AIRCRAFT ACCIDENT REPORT NO: 1/77

CHIEF INSPECTOR OF ACCIDENTS & SAFETY,
DEPARTMENT OF CIVIL AVIATION,
MALAYSIA.

McDONNELL DOUGLAS DC8 (SUPER 62) - JA8051 -
REPORT ON THE ACCIDENT NEAR KUALA LUMPUR
INTERNATIONAL AIRPORT, SUBANG, SELANGOR
ON 27TH SEPTEMBER, 1977.
03° 11'N 101° 30'E

Engines:	Four Pratt & Whitney JT3D-3B
Owner and Operator:	Japan Airlines
Flight Crew:	4 - Killed
Cabin Crew:	4 - Killed 2 - Seriously injured
Passengers:	26 - Killed 40 - Seriously injured 3 - Minor injuries
Place of Accident:	Near Kuala Lumpur International Airport, Subang, Selangor. 03° 11'N 101° 30'E
Date and Time:	27 September, 1977 at 1113 hours (1843LT). All times in this report are GMT and (Local Time).

SUMMARY

During a VOR/ADF approach at dusk in bad weather for Runway 15, Kuala Lumpur International Airport, the aircraft descended and intercepted the Minimum Descent Altitude (MDA) of 750 feet for the let-down, approximately 8 nautical miles (nm) from the runway. At this point, the runway could not be sighted. The aircraft continued to descend without the crew sighting the runway until it struck a low hill just past the North Marker (NM) beacon. The report concludes that the accident was caused by the crew of the aircraft descending below MDA although the airfield was not in sight. The aircraft descended so low that it struck a hill 260 feet high 4 nms short of the airfield.

Following the accident, Department of Civil Aviation, Malaysia advised and invited representatives from the following bodies to act either as Accredited Representatives or as Advisers to the accident investigation:-

USA	National Transportation Safety Board (NTSB) McDonnell Douglas Corporation
UK	Ministry of Trade, Accident Investigation Branch (UK AIB)
JAPAN	The Japan Aircraft Accident Investigation Commission (JAAIC) Japan Airlines

international passenger flight, from Tokyo to Singapore with intermediate stops at Hongkong and Kuala Lumpur. The flight began on 27 September, 1977. It was uneventful en-route Tokyo to Hongkong. The aircraft subsequently departed with no reported defects from Hongkong for Kuala Lumpur on an IFR flight plan with 69 passengers and 10 crew on board.

The aircraft maintained flight level (FL) 280 to the Kuala Lumpur (KL) VOR station VBA via airways R-85 and G-66. At 1025 hours (1755LT) Lumpur ACC issued a descent clearance to FL180 and later to FL110. At 1034 hours (1804LT), the aircraft reported over VBA at FL110 and KL Tower issued an Expected Approach Time (EAT) of 1055 hours (1825LT). During the hold over VBA, the EAT was revised to 1105 hours (1835LT) and then to 1110 hours (1840LT). At 1107:16 hours (1837:16LT), Lumpur ATC issued an approach clearance to the aircraft when it was at 3000 feet in the hold, as follows: "JL715 cleared for approach now, report passing 2000 and VBA inbound". The aircraft responded: "JL715 cleared for approach, report passing VBA". At 1110 hours (1840LT), JL715 reported: "JL715 depart VBA, leaving 2000 over".

This was the last transmission received from the aircraft. It crashed at 1113 hours (1843LT). There were no eye-witnesses to the crash other than those on board the aircraft. Lumpur ATC initiated full emergency action as soon as urgent attempts failed to re-establish radio contact with the aircraft. After a ground and air search, the aircraft was finally located close to the NM beacon 4 nms short of the airfield.

Survivors from the crash reported that the flight felt completely normal up to the point of impact except that during the last phase of the flight, several survivors noticed the aircraft was flying low over trees. They reported that there was little or no turbulence, that the ground could be seen from the cabin windows whilst the aircraft was in the holding pattern and also throughout the approach until shortly before the impact. It was raining heavily as they escaped from the aircraft. Survivors from the rear cabin area described the impact as being like a rough landing in which they did not realise they were involved in an accident until the fuselage ahead of them broke away.

1.2 INJURIES TO PERSONS

INJURIES	CREW	PASSENGERS	OTHERS
Fatal	8	26	0
Serious	2	40	0
Minor/None	0	3	0

1.3 DAMAGE TO AIRCRAFT

The aircraft was completely destroyed by impact and fire damage.

1.5 FLIGHT CREW INFORMATION

The aircraft carried an operating crew of two pilots, one flight engineer and one flight engineer under training.

(a) COMMANDER

Age:	36 years
Licence:	Japan Airline Transport Pilot's Certificate
Aircraft Ratings:	DC8 and Boeing 727
Medical Certificate:	Valid until 29 October, 1977 (Last examination 28 March, 1977)
Last Competency Check:	23 June, 1977
Last Route Check:	02 December, 1976

FLYING EXPERIENCE

Total Pilot Hours:	6,575 hours
Total Flying Hours in Command of DC8 Aircraft:	2,986 hours
Total Flying Hours as Co-Pilot of DC8 Aircraft:	2,060 hours
Total DC8 Time:	5,046 hours
Total Flying Hours in Last 28 Days:	54:57 hours

The Commander had last flown into Kuala Lumpur on 02 September, 1977. He had also flown into the same airfield at least twice a month in the last 3 months. His last periodic check included a satisfactory VOR approach in a DC8 simulator on 23 June, 1977. His rest and duty periods in the 7 days prior to the accident were examined and found satisfactory.

The Commander had been employed by the Company since 01 April, 1965.

Medical Certificate:	Valid until 30 January, 1978 (Last examination 04 July, 1977)
Last Competency Check:	24 May, 1977
Last Route Check:	25 April, 1977

FLYING EXPERIENCE

Total Pilot Hours:	3,635 hours
Total Flying Hours as Co-Pilot of DC8 Aircraft:	2,277 hours
Total Flying Hours in Last 28 Days:	42:32 hours

The Co-Pilot had last flown into Kuala Lumpur on 08 August, 1977. He had carried out a satisfactory DC8 Qualification Check (Route) on 25 April, 1977. His rest and duty periods in the 7 days prior to the accident were examined and found satisfactory.

(c) FLIGHT ENGINEER

Age:	46 years
Licence:	Japan Flight Engineer's Certificate
Aircraft Ratings:	DC8, Boeing 727 and DC6
Medical Certificate:	Valid until 31 May, 1978 (Last examination 25 April, 1977)
Last Competency Check:	04 July, 1977
Last Route Check:	22 February, 1977

FLYING HOURS

Total Flight Engineer Hours:	6,052 hours
Total Flying Hours as Flight Engineer on DC8 Aircraft:	4,536 hours
Total Flying Hours in Last 28 Days:	22 hours

Medical Certificate:	Valid until 30 December, 1977 (Last examination 22 November, 1976)
Last Competency Check:	01 July, 1977
Last Route Check:	16 April, 1977

FLYING HOURS

Total Flight Engineer Hours:	4,630 hours
Total Flying Hours as Flight Engineer on DC8 Aircraft:	1,230 hours
Total Flying Hours in Last 28 Days:	8 hours

1.6 AIRCRAFT INFORMATION - Douglas DC8-62 JA8051

1.6.1	Manufacturer:	McDonnell Douglas Corporation, California, USA
	Year of Manufacture:	1971
	Owner:	Registered in the name of Japan Airlines in August, 1971
	Certificate of Airworthiness (C of A):	Certificated by Japan Civil Aviation Bureau in August, 1971 and valid at the time of the accident.
	Last Maintenance:	"C" Check
	Hours Flown Since Maintenance:	Zero since "C" Check at departure from Tokyo
	Hours Flown Since New:	19,225:55 hours at departure from Tokyo
	Maximum Regulated Landing Weight:	240,000 lbs
	Estimated Weight at Time of Accident:	185,700 lbs - 188,400 lbs

Defects:	There were no recorded defects pertinent to the accident
Maintenance History:	The aircraft had been maintained satisfactorily to a Maintenance Programme approved by the Japan Civil Aviation Bureau, and all relevant Airworthiness Directives had been complied with.

The aircraft was equipped with a rain removal system comprising high pressure air jets in front of the Captain's and Co-Pilot's wind-shields, and a dispensing system for a rain repellant liquid. The aircraft was equipped with dual low range radio altimeter systems and an altitude alert system. However no ground proximity warning system was installed.

1.7 METEOROLOGICAL INFORMATION

1.7.1 GENERAL

The month of September is an inter-monsoon period at Kuala Lumpur. During this period, there is a peak in the frequency of thunderstorms, the storms normally occurring in the late afternoons and early evenings. On 27 September, 1977 the weather was generally cool and cloudy with rain and thunderstorms in the evening.

1.7.2 AIRFIELD WEATHER

There was a storm giving heavy rain over the airfield at the time of the accident. Cumulonimbus (Cb) clouds with rain had begun forming to the south of the airfield earlier in the afternoon. This localised weather extended in a north-easterly to south-westerly line south of the airfield. It progressively moved overhead, and then to the north of the airfield. At the time of the accident, the line of weather consisting by now of rain and dark, low-level layer cloud mixed with Cbs had moved to between the airfield and the VOR/VBA beacon. There was a corresponding improvement of weather to the south of the airfield as a result of the northward movement of the weather.

The rainfall analysis covering the period of the accident between 1015 hours (1745LT) and 1415 hours (2145LT) is as follows:-

(e)	Moderate rain	2025	2035	3.6 mm/hr	} storms between 1815 and
(f)	Slight rain	2035	2155	0.1 mm/hr	} 2050

( ) heaviest rainfall occurred between 1825LT and 1833LT; the intensity was, at that time, 75 mm/hr. This intensity of precipitation is not an extreme value. The highest intensity recorded at the Kuala Lumpur airfield station is 212 mm/hr on 15 April, 1973. All rain figures quoted refer to a point).

The relevant weather reports, as recorded at the Meteorological Station, Kuala Lumpur International Airport were as follows:-

METAR WMKK 1000 00000 9999 1CB017
3SC030 7Cs260 27/24 1008 CB E-SW
TREND NO. SIG =

METAR WMKK 1030 19004 9999 60RA
1CB017 6SC030 5Cs260 27/24 1008 CB N-S
TREND TEMPO 1030/1230 Vis 5000M Wx 61RA =

SPECI WMKK 1045 15007 0800 95TS
2ST002 2CB017 4SC030 8As140 CB N-W slight
thunderstorm SE-S QBA 800 METRES SE-SW
Elsewhere 5-6 Km
TREND NO SIG =

METAR WMKK 1100 13008 0800 95TS
1ST002 2CB017 4SC030 8As140 24/23 1009
CB N-W Slight thunderstorm SE-S
TREND NO SIG =

METAR/SPECI WMKK 1130 00000
9999 95TS 1ST002 2CB017 4SC030 8As140
23/23 1010 CB SE-N Slight thunderstorm W-NW
TREND GRADU 1130/1230 Wx NIL 1CB017 4SC030 8As140 =

METAR WMKK 1200 00000 9999 95TS
1ST002 1CB017 3SC030 8As140 23/23 1010
CB and lightning SE-W, slight thunderstorm W-NW
TREND TEMPO 1200/1300 Wx 95TS/60RA

Weather reports were passed to ATC and put on the ATIS tape for broadcast at the following times:-

1030 hours (1800LT); SPECIAL 1050 hours (1820LT);
1100 hours (1830LT); SPECIAL 1130 hours (1900LT);

(a) At 1058:10 hours (1828:10LT) in reply to an aircraft (not JL715) which asked if the weather was clearing towards the south of the airfield, Lumpur replied: "There is a slight improvement".

(b) At 1058:25 hours (1828:25LT), Lumpur called: "Misty 46 is cleared to land. Wind is 140 six knots".

(c) At 1104:14 hours (1834:14LT), Lumpur broadcast: "This is Kuala Lumpur. There is a slight improvement in the weather - visibility is about 4 kilometres all round".

The transcript of the CVR confirms that the Japan Airline Company Office based at the airport passed the 1030 hours (1800LT) weather report to the aircraft crew at 1040 hours (1810LT) on the Company radio frequency. The crew were advised that there were Cbs extending North to South; wind 190/04 knots; there was a very heavy shower over the airport at the time with the QNH at 1008. Subsequent weather reports issued at 1045 hours (1815LT) and 1100 hours (1830LT) indicating significant deteriorations were not passed. Crew discussion on the weather following receipt of the Company report indicate that they were not unduly concerned. They were fully aware that there were heavy rain showers with Cbs extending North to South over the airfield, and that the weather was therefore bad.

1.7.2 APPROACH PATH WEATHER

A picture of the weather encountered by JL715 was built-up using statements from pilots of other aircraft which made approaches around the time of the accident; from surviving passengers and from one ground observer. There were 3 military aircraft (2 Caribous and one C130) who landed successfully off their approaches ahead of JL715. Behind JL715 in the hold over the VBA beacon were 3 other aircraft - a Qantas B747 (QF2); a MAS DC-10 and a SIA B737 (SQ112) all awaiting their turn for the approach to runway 15.

The weather in the holding pattern over VBA was reported to be fine with layers of broken cloud about 300-500 feet thick and no rain. The cloud base could not be established but there was cloud below 3000 feet - mainly stratiform with some breaks in the overcast. Aircraft in the holding pattern could see other aircraft below/above them. Some passengers could make out various features and lights on the ground whilst one observer on the ground could see several of the aircraft above him in the holding pattern.

und the NM beacon was affected [illegible] low cloud
e airport. In this area, there was low cloud with very
st above the hills, and moderate to heavy rain with
ili Pilots who flew through this weather stated that it
y dark cloud "like entering a black tunnel" accompanied by
n and slight to moderate turbulence. Misty 46 (an Airforce
aircraft) on his final approach at 1048 hours (1818LT) reported
a solid mass of rain cloud at 1800 feet soon after departing
orward visibility was virtually nil until he was overhead the
when he saw the runway lights. He reported slight turbulence
not see any lightning. At about 1101 hours (1831LT) some 12
before the accident, AMAN 244 (an Airforce C130 Hercules
ft) on his final approach reported encountering the same - very
loud with heavy rain accompanied by moderate turbulence and
Forward visibility. They saw three flashes of lightning.

at this time, MH811 (an MAS DC10 aircraft) in the holding pattern
that from where he was, the main Cb cell had passed the airfield
he east but there was a thick line of Cbs stretching across the
oach path of RW 15. This line of Cbs was observed to be about 5 nms
ck running approximately 040 degrees/060 degrees across the NM area.
reported that the weather looked like it was clearing to the south
this was confirmed by Lumpur ATC. Just prior to the accident
self at 1113 hours (1843LT), the majority of survivors of the
cident reported they experienced nil to light turbulence and little
n[illegible]ghtning. They confirmed it was raining heavily as they
vacuated the aircraft after the accident.

Some fifteen minutes after the accident, MH811 went through the edge of
this band of weather at altitude (4000 feet) on diversion to Singapore
and experienced lightning and slight turbulence. Five minutes later,
Singapore Airlines (SIA SQ112) also on diversion to Singapore at
altitude reported experiencing slight turbulence and rain. QF2 (a
Qantas B747) who was immediately behind JL715 confirmed the same
weather reports whilst in the hold over VBA and on diversion to Singapore.

Appendix "A" is a summary of the weather in the vicinity of the VOR
VBA and the airfield on the day of the accident.

1.7.3 SUMMARY

It is concluded that the weather factor in the accident was one of low
cloud base, heavy rain and poor forward visibility between VBA and NM
(probably within about one nautical mile of NM). Analysis of reports
on the weather from surviving passengers, meteorological stations and
from other aircraft airborne at the time appear to indicate that
there was no lightning or significant wind-shear or up/down draughts
at the time of approach.

There is no evidence to suggest that the aircraft was other than fully serviceable throughout the CVR recording. There was no reference to suggest any unusual phenomena, significant up/downdraughts, wind-shear or turbulence. The crew are heard to keep track of changes in weather conditions over the airfield through ATC and other aircraft radio transmissions as well as the Company Operation Officer's radio frequency. They did not appear unduly concerned about the weather, kept note of their position in the stack including those of other aircraft and had sufficient fuel remaining if required to divert to Singapore. They kept revising their EAT and monitored all approach radio transmissions advising of improvements to visibility, wet runway and surface wind conditions. Their calculated fuel remaining figures compare favourably with those established after the accident.

The CVR establishes that all cockpit drills for the approach and landing were carried out as per the Company operating procedures. Number One ADF was correctly identified and set to the NM beacon. They completed their approach checks (flaps 23 degrees; gear up) before reporting departure at VBA and then performed their landing checks. They completed their landing checks after passing VBA and the aircraft's final configuration was 35 degrees flap; gear down and locked; spoilers armed. The landing checks were completed with the exception of landing lights and final flap on standby at 1000 feet QNH.

Prior to departing VBA, the crew were heard to set their radio altimeters correctly to 750 feet, (681 feet) the airfield being 69 feet and the MDA 750 feet for Runway 15. The pressure altimeters were set at QNH 1008 mbs and cross-checked. The QNH settings on the pressure altimeters recovered from the crash site were 1006/7 and 1007/8 mbs respectively. However, these could be considered unreliable due to impact forces sustained by the instruments during the crash. The QNH setting at the time of the accident was 1009 mbs. It would therefore appear that the crew did not monitor the ATIS frequency which gave revised broadcasts indicating the QNH was rising from 1008 mb at 1030 hours (1800LT) to 1009 mb at 1100 hours (1830LT). Kuala Lumpur Tower also failed to advise the aircraft of the revised QNH.

The crew were heard to complete their checks normally down to MDA when radio altimeter warning notes were heard. The Approaching Minimas call was made and acknowledged at I-98 seconds. At I-76 seconds, the Captain was heard to say "Let us descend a little more" to which the Co-Pilot replied "Roger". It is evident from subsequent calls on the CVR that the crew were aware of the aircraft's steadily decreasing altitude, that this descent was executed knowingly and that they could not see the runway at any time. At I-8 seconds, the Captain was heard to say: "I still cannot see". The last comment at I-3 seconds, (probably by the Instructor Flight Engineer) was: "After passing through this, we will be able to see". Radio altimeter warning notes are evident at 2 seconds before impact, and a power increase is heard at one second before impact. (See Appendices "B" and "C" which were compiled using information from the FDR, CVR and the ATC tape transcripts).

north - facing side of a hill whose highest point was 305 feet amsl. An initial ground impact point for No:4 engine (starboard outer) was identified at approximately 260 feet amsl.

The aircraft's first contact was with rubber trees (typically standing 35 feet in height) on the dividing line between the rubber plantation and an adjacent plantation of oil palms. As oil palms are much the lower of the two types of vegetation, the aircraft collided with the main foliage of the rubber trees without contacting any of the oil palms. The swathe cut through the trees covered a distance of apporximately 350 feet.

A survey of the broken trees and initial ground impacts produced data from which the approach path could be estimated. The random nature of the tree breakage precluded high accuracy being achieved, but the evidence indicated that the approach path was a descent of not more than 8^{o} with a bank to port of not more than 6^{o}.

The noseleg, with the nosewheels attached, was impacted in the ground immediately up-track of its first ground contact. It was possible to identify two trees which had possibly caused its detachment. Compass sightings on the noseleg/ground impact and the No:4 engine impact yielded an approach direction of between 155^{o}M and 164^{o}M. A tree cut of significant length in the starboard wing leading edge was consistent with an approach direction of $160^{o}/166^{o}$M.

The ground slope was generally 1 in 4 upwards along the impact direction in a series of terraces and was typically 1 in 3 down from starboard to port across the track. The primary ground impacts were therefore taken on No:4 engine, No:3 engine and the aircraft's nose.

The aircraft came to rest near the top of the hill with the cockpit area 350 feet from its initial entry into the trees and at an altitude of 300 feet. Some wreckage including passenger seats and the starboard main landing gear was thrown further, upto a distance of 500 feet from the first tree impacts down the reverse slope of the hill.

1.12.2 WRECKAGE

The wreckage lay with its main components roughly in their normal relationship and displaced to port from its original track. The nose area and forward fuselage had disintegrated in a first tree collision near the top of the hill. Below them, the fuselage centre section, still attached to the port wing and inner starboard wing was almost completely burnt out. A large portion of the starboard wing, with the engine pylons attached, had broken away but lay close to the fuselage. All four engines lay separated behind their respective pylons in approximate line of track.

The tail section had broken off at station 1220 and was comparatively lightly damaged.

precluded an assessment of illumination.

All control surfaces were found on the accident site either attached to the airframe or detached by impact, and the extremities of the wings and empennage were identified. The spoilers were confirmed as being retracted and locked at impact and the auto-spoiler actuator was found to be in the spoiler retract position. The four leading edge slots had been damaged in the open position (the slots open with the initial deployment of the flaps). The flaps were found to be extended and the hydraulic jack extensions corresponded to flap positions from 12° to 35°. The control pedestal assembly containing the flap lever, power levers and fuel shut-off levers had been severely damaged by impact and fire and no reliable indication of the levers pre-crash position could be found. The aileron and rudder trim wheels were found on their mounting box complete with their bevel gears and the fractured co-axial shafts. The trim indicators were set at 1½ units to starboard for rudder and 1 unit left wing down for aileron. The stabilizer screw jack positions were measured and found to be equivalent to a trim setting of 3.6° ANU. The pitch trim compensator (mach trim) was found to be retracted.

Because of the nature of the crash, bulb filament analysis was an unreliable guide to system states. The warning lights for the generator unparalleled lights and system 1, 2 and 3 bus failure lights were illuminated, but this is considered to be due to electrical power loss caused by the crash. Positive evidence to confirm the availability of power to the aircraft's AC bus-bars 1, 2 and 3 was found, but that for the remaining AC bus-bar was not absolutely conclusive.

The extensive fire damage was consistent with a post-impact ground fire and there was no evidence of an in-flight fire. The airframe was examined as far as was possible for evidence of a lightning strike but none was found. Subsequent examination of electrical equipment also failed to produce any evidence of electrical discharge.

None of the reliable evidence obtained from the aircraft's equipment was considered to be anomalous with the aircraft being in a fully serviceable state.

NAVIGATIONAL EQUIPMENT

Radio/INS Switch (source for RDI): Destroyed

ADF 1 Controller, frequency selected: 333 KHz

ADF 2 Controller, frequency selected: 450 KHz

[illegible]	114:7
NAV 1 DME Switch:	Override
• NAV 2 Controller, frequency selected:	114:7
NAV 2 DME Switch:	Override

CAPTAIN'S RDI

DME 1 Indication:	Unreadable
DME 2 Indication:	Unreadable
• Heading:	162°
Set Heading:	Mechanism destroyed
ADF Bearing No:1	5°
No:2	332°

CO-PILOT'S RDI

DME 1 Indication:	083
DME 2 Indication:	Unreadable
• Heading:	161°
• Selected:	161°
ADF Bearing No:1	335°
No:2	325°

HORIZON AND FLIGHT DIRECTOR SYSTEM

FLIGHT DIRECTOR CONTROLLER

CRS Selector - Left:	Probably 159°
Right:	158°
Radio Selector Switch:	1
Mode Selector Switch:	Heading
Horizon Transfer Switch:	1

The instrument indications are those noted when the items concerned were removed from the wreckage. Subsequent specialist electronic investigations were carried out in Japan on a selection of navigation equipment and the significant results are listed below. It will be noted that some slight variations exist between the original and subsequent visual checks as a result of movement in transit between Malaysia and Japan.

Captain's RDI - HDG:	Visual	161°
	Synchro check	161°
* ADF 1:	Visual	7°
	Synchro check	7° (HDG 161°)
* ADF 2:	Visual	334°
	Synchro check	336° (HDG 161°)
Co-Pilot's RDI - HDG:	Visual	160°
	Synchro check	170°
ADF 1:	Visual	50°
	Synchro check	357° (HDG 161°)
ADF Controllers - No:1	Synchro check	327 ± 3 KHz
* No:2	Synchro check	220 ± 3 KHz
DME Transceivers - No:1	Frequency 94 channel (114:7 MHz)	
	Distance 8.4 (dial) 8.4 (synchro)	
* No:2	Frequency 94 channel (114:7 MHz)	
	Distance 8.3 (dial) 8.33 (synchro)	
Radio Altimeters - No:1	Pointer 0 feet	
	Bug set 75 feet	
No:2	Pointer 75 feet (unreliable)	
*	Bug set 680 feet	

It is considered that the instrument indications/switch positions of equipment moved from the wreckage marked * are the most reliable.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

1.13.1 A review of the operating crews' personal and medical records, character assessments, and of their activities in the 48 hours prior to reporting for duty at Tokyo Airport revealed no evidence that might have had a bearing on the accident. Post-mortem examinations on the operating crew and a review of their medical histories also brought to light no evidence that could be shown to have affected the performance of their duties.

1.13.2 Thirty-two bodies were recovered from the crash site, comprising 24 passengers, 4 operating crew and 4 cabin staff. One passenger died en-route to hospital and a further passenger died from injuries.

The cause of death for the majority of the victims was multiple injuries, the remainder being burnt to a degree which precluded exact determination of the cause of death.

1.14 FIRE

There was no evidence of in-flight fire. The entire front fuselage had been destroyed by impact and a large proportion subsequently consumed by a ground fire. The fuselage centre section was probably intact after impact but was subsequently burnt-out by the fire which also affected the wing inboard forward areas. Only one engine was damaged by fire, and that only externally. The fire was probably therefore, the result of impact or an electrical short-circuit or discharge after impact. It was evidently fuelled by combustible materials released by the destruction of the forward fuselage and by fuel spillage from wing tanks penetrated by collision with the trees.

1.15 SURVIVAL ASPECTS

1.15.1 SURVIVABILITY

The passengers and crew were all seated with their safety belts fastened for landing when the aircraft struck the ground. The interior cabin lights had also been dimmed for landing in accordance with JAL operating procedures. In the tail section, seat rows 24 (starboard only), and rows 25 to 28 were still in place. Several of the locking bars had been dislodged and the seats held secure only by their rear attachments. The seat belts were all found unfastened, undamaged and with their anchor points secure on passenger evacuation after the accident. The

to co-relate ejected seats and their deceased occupants. However, a drawing showing seat location of passengers, circumstances of survival, etc., was compiled from other information supplied by Japan Airlines survivors' statements, etc. (See Appendix "D").

In view of the location and nature of the accident and taking into consideration pathological evidence, it is not considered that the number of survivors would have been significantly increased even if rescue services could have been directed to the accident site immediately after loss of radio contact.

1.15.2 SEARCH AND RESCUE

Search and rescue activities were promptly initiated following loss of radio contact with the aircraft. The crash site, some two miles from the nearest surfaced road in a sparsely populated area, was situated in a large rubber/palm oil plantation spread across several low but steep hills serviced from a random maze of narrow laterite tracks contoured to follow the terrain. Heavy continuing rain after the accident softened the surface of the tracks and taken with their confusing nature made driving conditions extremely hazardous. Rescue vehicle VHF communications were severely affected by the surrounding terrain. However, following the first sighting of the post-crash fire from the air, rescuers reached the site in under four hours and the last of the injured was evacuated within six hours. Rescue operations were hampered by the steep muddy slope on which the wreckage lay, the very large number of trees knocked down across the site and the continuing rain and darkness.

1.16 TESTS AND RESEARCH

A test programme was carried out in the Company's DC8-62 flight simulator to evaluate the circumstances of the descent from the VOR/DME station to ground impact. The programme was based on information derived from the FDR read-out, CVR and ATC transcripts and JAL's standard operating procedures. Several approaches were carried out following the accident flight profile. The pattern of events that occurred in the accident were satisfactorily repeated. Several approaches were made using standard operating techniques for comparison purposes and two trial approaches were made using revised altitude minimas at the VOR/DME station and the NM locator beacon. The programme was arranged by the staff of JAL at very short notice and their co-operation greatly facilitated the work of the Malaysian Accident Investigation Team.

1.17 OTHER INFORMATION

made by JL715 into Kuala Lumpur Airport Runway 15 where the radio navigational aids available, are located some distance from the runway is shown at Appendix "E". The descent would be commenced from the minimum holding altitude (2000 feet) over the VOR/DME Station "VBA". The approach check list with either flap 23 degrees/gear up and manoeuvring speed (Vm) 150 knots; or flap 35 degrees/gear down and approach speed (Vapp) 135 knots selected, would then be completed. If the location of the low station is far from the runway, the crew is permitted to continue the approach after passing VBA in the manoeuvring configuration (flap 23 degrees/gear up, 150 knots Vm) until the altitude of 1500 feet. At 1500 feet altitude, they are required to change to the approach configuration (flap 35 degrees/gear down, 135 knots Vapp) at or below that altitude. The typical aircraft configuration for the approach to the Kuala Lumpur International Airport Runway 15 with the navigational aids available, and where the low station is located some distance from the runway would then be as follows:-

Landing Gear:	Up (down at or below 1500 feet altitude)
Flaps:	23 degrees (35 degrees at or below 1500 feet altitude)
VOR/DME Sets:	Both tuned to "VBA"
No:1 ADF Set:	Tuned to "NM"
No:2 ADF Set:	Tuned to "SM"
Autopilot:	Disengaged (Captain handling)
Altitude Alert:	Set at 2000 feet, then not required
Barometric Altimeters:	Captain's and Co-Pilot's each set with one index at the airfield elevation (69 feet) and the other at MDA (750 feet)
Captain's Radio Altimeter Index:	Set at 681 feet (750 feet MDA - threshold altitude of 69 feet)
Co-Pilot's Radio Altimeter Index:	Set at 2000 feet, until below this altitude, then reset to 681 feet

The aircraft would cross VBA inbound with IAS at manoeuvring speed (Vm) of 150 knots, and at VBA a rate of descent of 1000 feet per minute would be established with the airspeed being reduced to the approach speed (Vapp) of 135 knots at or below 1500 feet altitude with flaps 35

If the runway is identified, altitude is maintained at 750 feet until the T-VASIS 3° visual glide slope is intercepted. Thus although the JAL minima for a VOR/DME approach to Runway 15 is laid down as 750 feet and 2400 metres visibility, the requirement to use "NM" as a MAP in effect raises the minimum visibility level required to 4 nautical miles.

1.17.2 JAL'S MONITORING PROCEDURES AND CREW DUTIES

The approach and landing is normally made with the Captain handling the aircraft including the throttles. The monitoring procedures laid down are as follows:-

At 1500 feet:	Co-Pilot calls out the altitude and airspeed checking both barometric altimeters, and the Captain acknowledges.
At 1000 feet:	Co-Pilot calls out the altitude and airspeed checking both barometric altimeters, and the Captain acknowledges.
Below Field Elevation Plus 1000 Feet:	Co-Pilot calls out altitude and airspeed every 200 feet.
At 100 feet above Minimums: (In this case 850 feet on the barometric altimeters)	Co-Pilot calls "Approaching Minimums", and the Captain acknowledges. (Note: This call is mandatory only for precision approaches. It is not required for VOR/ADF approaches).
At MDA:	When the aircraft reaches the decision height or visual contact is established, the Co-Pilot should so advise the Captain.

If the runway is in sight, the Captain may descend when appropriate to establish a 3 degree approach path.

instruments, he is permitted to glance up throughout the approach as he considers necessary. The Flight Engineer takes no part in these monitoring duties.

1.17.3 APPROACH PATH PROFILE

The presentation of the KL RWY 15 VOR/ADF Vertical approach path profile in the various charts produced by various publishers for use by operators was compared with those issued by the Department of Civil Aviation, Malaysia. Some slight but relevant differences may be noted when these charts are compared together. (Figures in brackets indicate altitude above RWY 15 threshold).

One published chart (Chart A) shows a descent slope from 2000 feet (1931 feet) at VBA to level at an MDA of 750 feet (681 feet) 2.7 nms short of the NM beacon (6.7 nms short of the runway threshold). The missed approach procedure is shown commencing at NM. The runway threshold elevation is given as 69 feet.

Another published chart (Chart B) shows a continuous descent slope from 2000 feet (1931 feet) at VBA, crossing NM at 1260 feet (1191 feet) and continuing to an unspecified "Appd Min" upwind of NM. The missed approach procedure is shown commencing from this point. The runway threshold elevation is given as 69 feet.

The chart issued by the Department of Civil Aviation, Malaysia shows a continuous descent slope from 2000 feet at VBA to reach the MDA 750 feet (681 feet) at NM. The missed approach procedure is shown commencing at NM. The runway threshold elevation is given as 69 feet.

Following an accident in May, 1976 when a Boeing 747 struck trees 2.2 nms from the threshold of Runway 15 whilst carrying out the VOR/ADF approach by night, two airlines adopted a descent profile similar to that shown in the Chart B example indicated above to avoid an unduly prolonged level leg at Decision Height (DH)/MDA. The Decision Height for Runway 15 used by airlines operating jet aircraft varies from 750 feet (the MDA) to 1100 feet. Whilst there is an advantage in intersecting the 3° visual glide path from level flight at DH/MDA, it is considered less than satisfactory to extend this level flight phase of the approach unnecessarily far downwind of the runway threshold. It would therefore be prudent for the approach path profile to be reviewed and airlines and the publishers of aerodrome information charts agree to standardise to one common published profile to an agreed best standard. The VOR/ADF let-down procedure for Runway 15 at Kuala Lumpur should be reviewed with a view to making them more compatible with a stabilised final approach from above 1000 feet in the landing configuration. However, whilst the existing let-down procedure may not be the ideal, it is considered that the present

2.1 There is no evidence to suggest that the aircraft was other than fully serviceable when it left Hongkong. The crew reported no defects to the JAL Operations Officer or to Lumpur ATC. No defects are referred to in their conversations on the CVR tape covering the last thirty-three minutes of flight. Evidence from the wreckage and the site shows that when the aircraft hit the trees, it was not in an extreme attitude or experiencing a high rate of descent. The horizontal stabiliser trim state was consistent with the aircraft loading and an approach configuration.

No evidence was found to indicate that the aircraft was otherwise than intact and serviceable just before impact.

2.2 The evidence on the weather obtained from airport observations, other pilots, survivors and a ground witness shows that although the weather over the major part of the approach path between VBA and NM was fair, a large storm lay across the approach path in the vicinity of NM.

This storm was about 5 nms thick consisting of Cbs and heavy rain mixed with low-level, dark layer cloud. There is little doubt that this weather made flying conditions difficult on the approach to Runway 15. It was a major contributory factor to, but not the cause of the accident. Visibility was poor but there was no significant wind-shear or turbulence. What up or downdraughts there were associated with the rain storm could not have been more than those normally expected. Nor would these momentary up/downdraughts be expected to be of such magnitude that an experienced crew could not cope with them satisfactorily.

2.3 The FDR record shows a standard JAL descent of about 1000 feet per minute from 2000 feet over VBA to the MDA of 750 feet except that the airspeed is higher than the 150 knots (Vm) required to be established after passing the VBA and before reaching the altitude of 1500 feet; and higher than the 135 knots (Vapp) required at or below the altitude of 1500 feet, as specified in JAL's operating procedures. JL715's airspeed of 178 knots on leaving 2000 feet although gradually reduced during the descent to a mean of 145 knots at 750 feet suggests the let-down was not being flown with the expected degree of precision. Several aircraft were in the stack at the time; Expected Approach Times were continuously being revised and so were the weather forecasts including changes in QNH settings.

[illegible] to MDA. However, at I-40 seconds while still at MDA, the Captain reduced power and established a descent rate of 1090 feet per minute although the airfield was not visible and forward visibility was poor. At this time, as some survivors reported, the ground below the aircraft was visible through thin patches of cloud. This descent was executed contrary to safety considerations and JAL Company operating procedures. The Co-Pilot continued to call out the heights at 100 feet intervals whilst in the descent down to 300 feet in accordance with Company procedures. The Co-Pilot did not appear to make any remark to the Captain that might have made him apply power and climb. The aircraft continued to descend until it crashed at a height of 260 feet amsl. The altimeter warning note heard at I-2 seconds indicates that the Captain's radio altimeter index was by now set at a very low height.

2.5 Taken together this evidence leads to the conclusion that the accident was the result of the Captain knowingly letting down below MDA in bad weather without having the runway in sight, and then continuing to descend until the aircraft struck a low hill 4 nautical miles short of the runway threshold. A subsidiary contributory factor was the Co-Pilot's passive acceptance of this descent shown by his failure to challenge the Captain on his dangerous breach of a mandatory company procedure. Such a challenge by the Co-Pilot is not called for in the JAL Operations Manual although it is an implied part of every Co-Pilot's monitoring duties to speak out whenever necessary to safeguard the aircraft. Co-Pilots however, are sometimes hesitant to challenge or criticise a Captain's actions. It would strengthen a Co-Pilot's position and significantly reduce the chance of an accident resulting from a Captain's non-compliance with laid down minimas if Company Operations Manuals specified in precise words a challenge to be spoken by Co-Pilots (or other crew members) in circumstances such as occurred in this accident.

2.6 A standard rate of descent of 1000 feet per minute once inbound over the VBA station for the KL International VOR Runway 15 let-down might be considered a contributory factor to the accident especially since the VBA station is far from the runway. For the approach pattern which exists for Runway 15, such an initial rate of descent would bring the aircraft to MDA too quickly and far short of the pull-up overshoot point and/or runway threshold as happened in this accident. The aircraft would be far below a normal 3 degrees glide slope and have to fly level for an unduly prolonged period. Should the crew then suffer from visual illusions such as "black tunnel effect" or encounter thin layer cloud throught which the ground might be seen, there might be a temptation to "duck under" below MDA to maintain ground visual contact. More importantly, the margin of safety would be significantly eroded should the crew omit

a more established overall 3 degree glide slope to Runway 15, without changing MDA, would not only provide more precise but also more comfortable approach safety margins. Such a revision would eliminate the unduly extended level flight at low level at MDA to overhead the runway threshold which might be considered hazardous under extreme stress or emergency situations.

2.7 The quality of crew conversation recorded on the CVR tape through the area microphone was poor compared to that which could have been obtained through the crew's individual microphones. Whilst a cockpit area microphone is an important source for the CVR, speech fed to the recorder from flight crew microphone as an extra facility provides much better quality information for any investigation. This improved system has been incorporated by several airlines and is a requirement by at least one Contracting State.

3. CONCLUSIONS

3.1 FINDINGS

(i) The aircraft had been properly maintained in accordance with an approved schedule and its documentation was in order. There is no evidence to suggest that there was any technical failure or malfunction in flight.

(ii) The crew were appropriately licensed and experienced to conduct the flight. They had flown regularly into Kuala Lumpur and had carried out all necessary periodic checks.

(iii) There were no defects in the radio navigational aids in use either on the ground or in the aircraft.

(iv) There was adverse weather in the form of Cbs, heavy rain with dark, low-level layer clouds with base probably just above the hills between VBA and the airfield. Several aircraft were in the stack; weather conditions and expected approach times were continually revised. The crew did not set the revised QNH setting.

(v) The higher than normal airspeed at which the aircraft departed VBA to just before impact suggests the VOR/ADF let-down to Runway 15 was not flown with the expected degree of precision.

(vi) The aircraft entered the weather at MDA. Although the crew did not have the runway in sight and could not have seen it for some time, the crew continued to descend below MDA.

[illegible] the aircraft struck a low hill at 260 feet amsl 4 nms short of the runway threshold. This could suggest that the Captain might not possibly have taken note of the time or distance to run to the MAP and/or the runway threshold; or if he had, he had been distracted for the aircraft to be placed so far and so low from the runway.

(ix) During the descent from MDA 750 feet, the Co-Pilot called out the height and speeds at regular intervals in accordance with Company procedures, but the CVR tape bore no challenge from him or the Flight Engineer that might have made the Captain change his mind and initiate the missed approach procedure.

3.2. CAUSE

The accident was caused by the aircraft Captain descending below MDA without having the runway in sight, and continuing the descent until the aircraft struck a hill 260 feet amsl, 4 nms short of the runway threshold. A subsidiary contributory factor was insufficient monitoring of the aircraft's flight path by the Captain under the adverse weather conditions with several aircraft in the hold awaiting their turn for approach and, more importantly, the Co-Pilot's failure to challenge the Captain's breach of published Company regulations.

4. SAFETY RECOMMENDATIONS

It is recommended that:-

(1) The VOR/ADF approach path profile for Runway 15 be reviewed in order to provide a more stable glide slope from VBA to the Missed Approach Point and runway threshold.

(2) Airlines operating into Kuala Lumpur review their own Decision Heights for the existing VOR/ADF approach path profile for Runway 15 until an Instrument Landing System is installed.

(3) The Department of Civil Aviation, Malaysia provides an Instrument Landing System for Runway 15 as soon as practicable.

(4) JAL reviews their operating procedures/Company regulations to ensure their cockpit non-flying pilots (PNF) have suitable authority to challenge flying pilots (PF) should a dangerous breach of the Company regulations be contemplated. Such procedures should be kept simple but positive.

MAF CARIBOU ISTY 102B	17:33 at 5000 feet	Light rain between VBA and NM	Nil	Other aircraft and (partially) ground	Nil
MAF CARIBOU ISTY 46	17:27 est. at 6000 feet	Drizzle	Nil	Visibility 2/3 Km. Partially VMC and could see Misty 102B below, AMAN 244 at 7000 feet and JL715 at 8000 feet	Nil at 2000 f
MAF C.130 MAN 244	Not known	Marginal 5 Oktas Cu, 2 Oktas Cb.	2 flashes approx. 2 miles East	Could see QF2 and JL715	Mild

RELATIVE POSITION OF JL715

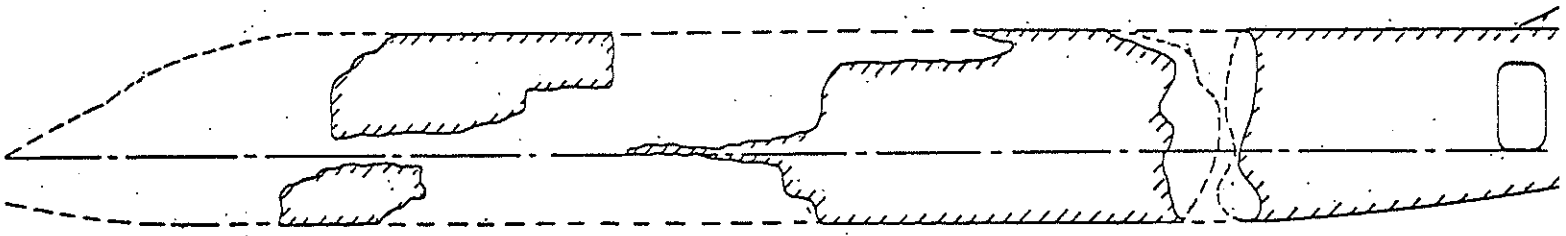
ANTAS B747 F2	18:02 at FL140. One minute behind JL715	Mainly overcast layer cloud, stratiform 2 Oktas Cb.	Some to South and East	Airborne visibility was good	Nil to slight
AS MH811 C10	17:46 est.	Weather clearing to South and East. A thick line of Cb's stretching across approach path to Runway 15, approx. 040/060°	Slight	Not mentioned	Slight

IAF CARIBOU :STY 102B. ınded on IY 1F	17:40	Heavy rain from NM to RWY 15 threshold. Large clump of black cloud towards NE of RWY 15 moving towards North	Not reported	Slant was fair, reduced when close to rwy. Visibility poor on rwy. Saw approach lights at 750 feet over NM.	Not reporte
IAF CARIBOU :STY 46. ınded on IY 33 after 'ershoot on IY 15	18:18	Entered solid mass of heavy rain cloud at 1800 feet	Not reported	Nil at BOH on initial approach, approach lights faintly visible at 1 mile from threshold. Runway visible at 450 feet overhead	Slight
IAF C.130 IAN 244. ınded on IY 15	18:31 est.	Heavy rain, solid cloud at 7 DME South	3 flashes	Found forward visibility zero. At BOH, RWY 15 approach lights faintly visible at 4 miles from threshold. Very dark.	Moderat

RELATIVE POSITION OF JL715

NTAS B747 ?2. iverted to ingapore. id not escend below)00 feet	N/A	Rain	Not reported	Not reported	Slight
AS MH811 :10. iverted to ingapore	N/A	15 minutes after accident, at 4000 feet passed through same band of weather	Some	Not reported	Slight

MAJOR SECTIONS OF WRECKAGE



CREW MEMBERS KILLED

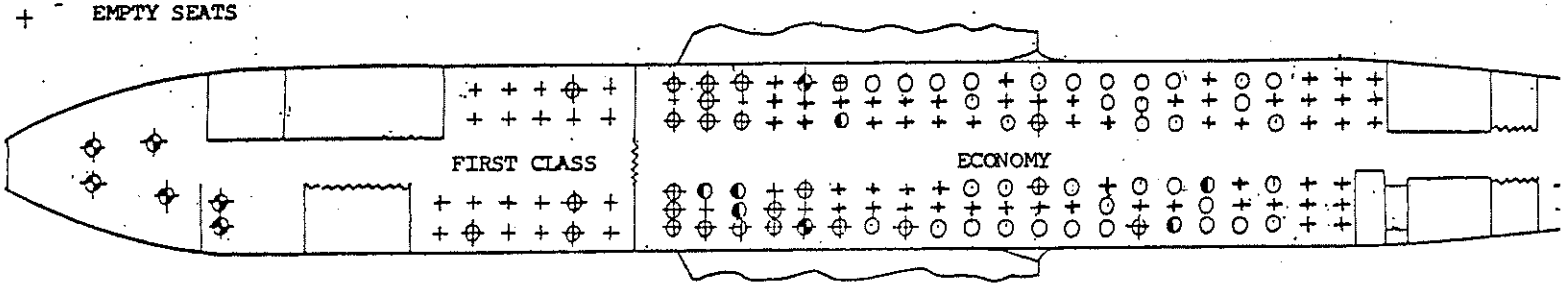
SURVIVING CREW MEMBERS

PASSENGERS KILLED

SURVIVING PASSENGERS - THROWN OUT AFTER FAILURE OF SEAT ATTACHMENTS OR SEAT BELT

SURVIVING PASSENGERS - ESCAPED/RESCUED FROM WRECKAGE

EMPTY SEATS



On down wind leg, set flaps 25° ((62) : flap 23°) and maintain maneuvering speed.
Prior to entering base leg, extend the landing gear and flaps 35°.
On final approach, extend flaps to full and reduce airspeed to V_{TH} at the threshold of runway.
The copilot should call out altitude and airspeed at 1,500 feet and 1,000 feet.
Below field elev + 1,000 feet, the copilot should call out altitude and airspeed every 200 feet. Below field elevation + 600 feet, the copilot should call out altitude and airspeed every 100 feet. As for airspeed, difference from V_{TH} should be called out after landing configuration is set.

2. Four & Three Engine ADF, VOR Approach

(1) Prior to entering the high station, extend the flaps 25° ((62) : 23°) and maintain airspeed at V_M.

(2) On the approved approach pattern, extend flap 25° ((62) : 23°), maintain airspeed at V_M, and descend at 1,000 feet/min descent rate. Make procedure turn at procedure turn altitude.

(3) Prior to entering low station, extend the landing gear and flaps 35°, and maintain airspeed at V_{APP}. At low station, fix time check required from the low station to the decision height. Maintain V_{APP} and descend at 1,000 feet/min descent rate on the approved approach pattern, and continue the approach to the decision height.

(4) Before descending to the altitude of field elev + 1,000 feet, the copilot should cross check the associated ADF or VOR instruments.
After passing through the low station, the copilot should call out altitude and airspeed at every 500 feet. Below field elev + 1,000 feet, call out altitude and airspeed every 200 feet and below field elev + 600 feet, call out altitude and airspeed every 100 feet. As for airspeed, difference from V_{TH} should be called out after landing configuration is set.
The copilot should direct his attention to find the runway.
The copilot should monitor the elapsed time and advise the captain.
When the airplane reaches decision height or visual contact is established, the copilot should so advise the captain.

(5) When the decision height is attained, maintain the altitude and the V_{APP} on the approved approach pattern, and continue the approach so far as visual contact i established or until pull up time is attained.

(6) If visual contact cannot be established with approach lights and the runway at th pull up time, missed approach should be immediately executed.

NOTE (1) If location of the low station is far from the runway, you may continue the approach with maneuvering configuration and V_M until the altitude of 1,500 feet and change to approach configuration at that altitude.

(2) For circling approach may commence the approach with maneuveri configuration and V_M from passing through the low station.

AIRCRAFT ACCIDENT REPORT NO: 1/77

CHIEF INSPECTOR OF ACCIDENTS & SAFETY,
DEPARTMENT OF CIVIL AVIATION,
MALAYSIA.

McDONNELL DOUGLAS DC8 (SUPER 62) - JA8051 -
REPORT ON THE ACCIDENT NEAR KUALA LUMPUR
INTERNATIONAL AIRPORT, SUBANG, SELANGOR
ON 27TH SEPTEMBER, 1977.
03° 11'N 101° 30'E

Engines:	Four Pratt & Whitney JT3D-3B
Owner and Operator:	Japan Airlines
Flight Crew:	4 - Killed
Cabin Crew:	4 - Killed 2 - Seriously injured
Passengers:	26 - Killed 40 - Seriously injured 3 - Minor injuries
Place of Accident:	Near Kuala Lumpur International Airport, Subang, Selangor. 03° 11'N 101° 30'E
Date and Time:	27 September, 1977 at 1113 hours (1843LT). All times in this report are GMT and (Local Time).

SUMMARY

During a VOR/ADF approach at dusk in bad weather for Runway 15, Kuala Lumpur International Airport, the aircraft descended and intercepted the Minimum Descent Altitude (MDA) of 750 feet for the let-down, approximately 8 nautical miles (nm) from the runway. At this point, the runway could not be sighted. The aircraft continued to descend without the crew sighting the runway until it struck a low hill just past the North Marker (NM) beacon. The report concludes that the accident was caused by the crew of the aircraft descending below MDA although the airfield was not in sight. The aircraft descended so low that it struck a hill 260 feet high 4 nms short of the airfield.

Following the accident, Department of Civil Aviation, Malaysia advised and invited representatives from the following bodies to act either as Accredited Representatives or as Advisers to the accident investigation:-

USA	National Transportation Safety Board (NTSB) McDonnell Douglas Corporation
UK	Ministry of Trade, Accident Investigation Branch (UK AIB)
JAPAN	The Japan Aircraft Accident Investigation Commission (JAAIC) Japan Airlines

international passenger flight, from Tokyo to Singapore with intermediate stops at Hongkong and Kuala Lumpur. The flight began on 27 September, 1977. It was uneventful en-route Tokyo to Hongkong. The aircraft subsequently departed with no reported defects from Hongkong for Kuala Lumpur on an IFR flight plan with 69 passengers and 10 crew on board.

The aircraft maintained flight level (FL) 280 to the Kuala Lumpur (KL) VOR station VBA via airways R-85 and G-66. At 1025 hours (1755LT) Lumpur ACC issued a descent clearance to FL180 and later to FL110. At 1034 hours (1804LT), the aircraft reported over VBA at FL110 and KL Tower issued an Expected Approach Time (EAT) of 1055 hours (1825LT). During the hold over VBA, the EAT was revised to 1105 hours (1835LT) and then to 1110 hours (1840LT). At 1107:16 hours (1837:16LT), Lumpur ATC issued an approach clearance to the aircraft when it was at 3000 feet in the hold, as follows: "JL715 cleared for approach now, report passing 2000 and VBA inbound". The aircraft responded: "JL715 cleared for approach, report passing VBA". At 1110 hours (1840LT), JL715 reported: "JL715 depart VBA, leaving 2000 over".

This was the last transmission received from the aircraft. It crashed at 1113 hours (1843LT). There were no eye-witnesses to the crash other than those on board the aircraft. Lumpur ATC initiated full emergency action as soon as urgent attempts failed to re-establish radio contact with the aircraft. After a ground and air search, the aircraft was finally located close to the NM beacon 4 nms short of the airfield.

Survivors from the crash reported that the flight felt completely normal up to the point of impact except that during the last phase of the flight, several survivors noticed the aircraft was flying low over trees. They reported that there was little or no turbulence, that the ground could be seen from the cabin windows whilst the aircraft was in the holding pattern and also throughout the approach until shortly before the impact. It was raining heavily as they escaped from the aircraft. Survivors from the rear cabin area described the impact as being like a rough landing in which they did not realise they were involved in an accident until the fuselage ahead of them broke away.

1.2 INJURIES TO PERSONS

INJURIES	CREW	PASSENGERS	OTHERS
Fatal	8	26	0
Serious	2	40	0
Minor/None	0	3	0

1.3 DAMAGE TO AIRCRAFT

The aircraft was completely destroyed by impact and fire damage.

1.5 FLIGHT CREW INFORMATION

The aircraft carried an operating crew of two pilots, one flight engineer and one flight engineer under training.

(a) COMMANDER

Age:	36 years
Licence:	Japan Airline Transport Pilot's Certificate
Aircraft Ratings:	DC8 and Boeing 727
Medical Certificate:	Valid until 29 October, 1977 (Last examination 28 March, 1977)
Last Competency Check:	23 June, 1977
Last Route Check:	02 December, 1976

FLYING EXPERIENCE

Total Pilot Hours:	6,575 hours
Total Flying Hours in Command of DC8 Aircraft:	2,986 hours
Total Flying Hours as Co-Pilot of DC8 Aircraft:	2,060 hours
Total DC8 Time:	5,046 hours
Total Flying Hours in Last 28 Days:	54:57 hours

The Commander had last flown into Kuala Lumpur on 02 September, 1977. He had also flown into the same airfield at least twice a month in the last 3 months. His last periodic check included a satisfactory VOR approach in a DC8 simulator on 23 June, 1977. His rest and duty periods in the 7 days prior to the accident were examined and found satisfactory.

The Commander had been employed by the Company since 01 April, 1965.

Medical Certificate:	Valid until 30 January, 1978 (Last examination 04 July, 1977)
Last Competency Check:	24 May, 1977
Last Route Check:	25 April, 1977

FLYING EXPERIENCE

Total Pilot Hours:	3,635 hours
Total Flying Hours as Co-Pilot of DC8 Aircraft:	2,277 hours
Total Flying Hours in Last 28 Days:	42:32 hours

The Co-Pilot had last flown into Kuala Lumpur on 08 August, 1977. He had carried out a satisfactory DC8 Qualification Check (Route) on 25 April, 1977. His rest and duty periods in the 7 days prior to the accident were examined and found satisfactory.

(c) FLIGHT ENGINEER

Age:	46 years
Licence:	Japan Flight Engineer's Certificate
Aircraft Ratings:	DC8, Boeing 727 and DC6
Medical Certificate:	Valid until 31 May, 1978 (Last examination 25 April, 1977)
Last Competency Check:	04 July, 1977
Last Route Check:	22 February, 1977

FLYING HOURS

Total Flight Engineer Hours:	6,052 hours
Total Flying Hours as Flight Engineer on DC8 Aircraft:	4,536 hours
Total Flying Hours in Last 28 Days:	22 hours

Medical Certificate:	Valid until 30 December, 1977 (Last examination 22 November, 1976)
Last Competency Check:	01 July, 1977
Last Route Check:	16 April, 1977

FLYING HOURS

Total Flight Engineer Hours:	4,630 hours
Total Flying Hours as Flight Engineer on DC8 Aircraft:	1,230 hours
Total Flying Hours in Last 28 Days:	8 hours

1.6 AIRCRAFT INFORMATION - Douglas DC8-62 JA8051

1.6.1	Manufacturer:	McDonnell Douglas Corporation, California, USA
	Year of Manufacture:	1971
	Owner:	Registered in the name of Japan Airlines in August, 1971
	Certificate of Airworthiness (C of A):	Certificated by Japan Civil Aviation Bureau in August, 1971 and valid at the time of the accident.
	Last Maintenance:	"C" Check
	Hours Flown Since Maintenance:	Zero since "C" Check at departure from Tokyo
	Hours Flown Since New:	19,225:55 hours at departure from Tokyo
	Maximum Regulated Landing Weight:	240,000 lbs
	Estimated Weight at Time of Accident:	185,700 lbs - 188,400 lbs

Defects:	There were no recorded defects pertinent to the accident
Maintenance History:	The aircraft had been maintained satisfactorily to a Maintenance Programme approved by the Japan Civil Aviation Bureau, and all relevant Airworthiness Directives had been complied with.

The aircraft was equipped with a rain removal system comprising high pressure air jets in front of the Captain's and Co-Pilot's wind-shields, and a dispensing system for a rain repellant liquid. The aircraft was equipped with dual low range radio altimeter systems and an altitude alert system. However no ground proximity warning system was installed.

1.7 METEOROLOGICAL INFORMATION

1.7.1 GENERAL

The month of September is an inter-monsoon period at Kuala Lumpur. During this period, there is a peak in the frequency of thunderstorms, the storms normally occurring in the late afternoons and early evenings. On 27 September, 1977 the weather was generally cool and cloudy with rain and thunderstorms in the evening.

1.7.2 AIRFIELD WEATHER

There was a storm giving heavy rain over the airfield at the time of the accident. Cumulonimbus (Cb) clouds with rain had begun forming to the south of the airfield earlier in the afternoon. This localised weather extended in a north-easterly to south-westerly line south of the airfield. It progressively moved overhead, and then to the north of the airfield. At the time of the accident, the line of weather consisting by now of rain and dark, low-level layer cloud mixed with Cbs had moved to between the airfield and the VOR/VBA beacon. There was a corresponding improvement of weather to the south of the airfield as a result of the northward movement of the weather.

The rainfall analysis covering the period of the accident between 1015 hours (1745LT) and 1415 hours (2145LT) is as follows:-

(e)	Moderate rain	2025	2035	3.6 mm/hr	} storms between 1815 and
(f)	Slight rain	2035	2155	0.1 mm/hr	} 2050

( ) heaviest rainfall occurred between 1825LT and 1833LT; the intensity was, at that time, 75 mm/hr. This intensity of precipitation is not an extreme value. The highest intensity recorded at the Kuala Lumpur airfield station is 212 mm/hr on 15 April, 1973. All rain figures quoted refer to a point).

The relevant weather reports, as recorded at the Meteorological Station, Kuala Lumpur International Airport were as follows:-

METAR WMKK 1000 00000 9999 1CB017
3SC030 7Cs260 27/24 1008 CB E-SW
TREND NO. SIG =

METAR WMKK 1030 19004 9999 60RA
1CB017 6SC030 5Cs260 27/24 1008 CB N-S
TREND TEMPO 1030/1230 Vis 5000M Wx 61RA =

SPECI WMKK 1045 15007 0800 95TS
2ST002 2CB017 4SC030 8As140 CB N-W slight
thunderstorm SE-S QBA 800 METRES SE-SW
Elsewhere 5-6 Km
TREND NO SIG =

METAR WMKK 1100 13008 0800 95TS
1ST002 2CB017 4SC030 8As140 24/23 1009
CB N-W Slight thunderstorm SE-S
TREND NO SIG =

METAR/SPECI WMKK 1130 00000
9999 95TS 1ST002 2CB017 4SC030 8As140
23/23 1010 CB SE-N Slight thunderstorm W-NW
TREND GRADU 1130/1230 Wx NIL 1CB017 4SC030 8As140 =

METAR WMKK 1200 00000 9999 95TS
1ST002 1CB017 3SC030 8As140 23/23 1010
CB and lightning SE-W, slight thunderstorm W-NW
TREND TEMPO 1200/1300 Wx 95TS/60RA

Weather reports were passed to ATC and put on the ATIS tape for broadcast at the following times:-

1030 hours (1800LT); SPECIAL 1050 hours (1820LT);
1100 hours (1830LT); SPECIAL 1130 hours (1900LT);

(a) At 1058:10 hours (1828:10LT) in reply to an aircraft (not JL715) which asked if the weather was clearing towards the south of the airfield, Lumpur replied: "There is a slight improvement".

(b) At 1058:25 hours (1828:25LT), Lumpur called: "Misty 46 is cleared to land. Wind is 140 six knots".

(c) At 1104:14 hours (1834:14LT), Lumpur broadcast: "This is Kuala Lumpur. There is a slight improvement in the weather - visibility is about 4 kilometres all round".

The transcript of the CVR confirms that the Japan Airline Company Office based at the airport passed the 1030 hours (1800LT) weather report to the aircraft crew at 1040 hours (1810LT) on the Company radio frequency. The crew were advised that there were Cbs extending North to South; wind 190/04 knots; there was a very heavy shower over the airport at the time with the QNH at 1008. Subsequent weather reports issued at 1045 hours (1815LT) and 1100 hours (1830LT) indicating significant deteriorations were not passed. Crew discussion on the weather following receipt of the Company report indicate that they were not unduly concerned. They were fully aware that there were heavy rain showers with Cbs extending North to South over the airfield, and that the weather was therefore bad.

1.7.2 APPROACH PATH WEATHER

A picture of the weather encountered by JL715 was built-up using statements from pilots of other aircraft which made approaches around the time of the accident; from surviving passengers and from one ground observer. There were 3 military aircraft (2 Caribous and one C130) who landed successfully off their approaches ahead of JL715. Behind JL715 in the hold over the VBA beacon were 3 other aircraft - a Qantas B747 (QF2); a MAS DC-10 and a SIA B737 (SQ112) all awaiting their turn for the approach to runway 15.

The weather in the holding pattern over VBA was reported to be fine with layers of broken cloud about 300-500 feet thick and no rain. The cloud base could not be established but there was cloud below 3000 feet - mainly stratiform with some breaks in the overcast. Aircraft in the holding pattern could see other aircraft below/above them. Some passengers could make out various features and lights on the ground whilst one observer on the ground could see several of the aircraft above him in the holding pattern.

...und the NM beacon was affected ... low cl... with ve...
...e airport. In this area, there was low ...
...st above the hills, and moderate to heavy rain with ...
...ili Pilots who flew through this weather stated that it
...y dark cloud "like entering a black tunnel" accompanied by
...n and slight to moderate turbulence. Misty 46 (an Airforce
...aircraft) on his final approach at 1048 hours (1818LT) reported
a solid mass of rain cloud at 1800 feet soon after departing
...rward visibility was virtually nil until he was overhead the
...when he saw the runway lights. He reported slight turbulence
not see any lightning. At about 1101 hours (1831LT) some 12
...before the accident, AMAN 244 (an Airforce C130 Hercules
...ft) on his final approach reported encountering the same - very
...loud with heavy rain accompanied by moderate turbulence and
...forward visibility. They saw three flashes of lightning.

...at this time, MH811 (an MAS DC10 aircraft) in the holding pattern
...that from where he was, the main Cb cell had passed the airfield
...he east but there was a thick line of Cbs stretching across the
...oach path of RW 15. This line of Cbs was observed to be about 5 nms
...ck running approximately 040 degrees/060 degrees across the NM area.
...reported that the weather looked like it was clearing to the south
...l this was confirmed by Lumpur ATC. Just prior to the accident
...self at 1113 hours (1843LT), the majority of survivors of the
...cident reported they experienced nil to light turbulence and little
...o no ...ghtning. They confirmed it was raining heavily as they
...vacuated the aircraft after the accident.

Some fifteen minutes after the accident, MH811 went through the edge of this band of weather at altitude (4000 feet) on diversion to Singapore and experienced lightning and slight turbulence. Five minutes later, Singapore Airlines (SIA SQ112) also on diversion to Singapore at altitude reported experiencing slight turbulence and rain. QF2 (a Qantas B747) who was immediately behind JL715 confirmed the same weather reports whilst in the hold over VBA and on diversion to Singapore.

Appendix "A" is a summary of the weather in the vicinity of the VOR VBA and the airfield on the day of the accident.

1.7.3 SUMMARY

It is concluded that the weather factor in the accident was one of low cloud base, heavy rain and poor forward visibility between VBA and NM (probably within about one nautical mile of NM). Analysis of reports on the weather from surviving passengers, meteorological stations and from other aircraft airborne at the time appear to indicate that there was no lightning or significant wind-shear or up/down draughts at the time of approach.

There is no evidence to suggest that the aircraft was other than fully serviceable throughout the CVR recording. There was no reference to suggest any unusual phenomena, significant up/downdraughts, wind-shear or turbulence. The crew are heard to keep track of changes in weather conditions over the airfield through ATC and other aircraft radio transmissions as well as the Company Operation Officer's radio frequency. They did not appear unduly concerned about the weather, kept note of their position in the stack including those of other aircraft and had sufficient fuel remaining if required to divert to Singapore. They kept revising their EAT and monitored all approach radio transmissions advising of improvements to visibility, wet runway and surface wind conditions. Their calculated fuel remaining figures compare favourably with those established after the accident.

The CVR establishes that all cockpit drills for the approach and landing were carried out as per the Company operating procedures. Number One ADF was correctly identified and set to the NM beacon. They completed their approach checks (flaps 23 degrees; gear up) before reporting departure at VBA and then performed their landing checks. They completed their landing checks after passing VBA and the aircraft's final configuration was 35 degrees flap; gear down and locked; spoilers armed. The landing checks were completed with the exception of landing lights and final flap on standby at 1000 feet QNH.

Prior to departing VBA, the crew were heard to set their radio altimeters correctly to 750 feet, (681 feet) the airfield being 69 feet and the MDA 750 feet for Runway 15. The pressure altimeters were set at QNH 1008 mbs and cross-checked. The QNH settings on the pressure altimeters recovered from the crash site were 1006/7 and 1007/8 mbs respectively. However, these could be considered unreliable due to impact forces sustained by the instruments during the crash. The QNH setting at the time of the accident was 1009 mbs. It would therefore appear that the crew did not monitor the ATIS frequency which gave revised broadcasts indicating the QNH was rising from 1008 mb at 1030 hours (1800LT) to 1009 mb at 1100 hours (1830LT). Kuala Lumpur Tower also failed to advise the aircraft of the revised QNH.

The crew were heard to complete their checks normally down to MDA when radio altimeter warning notes were heard. The Approaching Minimas call was made and acknowledged at I-98 seconds. At I-76 seconds, the Captain was heard to say "Let us descend a little more" to which the Co-Pilot replied "Roger". It is evident from subsequent calls on the CVR that the crew were aware of the aircraft's steadily decreasing altitude, that this descent was executed knowingly and that they could not see the runway at any time. At I-8 seconds, the Captain was heard to say: "I still cannot see". The last comment at I-3 seconds, (probably by the Instructor Flight Engineer) was: "After passing through this, we will be able to see". Radio altimeter warning notes are evident at 2 seconds before impact, and a power increase is heard at one second before impact. (See Appendices "B" and "C" which were compiled using information from the FDR, CVR and the ATC tape transcripts).

north - facing side of a hill whose highest point was 305 feet amsl. An initial ground impact point for No:4 engine (starboard outer) was identified at approximately 260 feet amsl.

The aircraft's first contact was with rubber trees (typically standing 35 feet in height) on the dividing line between the rubber plantation and an adjacent plantation of oil palms. As oil palms are much the lower of the two types of vegetation, the aircraft collided with the main foliage of the rubber trees without contacting any of the oil palms. The swathe cut through the trees covered a distance of apporximately 350 feet.

A survey of the broken trees and initial ground impacts produced data from which the approach path could be estimated. The random nature of the tree breakage precluded high accuracy being achieved, but the evidence indicated that the approach path was a descent of not more than 8^{o} with a bank to port of not more than 6^{o}.

The noseleg, with the nosewheels attached, was impacted in the ground immediately up-track of its first ground contact. It was possible to identify two trees which had possibly caused its detachment. Compass sightings on the noseleg/ground impact and the No:4 engine impact yielded an approach direction of between 155^{o}M and 164^{o}M. A tree cut of significant length in the starboard wing leading edge was consistent with an approach direction of $160^{o}/166^{o}$M.

The ground slope was generally 1 in 4 upwards along the impact direction in a series of terraces and was typically 1 in 3 down from starboard to port across the track. The primary ground impacts were therefore taken on No:4 engine, No:3 engine and the aircraft's nose.

The aircraft came to rest near the top of the hill with the cockpit area 350 feet from its initial entry into the trees and at an altitude of 300 feet. Some wreckage including passenger seats and the starboard main landing gear was thrown further, upto a distance of 500 feet from the first tree impacts down the reverse slope of the hill.

1.12.2 WRECKAGE

The wreckage lay with its main components roughly in their normal relationship and displaced to port from its original track. The nose area and forward fuselage had disintegrated in a first tree collision near the top of the hill. Below them, the fuselage centre section, still attached to the port wing and inner starboard wing was almost completely burnt out. A large portion of the starboard wing, with the engine pylons attached, had broken away but lay close to the fuselage. All four engines lay separated behind their respective pylons in approximate line of track.

The tail section had broken off at station 1220 and was comparatively lightly damaged.

produced an assessment of illumination.

All control surfaces were found on the accident site either attached to the airframe or detached by impact, and the extremities of the wings and empennage were identified. The spoilers were confirmed as being retracted and locked at impact and the auto-spoiler actuator was found to be in the spoiler retract position. The four leading edge slots had been damaged in the open position (the slots open with the initial deployment of the flaps). The flaps were found to be extended and the hydraulic jack extensions corresponded to flap positions from 12° to 35°. The control pedestal assembly containing the flap lever, power levers and fuel shut-off levers had been severely damaged by impact and fire and no reliable indication of the levers pre-crash position could be found. The aileron and rudder trim wheels were found on their mounting box complete with their bevel gears and the fractured co-axial shafts. The trim indicators were set at 1½ units to starboard for rudder and 1 unit left wing down for aileron. The stabilizer screw jack positions were measured and found to be equivalent to a trim setting of 3.6° ANU. The pitch trim compensator (mach trim) was found to be retracted.

Because of the nature of the crash, bulb filament analysis was an unreliable guide to system states. The warning lights for the generator unparalleled lights and system 1, 2 and 3 bus failure lights were illuminated, but this is considered to be due to electrical power loss caused by the crash. Positive evidence to confirm the availability of power to the aircraft's AC bus-bars 1, 2 and 3 was found, but that for the remaining AC bus-bar was not absolutely conclusive.

The extensive fire damage was consistent with a post-impact ground fire and there was no evidence of an in-flight fire. The airframe was examined as far as was possible for evidence of a lightning strike but none was found. Subsequent examination of electrical equipment also failed to produce any evidence of electrical discharge.

None of the reliable evidence obtained from the aircraft's equipment was considered to be anomalous with the aircraft being in a fully serviceable state.

NAVIGATIONAL EQUIPMENT

Radio/INS Switch (source for RDI): Destroyed

ADF 1 Controller, frequency selected: 333 KHz

ADF 2 Controller, frequency selected: 450 KHz

[illegible]	114:7
NAV 1 DME Switch:	Override
• NAV 2 Controller, frequency selected:	114:7
NAV 2 DME Switch:	Override

CAPTAIN'S RDI

DME 1 Indication:	Unreadable
DME 2 Indication:	Unreadable
• Heading:	162°
Set Heading:	Mechanism destroyed
ADF Bearing No:1	5°
No:2	332°

CO-PILOT'S RDI

DME 1 Indication:	083
DME 2 Indication:	Unreadable
• Heading:	161°
• Selected:	161°
ADF Bearing No:1	335°
No:2	325°

HORIZON AND FLIGHT DIRECTOR SYSTEM

FLIGHT DIRECTOR CONTROLLER

CRS Selector - Left:	Probably 159°
Right:	158°
Radio Selector Switch:	1
Mode Selector Switch:	Heading
Horizon Transfer Switch:	1

The instrument indications are those noted when the items concerned were removed from the wreckage. Subsequent specialist electronic investigations were carried out in Japan on a selection of navigation equipment and the significant results are listed below. It will be noted that some slight variations exist between the original and subsequent visual checks as a result of movement in transit between Malaysia and Japan.

Captain's RDI - HDG:	Visual	161°
	Synchro check	161°
* ADF 1:	Visual	7°
	Synchro check	7° (HDG 161°)
* ADF 2:	Visual	334°
	Synchro check	336° (HDG 161°)
Co-Pilot's RDI - HDG:	Visual	160°
	Synchro check	170°
ADF 1:	Visual	50°
	Synchro check	357° (HDG 161°)
ADF Controllers - No:1	Synchro check	327 ± 3 KHz
* No:2	Synchro check	220 ± 3 KHz
DME Transceivers - No:1	Frequency 94 channel (114:7 MHz)	
	Distance 8.4 (dial) 8.4 (synchro)	
* No:2	Frequency 94 channel (114:7 MHz)	
	Distance 8.3 (dial) 8.33 (synchro)	
Radio Altimeters - No:1	Pointer 0 feet	
	Bug set 75 feet	
No:2	Pointer 75 feet (unreliable)	
*	Bug set 680 feet	

It is considered that the instrument indications/switch positions of equipment moved from the wreckage marked * are the most reliable.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

1.13.1 A review of the operating crews' personal and medical records, character assessments, and of their activities in the 48 hours prior to reporting for duty at Tokyo Airport revealed no evidence that might have had a bearing on the accident. Post-mortem examinations on the operating crew and a review of their medical histories also brought to light no evidence that could be shown to have affected the performance of their duties.

1.13.2 Thirty-two bodies were recovered from the crash site, comprising 24 passengers, 4 operating crew and 4 cabin staff. One passenger died en-route to hospital and a further passenger died from injuries.

The cause of death for the majority of the victims was multiple injuries, the remainder being burnt to a degree which precluded exact determination of the cause of death.

1.14 FIRE

There was no evidence of in-flight fire. The entire front fuselage had been destroyed by impact and a large proportion subsequently consumed by a ground fire. The fuselage centre section was probably intact after impact but was subsequently burnt-out by the fire which also affected the wing inboard forward areas. Only one engine was damaged by fire, and that only externally. The fire was probably therefore, the result of impact or an electrical short-circuit or discharge after impact. It was evidently fuelled by combustible materials released by the destruction of the forward fuselage and by fuel spillage from wing tanks penetrated by collision with the trees.

1.15 SURVIVAL ASPECTS

1.15.1 SURVIVABILITY

The passengers and crew were all seated with their safety belts fastened for landing when the aircraft struck the ground. The interior cabin lights had also been dimmed for landing in accordance with JAL operating procedures. In the tail section, seat rows 24 (starboard only), and rows 25 to 28 were still in place. Several of the locking bars had been dislodged and the seats held secure only by their rear attachments. The seat belts were all found unfastened, undamaged and with their anchor points secure on passenger evacuation after the accident. The

to co-relate ejected seats and their deceased occupants. However, a drawing showing seat location of passengers, circumstances of survival, etc., was compiled from other information supplied by Japan Airlines survivors' statements, etc. (See Appendix "D").

In view of the location and nature of the accident and taking into consideration pathological evidence, it is not considered that the number of survivors would have been significantly increased even if rescue services could have been directed to the accident site immediately after loss of radio contact.

1.15.2 SEARCH AND RESCUE

Search and rescue activities were promptly initiated following loss of radio contact with the aircraft. The crash site, some two miles from the nearest surfaced road in a sparsely populated area, was situated in a large rubber/palm oil plantation spread across several low but steep hills serviced from a random maze of narrow laterite tracks contoured to follow the terrain. Heavy continuing rain after the accident softened the surface of the tracks and taken with their confusing nature made driving conditions extremely hazardous. Rescue vehicle VHF communications were severely affected by the surrounding terrain. However, following the first sighting of the post-crash fire from the air, rescuers reached the site in under four hours and the last of the injured was evacuated within six hours. Rescue operations were hampered by the steep muddy slope on which the wreckage lay, the very large number of trees knocked down across the site and the continuing rain and darkness.

1.16 TESTS AND RESEARCH

A test programme was carried out in the Company's DC8-62 flight simulator to evaluate the circumstances of the descent from the VOR/DME station to ground impact. The programme was based on information derived from the FDR read-out, CVR and ATC transcripts and JAL's standard operating procedures. Several approaches were carried out following the accident flight profile. The pattern of events that occurred in the accident were satisfactorily repeated. Several approaches were made using standard operating techniques for comparison purposes and two trial approaches were made using revised altitude minimas at the VOR/DME station and the NM locator beacon. The programme was arranged by the staff of JAL at very short notice and their co-operation greatly facilitated the work of the Malaysian Accident Investigation Team.

1.17 OTHER INFORMATION

made by JL715 into Kuala Lumpur Airport Runway 15 where the radio navigational aids available, are located some distance from the runway is shown at Appendix "E". The descent would be commenced from the minimum holding altitude (2000 feet) over the VOR/DME Station "VBA". The approach check list with either flap 23 degrees/gear up and manoeuvring speed (Vm) 150 knots; or flap 35 degrees/gear down and approach speed (Vapp) 135 knots selected, would then be completed. If the location of the low station is far from the runway, the crew is permitted to continue the approach after passing VBA in the manoeuvring configuration (flap 23 degrees/gear up, 150 knots Vm) until the altitude of 1500 feet. At 1500 feet altitude, they are required to change to the approach configuration (flap 35 degrees/gear down, 135 knots Vapp) at or below that altitude. The typical aircraft configuration for the approach to the Kuala Lumpur International Airport Runway 15 with the navigational aids available, and where the low station is located some distance from the runway would then be as follows:-

Landing Gear:	Up (down at or below 1500 feet altitude)
Flaps:	23 degrees (35 degrees at or below 1500 feet altitude)
VOR/DME Sets:	Both tuned to "VBA"
No:1 ADF Set:	Tuned to "NM"
No:2 ADF Set:	Tuned to "SM"
Autopilot:	Disengaged (Captain handling)
Altitude Alert:	Set at 2000 feet, then not required
Barometric Altimeters:	Captain's and Co-Pilot's each set with one index at the airfield elevation (69 feet) and the other at MDA (750 feet)
Captain's Radio Altimeter Index:	Set at 681 feet (750 feet MDA - threshold altitude of 69 feet)
Co-Pilot's Radio Altimeter Index:	Set at 2000 feet, until below this altitude, then reset to 681 feet

The aircraft would cross VBA inbound with IAS at manoeuvring speed (Vm) of 150 knots, and at VBA a rate of descent of 1000 feet per minute would be established with the airspeed being reduced to the approach speed (Vapp) of 135 knots at or below 1500 feet altitude with flaps 35

If the runway is identified, altitude is maintained at 750 feet until the T-VASIS 3^{o} visual glide slope is intercepted. Thus although the JAL minima for a VOR/DME approach to Runway 15 is laid down as 750 feet and 2400 metres visibility, the requirement to use "NM" as a MAP in effect raises the minimum visibility level required to 4 nautical miles.

1.17.2 JAL'S MONITORING PROCEDURES AND CREW DUTIES

The approach and landing is normally made with the Captain handling the aircraft including the throttles. The monitoring procedures laid down are as follows:-

At 1500 feet:	Co-Pilot calls out the altitude and airspeed checking both barometric altimeters, and the Captain acknowledges.
At 1000 feet:	Co-Pilot calls out the altitude and airspeed checking both barometric altimeters, and the Captain acknowledges.
Below Field Elevation Plus 1000 Feet:	Co-Pilot calls out altitude and airspeed every 200 feet.
At 100 feet above Minimums: (In this case 850 feet on the barometric altimeters)	Co-Pilot calls "Approaching Minimums", and the Captain acknowledges. (Note: This call is mandatory only for precision approaches. It is not required for VOR/ADF approaches).
At MDA:	When the aircraft reaches the decision height or visual contact is established, the Co-Pilot should so advise the Captain.

If the runway is in sight, the Captain may descend when appropriate to establish a 3 degree approach path.

instruments, he is permitted to glance up throughout the approach as he considers necessary. The Flight Engineer takes no part in these monitoring duties.

1.17.3 APPROACH PATH PROFILE

The presentation of the KL RWY 15 VOR/ADF Vertical approach path profile in the various charts produced by various publishers for use by operators was compared with those issued by the Department of Civil Aviation, Malaysia. Some slight but relevant differences may be noted when these charts are compared together. (Figures in brackets indicate altitude above RWY 15 threshold).

One published chart (Chart A) shows a descent slope from 2000 feet (1931 feet) at VBA to level at an MDA of 750 feet (681 feet) 2.7 nms short of the NM beacon (6.7 nms short of the runway threshold). The missed approach procedure is shown commencing at NM. The runway threshold elevation is given as 69 feet.

Another published chart (Chart B) shows a continuous descent slope from 2000 feet (1931 feet) at VBA, crossing NM at 1260 feet (1191 feet) and continuing to an unspecified "Appd Min" upwind of NM. The missed approach procedure is shown commencing from this point. The runway threshold elevation is given as 69 feet.

The chart issued by the Department of Civil Aviation, Malaysia shows a continuous descent slope from 2000 feet at VBA to reach the MDA 750 feet (681 feet) at NM. The missed approach procedure is shown commencing at NM. The runway threshold elevation is given as 69 feet.

Following an accident in May, 1976 when a Boeing 747 struck trees 2.2 nms from the threshold of Runway 15 whilst carrying out the VOR/ADF approach by night, two airlines adopted a descent profile similar to that shown in the Chart B example indicated above to avoid an unduly prolonged level leg at Decision Height (DH)/MDA. The Decision Height for Runway 15 used by airlines operating jet aircraft varies from 750 feet (the MDA) to 1100 feet. Whilst there is an advantage in intersecting the 3° visual glide path from level flight at DH/MDA, it is considered less than satisfactory to extend this level flight phase of the approach unnecessarily far downwind of the runway threshold. It would therefore be prudent for the approach path profile to be reviewed and airlines and the publishers of aerodrome information charts agree to standardise to one common published profile to an agreed best standard. The VOR/ADF let-down procedure for Runway 15 at Kuala Lumpur should be reviewed with a view to making them more compatible with a stabilised final approach from above 1000 feet in the landing configuration. However, whilst the existing let-down procedure may not be the ideal, it is considered that the present

2.1 There is no evidence to suggest that the aircraft was other than fully serviceable when it left Hongkong. The crew reported no defects to the JAL Operations Officer or to Lumpur ATC. No defects are referred to in their conversations on the CVR tape covering the last thirty-three minutes of flight. Evidence from the wreckage and the site shows that when the aircraft hit the trees, it was not in an extreme attitude or experiencing a high rate of descent. The horizontal stabiliser trim state was consistent with the aircraft loading and an approach configuration.

No evidence was found to indicate that the aircraft was otherwise than intact and serviceable just before impact.

2.2 The evidence on the weather obtained from airport observations, other pilots, survivors and a ground witness shows that although the weather over the major part of the approach path between VBA and NM was fair, a large storm lay across the approach path in the vicinity of NM.

This storm was about 5 nms thick consisting of Cbs and heavy rain mixed with low-level, dark layer cloud. There is little doubt that this weather made flying conditions difficult on the approach to Runway 15. It was a major contributory factor to, but not the cause of the accident. Visibility was poor but there was no significant wind-shear or turbulence. What up or downdraughts there were associated with the rain storm could not have been more than those normally expected. Nor would these momentary up/downdraughts be expected to be of such magnitude that an experienced crew could not cope with them satisfactorily.

2.3 The FDR record shows a standard JAL descent of about 1000 feet per minute from 2000 feet over VBA to the MDA of 750 feet except that the airspeed is higher than the 150 knots (Vm) required to be established after passing the VBA and before reaching the altitude of 1500 feet; and higher than the 135 knots (Vapp) required at or below the altitude of 1500 feet, as specified in JAL's operating procedures. JL715's airspeed of 178 knots on leaving 2000 feet although gradually reduced during the descent to a mean of 145 knots at 750 feet suggests the let-down was not being flown with the expected degree of precision. Several aircraft were in the stack at the time; Expected Approach Times were continuously being revised and so were the weather forecasts including changes in QNH settings.

[illegible] to MDA. However, at I-40 seconds while still at MDA, the Captain reduced power and established a descent rate of 1090 feet per minute although the airfield was not visible and forward visibility was poor. At this time, as some survivors reported, the ground below the aircraft was visible through thin patches of cloud. This descent was executed contrary to safety considerations and JAL Company operating procedures. The Co-Pilot continued to call out the heights at 100 feet intervals whilst in the descent down to 300 feet in accordance with Company procedures. The Co-Pilot did not appear to make any remark to the Captain that might have made him apply power and climb. The aircraft continued to descend until it crashed at a height of 260 feet amsl. The altimeter warning note heard at I-2 seconds indicates that the Captain's radio altimeter index was by now set at a very low height.

2.5 Taken together this evidence leads to the conclusion that the accident was the result of the Captain knowingly letting down below MDA in bad weather without having the runway in sight, and then continuing to descend until the aircraft struck a low hill 4 nautical miles short of the runway threshold. A subsidiary contributory factor was the Co-Pilot's passive acceptance of this descent shown by his failure to challenge the Captain on his dangerous breach of a mandatory company procedure. Such a challenge by the Co-Pilot is not called for in the JAL Operations Manual although it is an implied part of every Co-Pilot's monitoring duties to speak out whenever necessary to safe-guard the aircraft. Co-Pilots however, are sometimes hesitant to challenge or criticise a Captain's actions. It would strengthen a Co-Pilot's position and significantly reduce the chance of an accident resulting from a Captain's non-compliance with laid down minimas if Company Operations Manuals specified in precise words a challenge to be spoken by Co-Pilots (or other crew members) in circumstances such as occurred in this accident.

2.6 A standard rate of descent of 1000 feet per minute once inbound over the VBA station for the KL International VOR Runway 15 let-down might be considered a contributory factor to the accident especially since the VBA station is far from the runway. For the approach pattern which exists for Runway 15, such an initial rate of descent would bring the aircraft to MDA too quickly and far short of the pull-up overshoot point and/or runway threshold as happened in this accident. The aircraft would be far below a normal 3 degrees glide slope and have to fly level for an unduly prolonged period. Should the crew then suffer from visual illusions such as "black tunnel effect" or encounter thin layer cloud throught which the ground might be seen, there might be a temptation to "duck under" below MDA to maintain ground visual contact. More importantly, the margin of safety would be significantly eroded should the crew omit

a more established overall 3 degree glide slope to Runway 15, without changing MDA, would not only provide more precise but also more comfortable approach safety margins. Such a revision would eliminate the unduly extended level flight at low level at MDA to overhead the runway threshold which might be considered hazardous under extreme stress or emergency situations.

2.7 The quality of crew conversation recorded on the CVR tape through the area microphone was poor compared to that which could have been obtained through the crew's individual microphones. Whilst a cockpit area microphone is an important source for the CVR, speech fed to the recorder from flight crew microphone as an extra facility provides much better quality information for any investigation. This improved system has been incorporated by several airlines and is a requirement by at least one Contracting State.

3. CONCLUSIONS

3.1 FINDINGS

(i) The aircraft had been properly maintained in accordance with an approved schedule and its documentation was in order. There is no evidence to suggest that there was any technical failure or malfunction in flight.

(ii) The crew were appropriately licensed and experienced to conduct the flight. They had flown regularly into Kuala Lumpur and had carried out all necessary periodic checks.

(iii) There were no defects in the radio navigational aids in use either on the ground or in the aircraft.

(iv) There was adverse weather in the form of Cbs, heavy rain with dark, low-level layer clouds with base probably just above the hills between VBA and the airfield. Several aircraft were in the stack; weather conditions and expected approach times were continually revised. The crew did not set the revised QNH setting.

(v) The higher than normal airspeed at which the aircraft departed VBA to just before impact suggests the VOR/ADF let-down to Runway 15 was not flown with the expected degree of precision.

(vi) The aircraft entered the weather at MDA. Although the crew did not have the runway in sight and could not have seen it for some time, the crew continued to descend below MDA.

[illegible] Captain continued to descend until the aircraft struck a low hill at 260 feet amsl 4 nms short of the runway threshold. This could suggest that the Captain might not possibly have taken note of the time or distance to run to the MAP and/or the runway threshold; or if he had, he had been distracted for the aircraft to be placed so far and so low from the runway.

(ix) During the descent from MDA 750 feet, the Co-Pilot called out the height and speeds at regular intervals in accordance with Company procedures, but the CVR tape bore no challenge from him or the Flight Engineer that might have made the Captain change his mind and initiate the missed approach procedure.

3.2. CAUSE

The accident was caused by the aircraft Captain descending below MDA without having the runway in sight, and continuing the descent until the aircraft struck a hill 260 feet amsl, 4 nms short of the runway threshold. A subsidiary contributory factor was insufficient monitoring of the aircraft's flight path by the Captain under the adverse weather conditions with several aircraft in the hold awaiting their turn for approach and, more importantly, the Co-Pilot's failure to challenge the Captain's breach of published Company regulations.

4. SAFETY RECOMMENDATIONS

It is recommended that:-

(1) The VOR/ADF approach path profile for Runway 15 be reviewed in order to provide a more stable glide slope from VBA to the Missed Approach Point and runway threshold.

(2) Airlines operating into Kuala Lumpur review their own Decision Heights for the existing VOR/ADF approach path profile for Runway 15 until an Instrument Landing System is installed.

(3) The Department of Civil Aviation, Malaysia provides an Instrument Landing System for Runway 15 as soon as practicable.

(4) JAL reviews their operating procedures/Company regulations to ensure their cockpit non-flying pilots (PNF) have suitable authority to challenge flying pilots (PF) should a dangerous breach of the Company regulations be contemplated. Such procedures should be kept simple but positive.

MAF CARIBOU ISTY 102B	17:33 at 5000 feet	Light rain between VBA and NM	Nil	Other aircraft and (partially) ground	Nil
MAF CARIBOU ISTY 46	17:27 est. at 6000 feet	Drizzle	Nil	Visibility 2/3 Km. Partially VMC and could see Misty 102B below, AMAN 244 at 7000 feet and JL715 at 8000 feet	Nil at 2000 f
MAF C.130 MAN 244	Not known	Marginal 5 Oktas Cu, 2 Oktas Cb.	2 flashes approx. 2 miles East	Could see QF2 and JL715	Mild

RELATIVE POSITION OF JL715

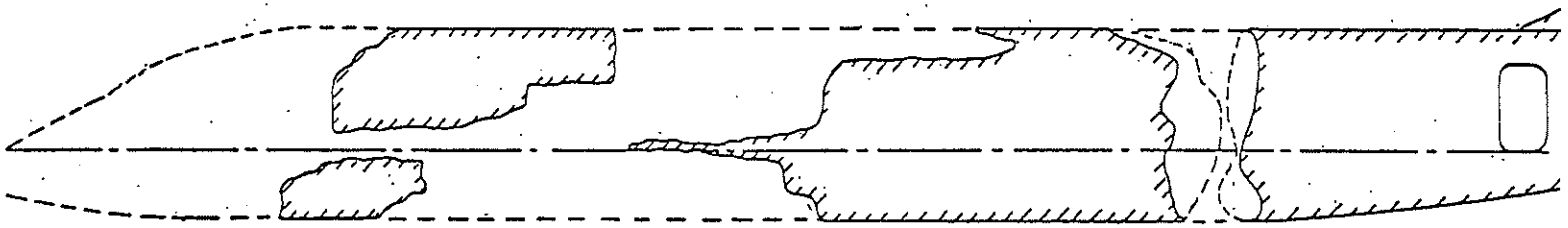
ANTAS B747 F2	18:02 at FL140. One minute behind JL715	Mainly overcast layer cloud, stratiform 2 Oktas Cb.	Some to South and East	Airborne visibility was good	Nil to slight
AS MH811 C10	17:46 est.	Weather clearing to South and East. A thick line of Cb's stretching across approach path to Runway 15, approx. 040/060°	Slight	Not mentioned	Slight

IAF CARIBOU :STY 102B. ınded on IY 1	17:40	Heavy rain from NM to RWY 15 threshold. Large clump of black cloud towards NE of RWY 15 moving towards North	Not reported	Slant was fair, reduced when close to rwy. Visibility poor on rwy. Saw approach lights at 750 feet over NM.	Not reporte
IAF CARIBOU :STY 46. ınded on IY 33 after 'ershoot on IY 15	18:18	Entered solid mass of heavy rain cloud at 1800 feet	Not reported	Nil at BOH on initial approach, approach lights faintly visible at 1 mile from threshold. Runway visible at 450 feet overhead	Slight
IAF C.130 IAN 244. ınded on IY 15	18:31 est.	Heavy rain, solid cloud at 7 DME South	3 flashes	Found forward visibility zero. At BOH, RWY 15 approach lights faintly visible at 4 miles from threshold. Very dark.	Moderat

RELATIVE POSITION OF JL715

ANTAS B747 ?2. iverted to ingapore. id not escend below)00 feet	N/A	Rain	Not reported	Not reported	Slight
AS MH811 :10. iverted to ingapore	N/A	15 minutes after accident, at 4000 feet passed through same band of weather	Some	Not reported	Slight

MAJOR SECTIONS OF WRECKAGE



CREW MEMBERS KILLED

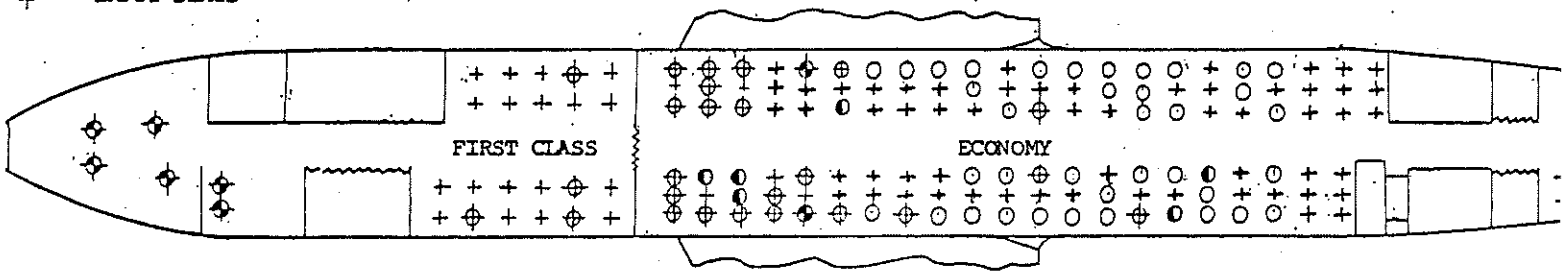
SURVIVING CREW MEMBERS

PASSENGERS KILLED

SURVIVING PASSENGERS - THROWN OUT AFTER FAILURE OF SEAT ATTACHMENTS OR SEAT BELT

SURVIVING PASSENGERS - ESCAPED/RESCUED FROM WRECKAGE

EMPTY SEATS



On down wind leg, set flaps 25° ((62) : flap 23°) and maintain maneuvering speed.
Prior to entering base leg, extend the landing gear and flaps 35°.
On final approach, extend flaps to full and reduce airspeed to V_{TH} at the threshold of runway.
The copilot should call out altitude and airspeed at 1,500 feet and 1,000 feet.
Below field elev + 1,000 feet, the copilot should call out altitude and airspeed every 200 feet. Below field elevation + 600 feet, the copilot should call out altitude and airspeed every 100 feet. As for airspeed, difference from V_{TH} should be called out after landing configuration is set.

2. Four & Three Engine ADF, VOR Approach

(1) Prior to entering the high station, extend the flaps 25° ((62) : 23°) and maintain airspeed at V_M.

(2) On the approved approach pattern, extend flap 25° ((62) : 23°), maintain airspeed at V_M, and descend at 1,000 feet/min descent rate. Make procedure turn at procedure turn altitude.

(3) Prior to entering low station, extend the landing gear and flaps 35°, and maintain airspeed at V_{APP}. At low station, fix time check required from the low station to the decision height. Maintain V_{APP} and descend at 1,000 feet/min descent rate on the approved approach pattern, and continue the approach to the decision height.

(4) Before descending to the altitude of field elev + 1,000 feet, the copilot should cross check the associated ADF or VOR instruments.
After passing through the low station, the copilot should call out altitude and airspeed at every 500 feet. Below field elev + 1,000 feet, call out altitude and airspeed every 200 feet and below field elev + 600 feet, call out altitude and airspeed every 100 feet. As for airspeed, difference from V_{TH} should be called out after landing configuration is set.
The copilot should direct his attention to find the runway.
The copilot should monitor the elapsed time and advise the captain.
When the airplane reaches decision height or visual contact is established, the copilot should so advise the captain.

(5) When the decision height is attained, maintain the altitude and the V_{APP} on the approved approach pattern, and continue the approach so far as visual contact i established or until pull up time is attained.

(6) If visual contact cannot be established with approach lights and the runway at th pull up time, missed approach should be immediately executed.

NOTE (1) If location of the low station is far from the runway, you may continue the approach with maneuvering configuration and V_M until the altitude of 1,500 feet and change to approach configuration at that altitude.

(2) For circling approach may commence the approach with maneuveri configuration and V_M from passing through the low station.