four
APP	119.1	0114:33	China Three Zero One I see you're established you are cleared for the ILS Approach
CCA301	119.1	0114:37	China Three Zero One established ILS Approach can

Station	Frequency	Time (UTC)	Communication
APP	119.1	0114:42	China Three Zero One expect your ILS Approach monitored by Precision Radar
CCA301	119.1	0114:47	Ah thank you
APP	119.1	0115:20	China Three Zero One contact Precision One One Nine Decimal Five
CCA301	119.1	0115:24	On ah Nine Decimal Five China Three Zero One
CCA301	119.5	0115:39	Hong Kong Precision China Three Zero One established ah ILS Approach Runway One Three One
PAR	119.5	0115:47	China Three Zero One good morning your ILS Approach will be monitored by Precision Radar pass advisory information only if required
CCA301	119.5	0115:54	Roger Three Zero One
PAR	119.5	0115:58	Roger
AMC/PAR	Intercom	0116:01	AMC : Visibility is now around Three Thousand meters I don't know what's wrong with the RVR
			PAR : Thanks
			AMC : and the China Three Zero One clear to land
			PAR : Roger

Station	Frequency	Time (UTC)	Communication
PAR	119.5	0116:46	China Three Zero One I have no Precision Radar contact no contact Surface wind is zero nine zero at seven knots you are cleared to land
CCA301	119.5	0116:59	(Ro)ger China Three Zero One
PAR	119.5	0117:46	China Three Zero One I still have no radar contact continue the ILS Approach
COO/AMC	Intercom	0118:41	AMC : Go ahead
			COO : Check latest vis
			AMC : Three Thousand meters in shower
			COO : O Kay
AMC/PAR	Intercom	0119:30	AMC : Crashed

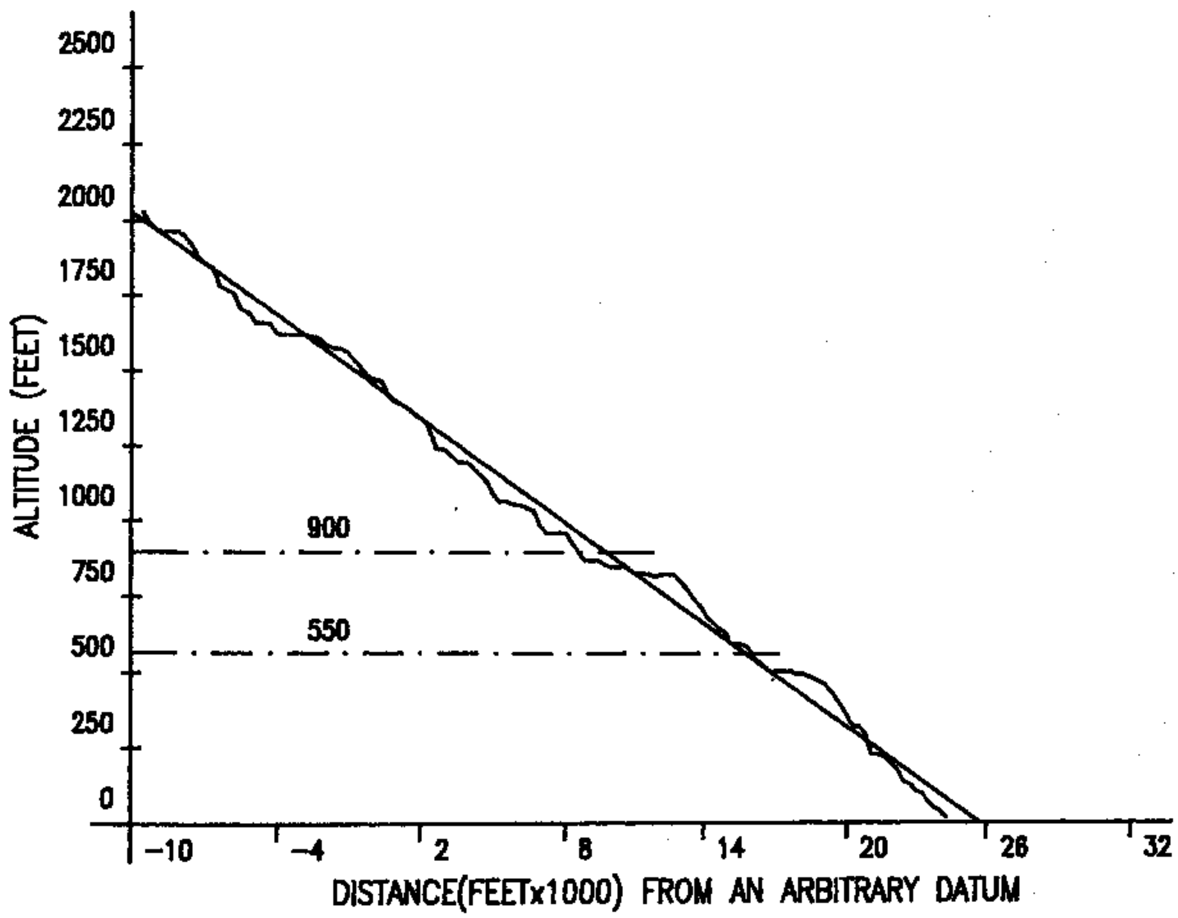
- End of Transcript -

Plan of Hong Kong International Airport

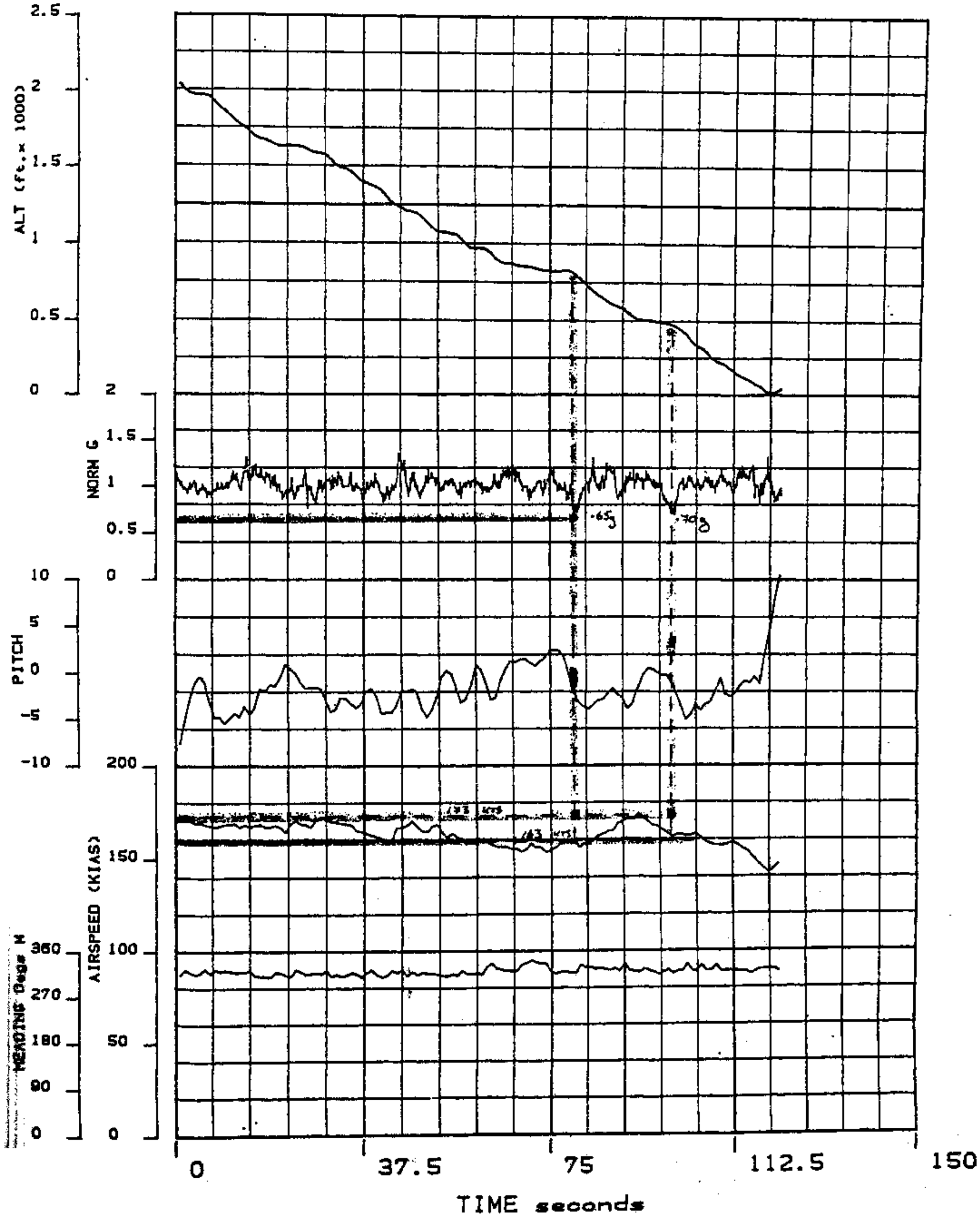


Flight Data Recorder Plot

CAAC TRIDENT ACCIDENT WIND GLIDESLOPE

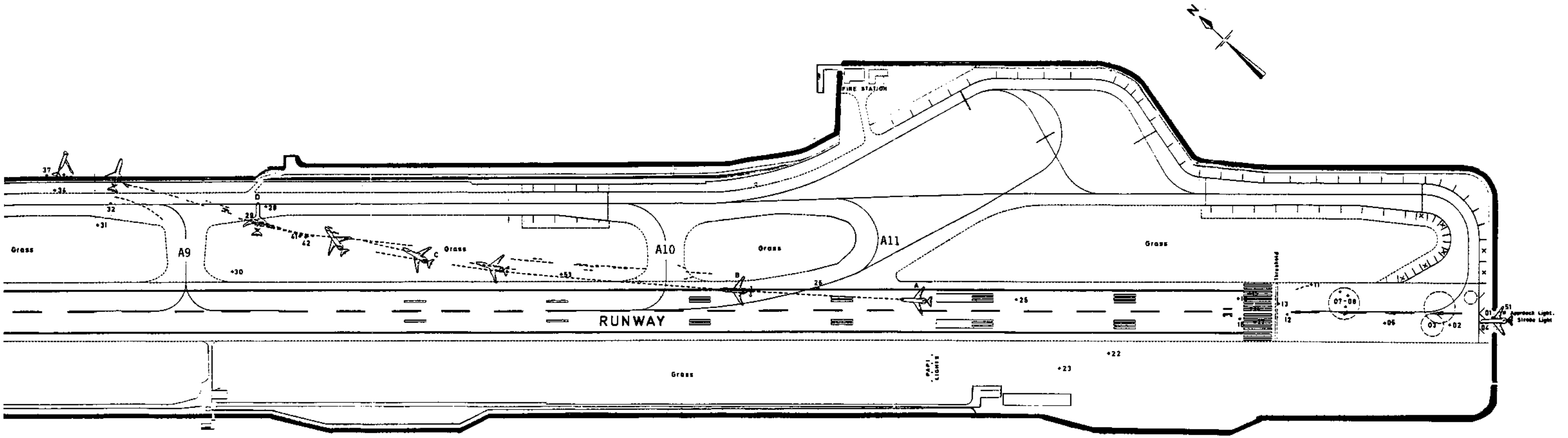


Flight Data Recorder Plot
(including derived PITCH parameter)



TRIDENT (B2218) AIRCRAFT ACCIDENT
FLIGHT CCA 301

Wreckage Distribution and Impact Sequence



LEGEND

- Wreckage item
- Scattered wreckage
- Ground witness marks

POSITION OF OCCURRENCE

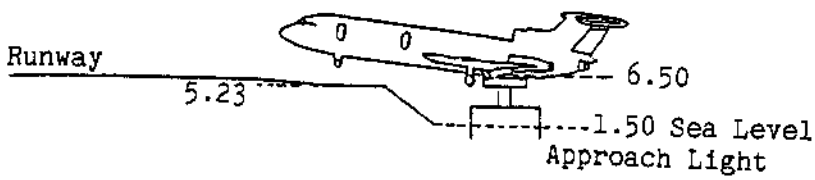
51	Right outboard flap strikes
01	Right maingear strikes
01-A	No ground contact
04	Left maingear mark
A	Left maingear touchdown
B	Start of right flap contact
53	Deep cut on ground
C	Nosegear collapse
D	Left maingear collapse

IDENTIFIED WRECKAGE ITEMS

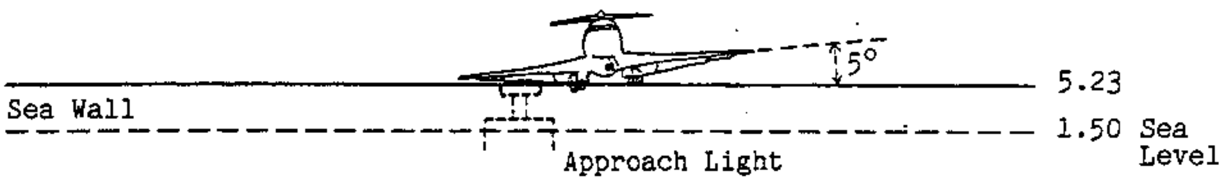
ITEM No.	DESCRIPTION
02	Brake fan guard
03	Fragments of main wheel
05	Tyre piece; sections of main wheel
07	Main gear door
08	Part of wing spar landing gear support
11	Trailing edge flap
12	Refueling valve
13	Tyre fragment
14	Falsework wing trailing edge
15	Trailing edge flap
16	Drive shaft (flap)
17	Wheel antiskid unit
19	Main wheel retaining part
22	Wheel tyre
23	Main wheel tyre
25	Main landing gear down lock link
26	Main landing gear RH, and nib # 5, fractured wing skin
28	Nose gear
29	Refueling component
30	Main wheel tyre
31	Nose wheels and axle
32	TE OB right flap section
34	Tail cone & APU exhaust
35	Oxygen tank, No. 2 engine cowling
37	Trailing edge "wedge" inboard & outboard flap
38	Main wheel
41	Portion of landing edge flap & track
42	Leading edge slat

Aircraft Attitude at Time of Impact

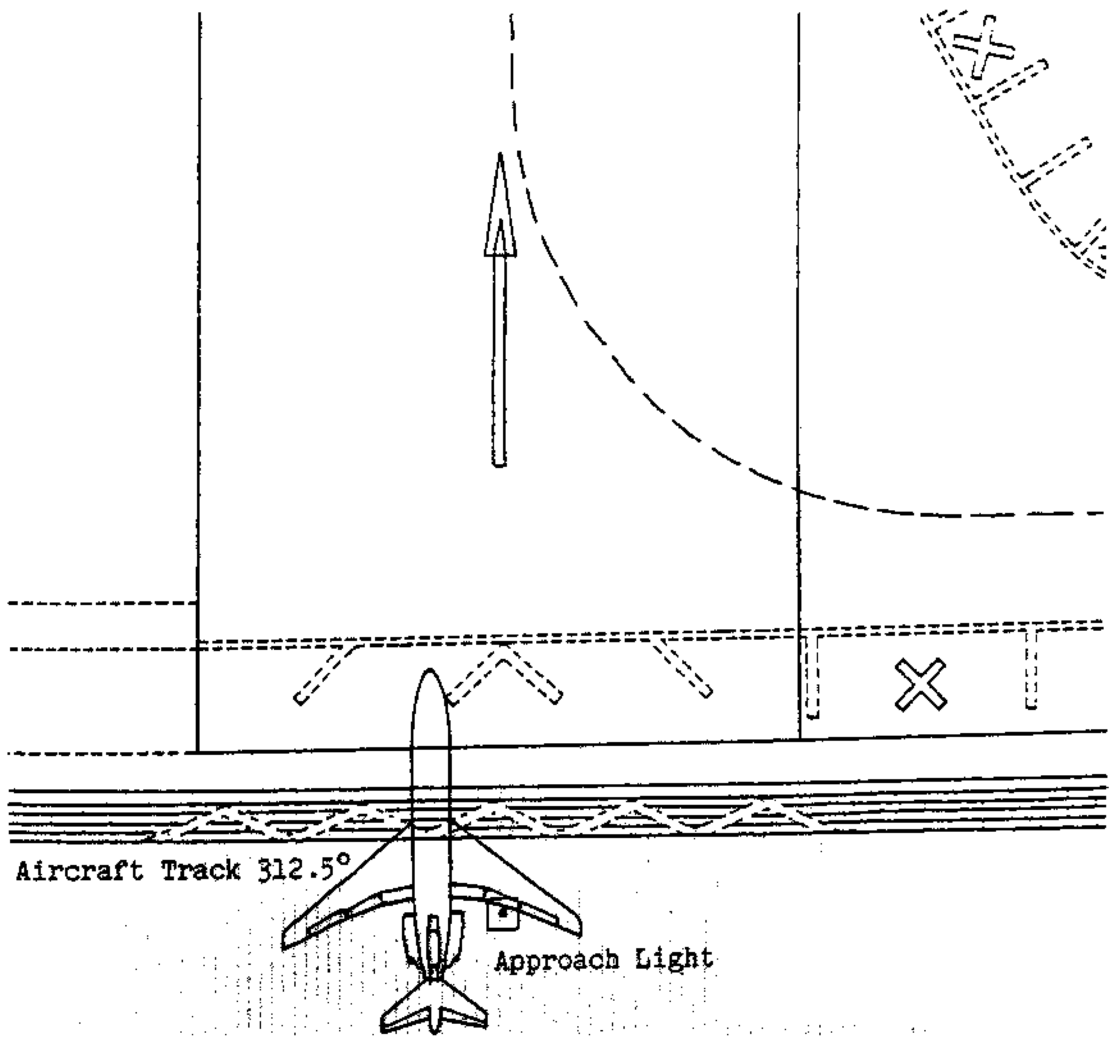
Side Elevation



Front Elevation

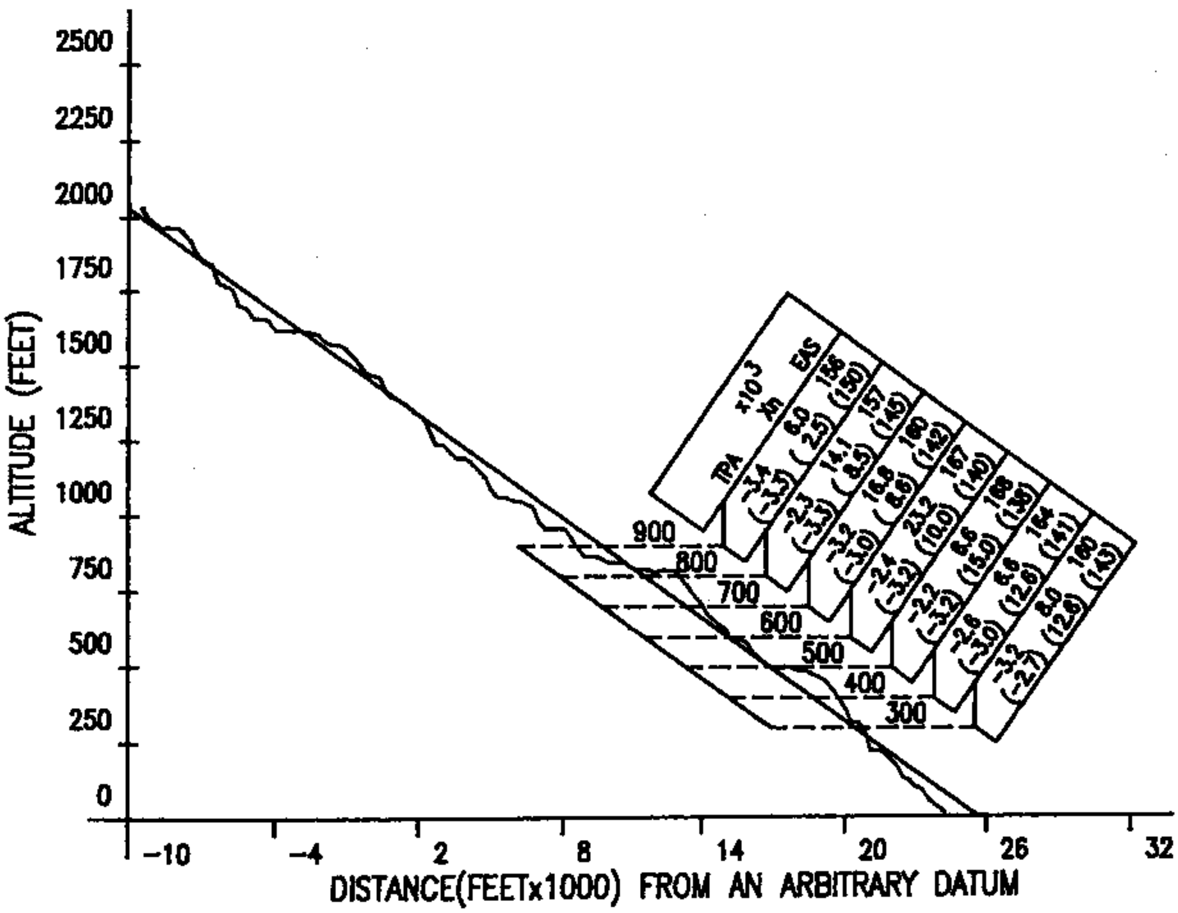


Plan



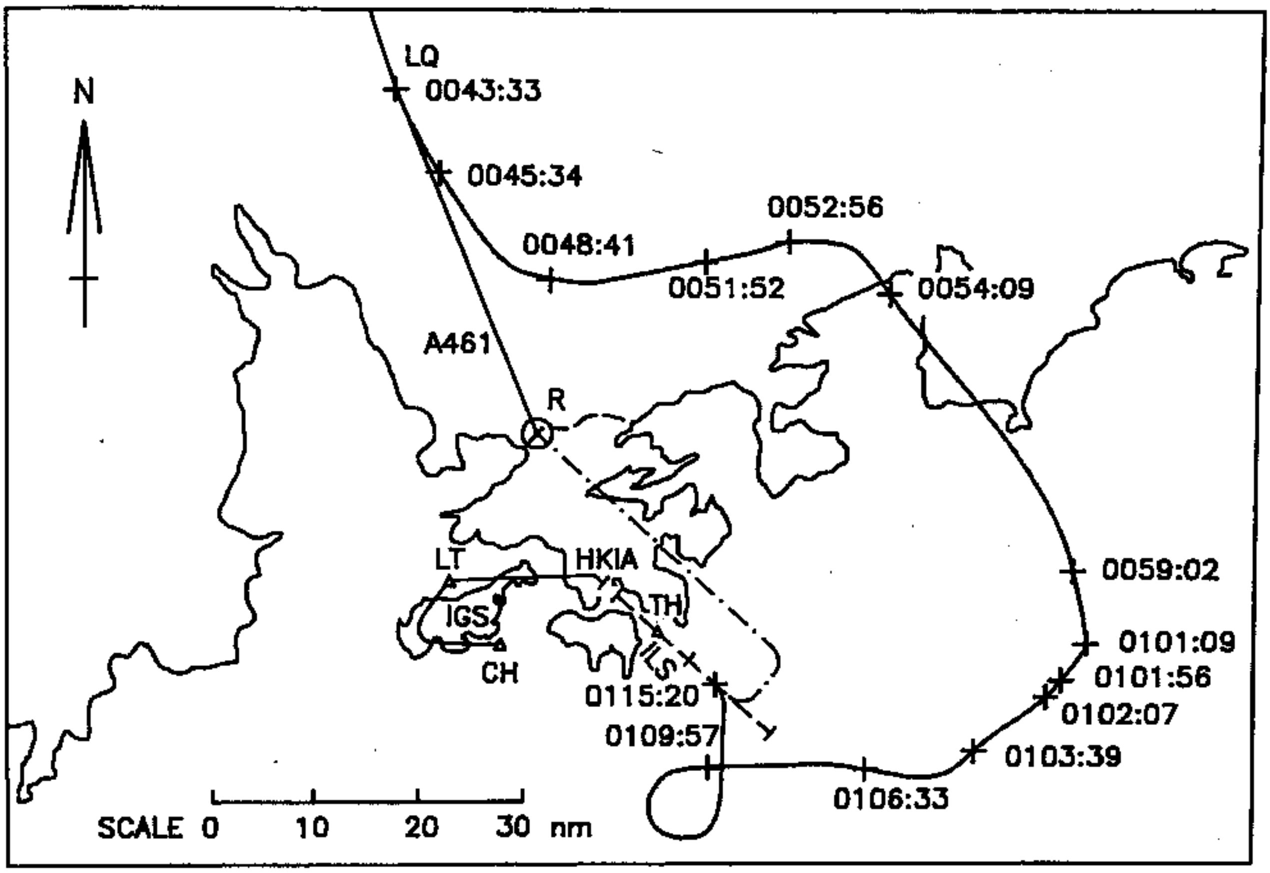
Flight Simulation

CAAC TRIDENT ACCIDENT WIND GLIDESLOPE



FDR Derived Profile

Aircraft Track Made Good



LEGEND

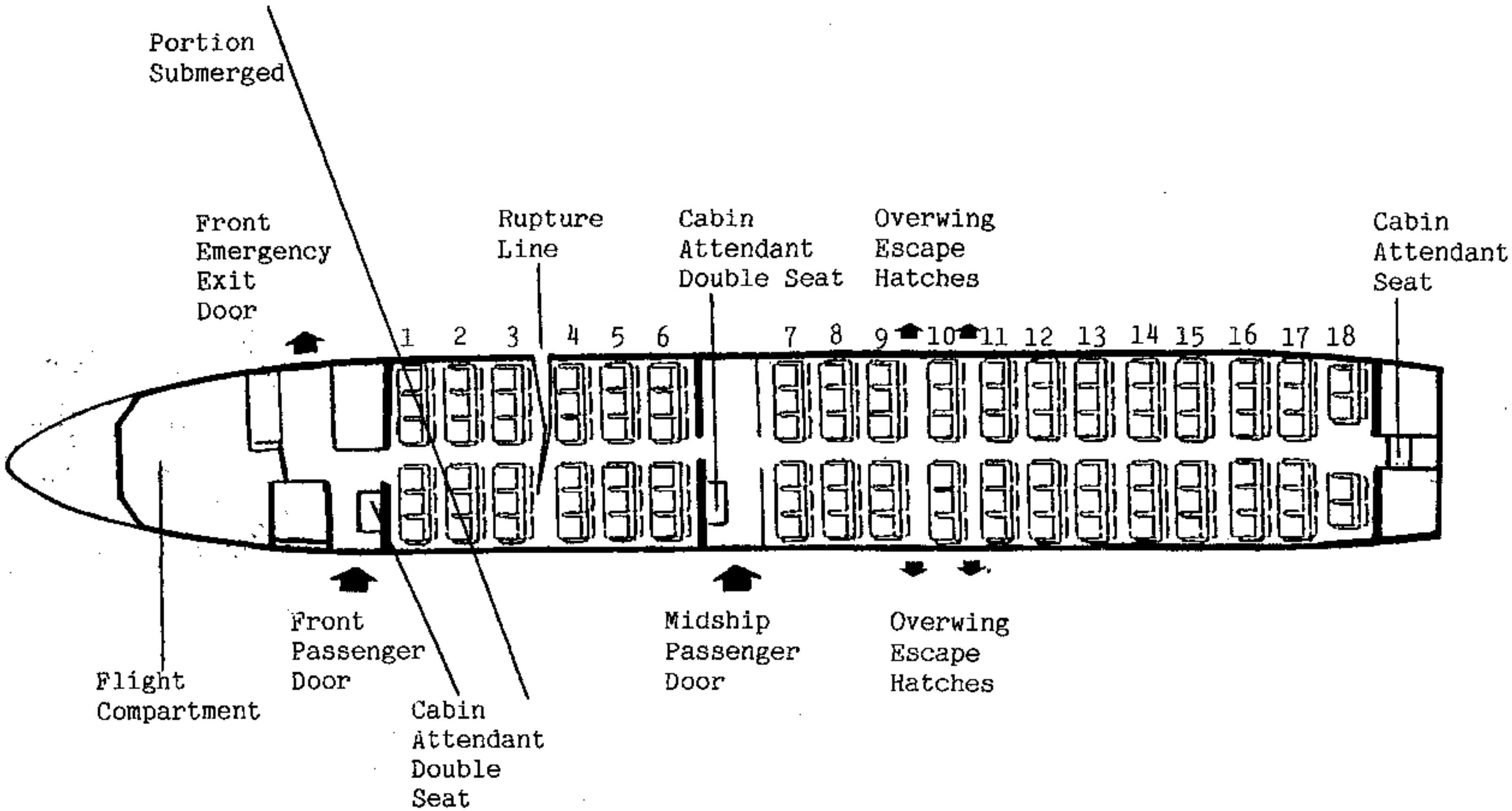
———	CCA301 Route of flight
·—·—	Route normally used by inbound flights from Guangzhou for Runway 31
LQ	Shilong NDB
A461	CCA301 flight plan route
R	Transfer Point 'Rumet'
LT	Chek Lap Kok NDB
IGS	Instrument Guidance System
CH	Cheung Chau VOR
HKIA	Hong Kong International Airport
TH	Tathong VOR
ILS	Instrument Landing System

Note: **Heading Information** at time shown along the route can be obtained from the transcript in Appendix 5.

Crash scene - left side of aircraft

Crash scene - right side of aircraft

APPENDIX 12



LAYOUT OF PASSENGER ACCOMMODATION

Report on the accident
to Hawker Siddeley
1990.

Reprography by the Government Printer, Hong Kong 186888—6L—7/90