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CIVIL AIRCRAFT ACCIDENT

Report on the accident to Nigeria Airways VC 10 5N ABD

at Lagos Airport, Nigeria

on 20 November 1969

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CIVIL AIRCRAFT ACCIDENT REPORT No. CA/04/151/C

AIRCRAFT:	BAC VC 10 Type 1101 - 5N-ABD	
ENGINES:	Four Rolls Royce Conway 540	
OWNER AND OPERATOR:	Nigeria Airways (WAAC) Ltd.	
OPERATING CREW:	Commander - Captain V S Moore	- Killed
	Co-pilot - First Officer J P Wallis	- Killed
	Flight Engineer - Engineer Officer G A Baker	- Killed
	Navigating Officer - Navigating Officer B F Payton	- Killed
CABIN CREW:	7	
PASSENGERS:	76	
PLACE OF ACCIDENT:	8 miles north of Lagos Airport, Ikeja, Nigeria, 80 ft amsl	
DATE AND TIME:	20 November 1969 at approximately 0730 hrs.	
	All times in this report are GMT	

SUMMARY

The aircraft was making a straight in approach over low lying tree covered terrain to Runway 19 at Lagos Airport when it crashed following a collision with some trees 8 miles north of the airfield. The aircraft broke up on impact and a severe fire occurred which consumed the main part of the fuselage. There were no survivors. A routine radio call from the aircraft immediately before the accident did not indicate any abnormality with the flight at that stage. An examination of the wreckage at the site indicated that when it first came into contact with the trees the aircraft was descending with its undercarriage down and the flaps partially extended. It was also established that at the time of the accident the aircraft was structurally complete and that all the engines were developing power. No evidence was found of any pre-crash mechanical failure or technical defect, nor was there any sign of pre-crash fire. The position of a valve in the air conditioning system indicated that the crew had most probably just begun the landing check when the accident occurred. The weather in the area of the accident site at the time was foggy though the airport itself was clear.

The report concludes that though the cause of the accident could not be established with certainty, it was most probably due to the Commander being unaware of the aircraft's actual altitude during the final approach and allowing the aircraft to come below a safe height when he was not in visual contact with the ground.

1. INVESTIGATION

1.1. History of the Flight

The aircraft was operating Nigeria Airways Flight WT 925 and had left London for Lagos at 2210 hrs on 19 November in the charge of the crew later concerned in the accident. Transit stops were made at Rome and Kano. Whilst at Kano, where the aircraft landed at 0514 hrs on 20 November, the Commander expressed concern about the civil disturbances which had occurred near Lagos airport the previous day. Though he was informed that the situation was back to normal, he nevertheless decided, as a precaution, to have the aircraft refuelled to 30,000 kgs of fuel to allow enough for a diversion back to Kano if necessary. The actual fuel requirement for the sector to Lagos was 18,900 kgs, including standard reserves. During the stop at Kano, the crew reported that the aircraft was free of defects.

In accordance with the normal practice, the crew did not attend for briefing at the meteorological office, and a weather report for Lagos obtained by the Kano Flight Information Centre was passed to the aircraft by radio whilst it was on the ground.

A "thru" flight plan for the Kano to Lagos sector had been filed by the crew at Rome, but this had not been received by Kano when the aircraft called for start up clearance. The essential details of the flight to Lagos, giving an estimated en-route time of 1 hour and 06 minutes, were therefore passed by radio from the aircraft to Kano Tower. At 0612 hrs, an Advisory Route clearance to climb to and maintain Flight Level (FL) 350 was given to the aircraft, which took off for Lagos at 0624 hrs.

The flight proceeded normally and the aircraft reported over the Kaduna and Bida non-directional beacons (NDBs) at 0642 and 0658 hrs respectively, both times being within a minute of ETA. At 0704 hrs the aircraft established contact with Lagos Approach on 124.3 Mc/s giving ETAs for the Ibadan NDB at 0720 hrs and arrival at Lagos at 0728 hrs. Descent clearance from FL350 was requested for 0711 hrs. The flight was initially cleared to FL140 because of north-bound traffic (a Fokker F27) at FL130 which was estimating the Ibadan NDB at 0715 hrs but otherwise no delay was expected. At this time the 0700 hrs Lagos weather was also passed to the aircraft, giving a visibility of 5 kilometres in mist; 1/8 of strato-cumulus at 1,000 feet; 4/8 of cirro-stratus at 28,000 feet and the QNH of 1012, The temperature and dew point were both 24°C; the surface wind was 030° at 3 knots, and the aircraft was informed that the runway in use was 01. The aircraft acknowledged receipt of this weather information. At about 0708 hrs the VC 10 reported leaving FL350 for FL140. At this point the recording tape in the tower at Lagos ceased to function and no further information was obtainable from it until 0753 hrs. Also at about this time the VC 10 reported on the company frequency that there were 'nil' defects and 23,200 kgs of fuel on board.

Shortly before 0718 hrs the crew of the F.27 sighted the VC 10 on a reciprocal track at an estimated height of 17,000 feet, and a moment later heard the aircraft call over the Ibadan NDB. Having been advised by the F.27 crew that they had passed the inbound traffic, Lagos cleared the VC 10 down to FL 50 (the transition level). A short while later, Lagos received a request from the VC 10 for clearance to intercept the 014 VOR radial for a straight in approach to runway 19. This request was approved and the aircraft was instructed to report established on the 014 radial and reaching 2,200 feet on the QNH. At approximately 0729 hrs the aircraft reported that it was established on the radial at 12 miles range and that it was approaching 2,200 feet. It was then re-cleared to report 8 miles finals to Lagos Tower on 118.1 Mc/s. At approximately 0730 hrs, the aircraft was called by Lagos Tower for a check on its range from the threshold as it was hoped that there would be time for a DC9 to take off before the VC 10 arrived. There was no reply to this or subsequent transmissions on either tower or approach frequencies. By 0735 hrs the ATC Supervisor at Lagos Airport had alerted the search and rescue organisation and had advised senior airport officials that the VC 10 had failed to land. The DC 9, which was delayed until 0743 hrs, was requested to search the area to the north of the airfield for the missing aircraft, but nothing was seen by the crew due to extensive low cloud in the area. At approximately 0805 hrs two Nigerian Air Force aircraft took off to search the area and shortly afterwards sighted smoke coming up through the cloud. However they were unable to determine the source of this smoke as the cloud base was too low. It was not until 0905 hrs that the cloud cleared sufficiently for a searching F.27 to establish that the VC 10 had crashed in low lying forest an estimated 12 miles north of the airport on the extended centre line of the runway. At 0912 hrs search and rescue parties were despatched to the site where it was found that the aircraft had been completely destroyed and all 87 occupants had been killed.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	11	76	-
Non-Fatal	-	-	-
None	-	-	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

Varying degrees of damage to trees for a distance of 700 yards north of the accident site.

1.5 Crew information

Captain V S Moore, aged 56 years, qualified as a pilot in the Royal New Zealand Air Force in 1940. He was seconded to BOAC in 1944 and promoted to Captain in 1946. He first flew the VC 10 in 1963 and remained with the BOAC VC 10 fleet until October 1969 when he joined Nigeria Airways. At the time of the accident he held a current British Airline Transport Pilot's Licence (ATPL) endorsed in group I for the VC 10 and this was validated by the Nigerian authorities pending the issue of a Nigerian ATPL. He had flown 15,173 hours of which 3,323 hours were in command of the VC 10. He had flown 38 hours in the previous 28 days and had had 8 days rest before reporting for duty on the 19 November 1969. He passed a medical examination for the renewal of his licence on 6 November 1969 and he was also examined by the Company doctor before joining Nigeria Airways. His last competency check and instrument rating had been carried out in the VC 10 simulator on 15 May 1969 as a result of which he had been assessed as "unorthodox but competent". Following a route check on 19 September 1969 his check captain remarked that although the check had been satisfactory he found Captain Moore to be "unorthodox and individualistic in some aspects of his flying". It is known that he had developed a technique for making approaches to land at Lagos using the auto-pilot coupled to the VOR and with the auto-throttle engaged. Since joining Nigeria Airways he had made 5 flights into Lagos and it is reasonable to believe that he was familiar with the characteristics of the local area as a result of his BOAC service in this region.

First Officer J P Wallis, aged 30 years, learned to fly with a civilian flying club in England. He held a current Kenya Airline Transport Pilot's Licence validated by the Nigerian Authorities pending the issue of a Nigerian ATPL. His last medical examination had been on 23 June 1969 when he was assessed as fit to fly. He had also been examined by the Company doctor before joining Nigeria Airways in November 1969. Prior to this he had served 2½ years with East African Airways' VC 10 fleet. Altogether he had flown a total of 3,500 hours of which 900 hours had been in the VC 10, 175 of these as pilot in command under supervision. In the previous 28 days he had flown 22 hours and had had 6 days rest prior to 19 November 1969. He had carried out one previous trip to Lagos with Nigeria Airways, as a supernumerary first officer undergoing a line check, and was

assessed by the captain as "diligent and competent".

Engineer Officer G A Baker, aged 50, was on secondment to Nigeria Airways from British United Airways. He held a British Flight Engineer's Licence, endorsed for VC 10 aircraft and validated by the Nigerian authorities. His last competency check was on 3 January 1969 and his last medical examination was on 27 October 1969. His total flying experience was about 13,000 hours of which 3,000 hours were on VC 10 aircraft. He had flown 45 hours in the 28 days before the accident and had been free of duty for 6 days prior to 19 November 1969. Since joining Nigeria Airways, Mr Baker had completed 5 round trips to Lagos.

Navigating Officer B F Payton, aged 49, was on secondment to Nigeria Airways from British United Airways. In 1946 he joined BOAC as a navigator and left to join British United Airways in 1964. He held a British Flight Navigator's Licence validated by the Nigerian authorities. His last route check was on 14 January 1969 and his last medical examination was on 5 September 1969. His total flying experience was approximately 15,100 hours and he had completed 45 hours in the 28 days preceding the accident. He had been free of duty for 6 days prior to 19 November 1969. Since joining Nigeria Airways he had completed 6 round trips to Lagos.

1.6 Aircraft information

(a) General

The aircraft was a Standard VC 10, type 1101 and built in November 1962. For approximately 2 years it was employed on development trials by the constructors, Vickers Armstrong (Aircraft) Ltd., now the British Aircraft Corporation. Subsequently it went into service with BOAC in November 1964 as G-ARVA. It remained with this Corporation until 29 September 1969 when it was sold to Nigeria Airways Ltd., at which time it was transferred to the Nigerian Registry as 5N-ABD. It had been regularly serviced in accordance with an approved maintenance schedule and a major inspection was carried out on the aircraft during September 1969, by which time the aircraft had completed 18,018 hours. No significant defects had been reported on the aircraft since this major inspection. A Certificate of Maintenance (C of M) was issued in respect of the aircraft on 1 October 1969 and was valid until 29 December 1969 or on the completion of 800 hours flying. At the time of the accident, the aircraft had flown a total of 18,431 hours, that is 413 hours since the change of ownership and the issue of the C of M.

The aircraft had a British Certificate of Airworthiness, No A7732 which was valid until 7 December 1969. However, following the completion of the major inspection and transfer of ownership to Nigeria Airways, a Nigerian Certificate of Airworthiness, No 242, was issued in respect of the aircraft and this was valid until 28 September 1970.

(b) Aircraft weight and centre of gravity

The aircraft's weight at take-off from Kano was 110,445 kgs. The estimated fuel burn off was 9,410 kgs, which would have resulted in a landing weight at Lagos of 101,035 kgs. This would have been 3,059 kgs over the maximum permitted weight for landing according to the Operations Manual. However an Air Registration Board Advance Amendment Bulletin to the Flight Manual authorising a maximum landing weight of 103,192 kgs was approved on 7 October 1969, thus the forecast landing weight would have been within these revised limits on arrival at Lagos.

At approximately 0707 hrs, the aircraft called Lagos on a Company frequency reporting that there was 23,200 kgs of fuel on board. By the time the aircraft had reached the area of the accident site this would have been further reduced to approximately 22,500 kgs, resulting in an all up aircraft weight of 102,500 kgs at impact. The aircraft centre of gravity throughout the flight was within the prescribed limits.

(c) Aircraft pressurisation system (See Appendix 1)

The positions of two valves in the aircraft's pressurisation system at the time of final impact with the ground were of considerable significance in helping to establish the activity of the crew immediately prior to the accident. In order that this particular feature of the investigation may be fully understood a brief description of the relevant part of the aircraft's pressurisation system is given below.

Four engine driven compressors (one mounted on each engine) supply air for cabin pressurisation and air conditioning. On each side of the aircraft the air supply from the compressors passes through a common duct. Air is delivered to the flight deck from the right hand side only. In both ducts, a short distance downstream from the compressors, is fitted a spill valve followed by a stop valve. Each is a butterfly type valve having a range of movement of 90° and can only be moved by an electric motor operating through a system of gears and a cam. The spill valve opens the duct to atmosphere through an outlet in the fin skin. The stop valve, when closed, prevents any air from the compressors on that side being delivered to the interior of the aircraft. Before the stop valve is shut, it is necessary for the spill valve to be opened to prevent an unacceptable increase of pressure in the duct itself. To ensure that this always occurs, each stop valve operates in sequence with its associated spill valve, so that one second before the spill valve reaches the fully open position a micro switch is operated and the stop valve starts to close and takes about a further 18 seconds to shut. This sequence of operation can be initiated in one of three ways:-

(i) Manually by the selection of the relevant 4-positioned switch on the Flight Engineer's Panel.

(ii) Automatically when a thermostat in the duct senses overheating.

(iii) On the ground only (ie with the undercarriage weight switch made) when the air conditioning refrigerator is brought into operation. In this case the spill valve fully opens and the stop valve half closes.

In order to obviate the risk of smoke entering the flight deck during critical stages of flight, ie during take-off and landing, operating procedures call for the right hand spill valve to be selected to SPILL at these times. This operation is the first item on the Engineer Officer's Landing Check List.

1.7 Meteorological information

1.7.1 The flight was despatched from Rome to Lagos via Kano and the following terminal forecasts were given to the crew at Rome:-

Station	Period of Validity	Surface Wind	Visibility	Weather	Cloud
Lagos	03-16	320/2	1.5 km		5 St 600 feet
	Tempo		0.6 km	Fog	
	Gradu 07				5 Cu Sc 1,000 feet
	Gradu 08-10	240/06	10 km		5 Cu 1,800 feet
Kano	03-16	Calm	8 km	Haze	3 Ci 30,000 feet
	Gradu 04-07	050/05	3 km	Haze	3 Ci 30,000 feet
	Gradu 07-09	060/10-15	1 km	Haze	3 Ci 30,000 feet
	Gradu	060/08	6 km	Haze	3 Ci 30,000 feet

A further forecast was prepared by Kano meteorological office but these documents were not collected by the crew. They contained the following information:-

Station	Period of Validity	Surface Wind	Visibility	Weather	Cloud
Lagos	07-10	VAR/03	5 km	Mist Patches	6 Sc 800 feet
	Gradu 09	230/08	10 km	NIL	Cu Sc 1,500 feet
Kano	06-09	070/05	3 km	Dust Haze	NIL
Accra	07-10	290/05	6 km	Mist Patches	3 Sc 1,100 feet 3 Ci 23,000 feet
	Gradu 09	230/06	10 km	NIL	3 Sc 1,000 feet 4 Cu 2,500 feet

Just prior to the aircraft's departure from Kano the Flight Information Controller obtained the 0600 hrs actual weather report from Lagos and passed this information to the aircraft by radio whilst it was on the ground. This was as follows:-

Surface Wind - 360/03

Visibility - 3 km in dust haze reducing to 2 km

Cloud - 3 oktas strato cumulus at 360 m.
5 oktas cirro stratus at 8,400 m.

QNH - 1011

Temperature - +23°C.

The following 0700 hrs observation was passed to the aircraft on initial contact with Lagos approach at 0705 hrs.

Surface Wind	-	030/03
Visibility	-	5 km
Cloud	-	1/8 Sc 1,000 feet 4/8 Cs 28,000 feet
Weather	-	Mist
Temperature	-	24°C
QNH	-	1012

1.7.2 Following the accident an appreciation of the weather conditions for the day of the accident was prepared by the principal meteorologist at Lagos Airport and it gave the following information:-

> "There was no significant departure from the weather normally experienced in Nigeria during the time of the year. The Sahara high pressure cell was well established over the country up to over 15,000 feet above the surface. Except in the coastal area, where slight moist southwesterly winds were observed up to 2,000 feet, winds were mainly northeasterly or easterly up to 15,000 feet, becoming south to southwesterly above 20,000 feet. The dry Sahara easterly air mass gave rise to widespread dust haze on the surface in areas to the north of the Niger/Benue Valley, reducing visibility to about 8-10 km in the Western Sector and 2-5 km in the Eastern Sector. In the areas south of the Niger/Benue Valley there were early morning mist patches along the coast becoming fog or fog patches further inland. Cloud amount along the coast was generally 1-2 oktas of strato cumulus at 1,000 feet, becoming 6-8 oktas at 400-700 feet further inland. There were no reports of thunderstorms or line squalls from any part of the country."

Actual reports made by observers on the ground and in the air shortly before and after the accident show that the thick fog started about one mile north of the airfield and extended beyond the accident site for many miles. The fog extended from tree top level to not less than 1,000 feet. Search aircraft found visual flight beneath the fog layer to be impossible. One aircraft report indicated that the tops might have been as high as 2,000-2,500 feet with conditions of poor visibility rising further to 5,000 feet. It was also reported that it was most unlikely that the airfield would have been visible at a distance of 12 miles from an aircraft approaching from the north.

The 0730 hrs observation at Lagos airport showed that the visibility had improved to 8 km (5 nm) and that the low cloud had dispersed.

1.8 Aids to navigation

All the navigational aids associated with Advisory Route 7 from Kano were serviceable on the morning of 20 November, including the Ibadan NDB, over which it is customary for VC 10 crews to update their doppler equipment. At Lagos airport both the locator beacon LA and the LS NDB were serviceable. The VOR had tripped off the air at 0628 hrs and again at 0634 hrs but was fully serviceable by 0704 hrs. Although it was under technical adjustment at the time of the accident, the northbound F.27 reported no difficulty with reception of VOR signals. The VDF at Lagos was unserviceable and although the DME was serviceable it was of a type unusable by this aircraft's equipment. There was no ILS installation at Lagos airport.

The equipment in the aircraft included the following relevant navigational and flight aids:-

ADF	-	dual installation
VOR/ILS	-	dual installation
Polar Compasses	-	dual installation
Doppler	-	dual installation (one set of which was unserviceable)
DME	-	incompatible with airfield equipment
Weather Radar	-	with mapping facility
Altimeters	-	2 Precision Electro-Mechanical Altimeters operating from separate sources. These altimeters had the digital/pointer type of display
	-	2 conventional Pressure Standby Altimeters operating from separate sources.
Radio Altimeter	-	Height range 0-500 feet

The aircraft carried a full set of relevant topographical and airways charts plus three sets of appropriate aerodrome approach charts.

1.9 Communications

The aircraft first established radio contact with Lagos approach on 124.3 Mc/s at 0704 hrs after maintaining routine contact with Kano since its departure from that airfield. Descent clearances were passed to the aircraft together with 0700 hrs Lagos weather. At 0729 hrs (time stated by the approach controller) the aircraft reported that it was established on the extended runway centre line at a range of 12 miles. It was then cleared to report "8 miles long finals" on the tower frequency 118.1 Mc/s. The Captain of the northbound F.27 timed this call at 0726 hrs. No further contact was made with the VC 10 on either approach or tower frequencies.

When the ATC frequency tape recordings were played back they were found to be nearly unreadable due to tape slip in the recording equipment but by careful transcription it was possible to recover some of the radio conversations. At 0709 hrs the tapes ran out and new tapes were automatically brought into operation. These had been installed incorrectly and there is no record of radio communications for the next 44 minutes. At 0753 hrs recording started again when further tapes were fitted and this continued until 0814 hrs when these tapes were removed from the machine. Considerable difficulty was also experienced in transcribing the Kano tapes due to heavy distortion. The tape itself was found to be badly worn. The voice on the tape in association with the aircraft transmissions was identified as most probably belonging to the First Officer.

1.10 Aerodrome and ground facilities

All airfield lighting was functioning at the time of the accident other than the Visual Approach Slope Indicators which were unserviceable.

1.11 The flight recorder

The Epsylon Flight Data Acquisition System (EFDAS) flight recorder was recovered undamaged from the wreckage and flown to the United Kingdom for read out. It was found that the signal recorded on the wire did not contain sensible information as it consisted solely of a series of alternate binary "ones" and "zeros". The nature of the faulty signal format was such that it was impossible to reconstitute the data into readable form. It was considered most probable that

the fault was due to a defective logic unit in the system which had been present for at least the 70 hour recording period covered by the spool. This fault would not have been apparent to the crew on the flight deck.

1.12 Wreckage (See Appendix 2)

An examination of the wreckage trail, together with survey measurements, indicated that the aircraft first struck the top of a tree 207 feet above mean sea level (amsl) at a position 8 nm on a bearing of 002°(M) from the threshold of runway 19 at Lagos Airport. The first impact was taken by No 2 and 3 port flaps, the port undercarriage fairing and the cooling drain beneath Nos 1 and 2 engine nacelles. The aircraft then brushed through the heads of two trees, respectively 250 and 280 feet further on before the port wing tip was ripped off in collision with the trunk of a tree 350 feet from the first impact point. The aircraft then collided with three other trees within the next 250 feet, removing Nos 2, 3 and 4 starboard flaps and No 4 port flap. The damage to the trees all occurred along a descending plane inclined at 6° to the horizontal. Over the total distance of 600 feet between the first and last tree in the initial impact area, the ground sloped down towards the south at an angle of approximately 3°. It continued to fall away until it reached 30 feet amsl some 1,250 feet from the first impact point, after which it began to rise gradually. The angle of descent of the aircraft reduced to 4° after it had struck the last tree in the initial impact area, and the aircraft remained clear of all other obstructions until it struck the ground in a pronounced nose up attitude and left wing down about 1,700 feet from the first impact point.

The force of the impact with the ground broke off the whole tail assembly and the four engines. The remainder of the aircraft came to rest 300 feet further on, the flight deck being crushed in the latter stages by collision with a tree. The cabin remained relatively intact, but both wings were severely damaged and all the fuel in the tanks was released.

The overall length of the wreckage trail from the point of first impact to where the aircraft finally came to rest was 2,025 feet. The axis of the trail varied between 188°(M) at its most northerly point to 169°(M) at the point where the aircraft finally came to rest.

The severe fire which broke out immediately after the aircraft came to rest consumed the main part of the wreckage, including the flight deck which was completely destroyed. However the tail assembly remained relatively intact and was only badly scorched. A detailed examination of the wreckage indicatedthe following:-

(a) The configuration of the aircraft was as follows:-

1. Landing gear down.
2. Flaps set to the approach (35°) setting.
3. Tailplane was at a setting appropriate to a flight deck indication of 6.7° nose up.
4. Leading edge slats were out.
5. Spoilers were in.

(b) The aircraft was structurally complete at the time of impact with the northernmost tree.

(c) The powered flying control units at the moment of final impact with the ground were all at, or very close to, the neutral position.

(d) All engines were at high rev/min and functioning normally up to the moment of final impact with the ground. There was no evidence of any pre-crash mechanical failure or defect.

(e) All low pressure fuel cocks were open and the inter-engine cocks were shut.

(f) The remains of one altimeter were recovered, a 3-pointer pressure type, and examination showed that its subscale was set to 1013 $\pm$2 mbs and the pointers were reading zero feet.

(g) The remains of the cabin pressure controller were recovered and found to be set at 1010 mbs and 250 feet. All other instruments and controls were completely destroyed.

(h) The right hand spill valve was found in the fully open position.

(i) The right hand stop valve was found at 50 degrees open.

(j) One of the fuel booster pumps was found to have been functioning at the time of impact. It could not be established if the other pumps were rotating due to the absence of significant damage. The ram air turbine (EMRAT) which is operated by the crew in the event of electrical power failure was not in use and was found in the stowed position.

(k) Three automatic pistols, which were very badly damaged by fire, were found in the wreckage.

1.13 Fire

No evidence was found of any pre-crash fire having occurred. A severe fire broke out immediately after the aircraft had come to rest following the release of approximately 22,500 kgs of JP1 fuel due to the disintegration of the tank structure at the moment of final impact. The main fuselage, including the flight deck, and part of the wings were consumed by the fire, which continued to burn unabated as the crash site was not immediately accessible to fire fighting equipment. It was found that No 2 engine fire extinguisher bottle had discharged. It has been established that this occurred as the result of overheating by the ground fire and not as the result of pre-crash electrical actuation.

1.14 Survivability

The injuries sustained by the occupants of the aircraft on impact were not fatal in every case, and the severe post crash fire which broke out as the aircraft came to rest resulted in death by asphyxiation of those who survived the impact. The inaccessibility of the accident site precluded any possibility of rescue. The accident is therefore classified as non-survivable.

1.15 Tests and research

1.15.1 Power Flying Control Units (PFCUs)

All PFCU's were recovered from the wreckage and were returned to the United Kingdom for examination. Four of the five Master PFCU's,

namely both inner elevators, the left inner aileron and the centre rudder were found to be still capable of operation. They were accordingly taken to the manufacturer and rig tested under the supervision of the United Kingdom Accidents Investigation Branch (AIB) and were found to be serviceable.

1.15.2 Right hand spill and stop valves

These were removed from the wreckage and returned to the BOAC Maintenance Base for examination and test under AIB supervision. The position of the butterfly valves in both units was measured and the spill valve was found to be fully open and the stop valve to have moved 40° towards the closed position of 90°. Both units were intact and undamaged by fire though the wiring insulation was burnt through. Both functioned normally when connected to an electrical supply. It was found that the spill valve took $17\frac{1}{2}$ seconds to open which was normal. The stop valve started to close 1 second before the spill valve reached the fully open position, which again was normal, and after 6 seconds reached the position found at impact. Thus the total sequence took $22\frac{1}{2}$ seconds under static conditions. In flight this operation would normally take about 25 seconds, that is 2 or 3 seconds longer than the static case, due to loads imposed by the air flow from the compressors.

Neither valve showed any signs of the heavy deposits of soot normally associated with smoke resulting from oil leaks in either of the cabin air compressors.

1.15.3 Aerodynamic calculations

The manufacturers of the aircraft were asked to undertake certain calculations to establish the loss of height resulting from specific malfunctions or mishandling. These calculations, which in some cases were backed by flight test results or operational experience, indicated the following:-

(a) In theory, an inadvertent operation of the stall identification system (stick pusher) in the approach configuration at normal approach speed would result in a height loss of no more than 150 feet. Practical experience of inadvertent stick pusher operation in service during a final approach to land resulted in a height loss of only 70 feet.

(b) Flight tests involving normal stick pusher operation following an approach to the stall in the landing configuration resulted in a height loss no greater than 300 feet with the power off and 150 feet with the power on.

(c) Tests were conducted on the manufacturer's variable stability simulator adjusted to represent a VC 10 with landing gear extended and 35° of flap set. The purpose of these tests was to experiment with a number of different flight profiles to establish which of them could have resulted in the aircraft hitting trees 207 feet amsl in a slightly nose-up attitude whilst descending on a 6° glide path. Most of the tests involved the application of full nose-down elevator at various heights up to 2,200 feet followed by a partial recovery to a 6° glide path. The remainder of the tests involved straight descents at varying speeds and power settings.

It was found that there were only two profiles from which the impact conditions could be achieved. The first of these was a steady descent at 160 knots with approximately flight idle power set on all engines. This gave a rate of descent of 1,800 feet per minute (ie a 6^{o} glide path).

The only other profile from which the impact conditions could be achieved was one which involved the application of full nose-down elevator between 300 and 400 feet AGL, followed immediately by a partial recovery to a 6^{o} glide path. When full nose-down elevator was applied above or below this height band, it was not possible thereafter to reproduce the right combination of attitude and glide path angle at impact during the recovery phase.

It was found that this manoeuvre took 6 seconds from initiation to partial recovery at 207 feet.

(d) Assuming that the deceleration was uniform, the time taken for the aircraft to come to rest after its initial impact with the trees was calculated to be 12.8 seconds. This time is consistent with the results of a calculation made in respect of a similar accident where data was available from the flight recorder.

1.15.4 Automatic weapons

The three automatic weapons found in the wreckage were examined by a ballistics expert of the Nigeria Police Force. Though all three weapons were very badly damaged, examination showed that none of them had been recently fired. The military authorities confirmed that the weapons were officially issued to the military personnel who were passengers on board the aircraft. The presence of these weapons near the forward end of the aircraft would indicate that these had been handed over to the Commander prior to take-off from Kano in accordance with the normal practice.

1.15.5 Pathological tests

A total of 63 or 64 bodies were recovered from the wreckage. Positive identification was possible in only 17 cases, and none of these were members of the operating crew. There is, therefore, no pathological evidence as to disease or injury in the aircrew being causative or contributory to the accident. None of the unidentified males, any of whom may have been members of the flight crew, were found to have signs of incapacitating disease.

.16 Relevant Airfield and Aircraft Operating Procedures (Appendix 3)

1.16.1 Airfield procedures (See Appendix 3)

The State procedure given in the Airfield Approach Charts used by the Company required that an aircraft making a straight in approach to land must maintain a minimum height of 2,000 feet amsl until in visual contact with the airport. This altitude is the Sector Safe Altitude within a radius of 25 nm of Lagos Airport. An aircraft carrying out a full let down procedure to runway 19 either on the "LA" non-directional beacon or "LA" VOR is initially required to hold 2,200 feet until over either beacon. Then on the outbound leg,

which is 5 nm in the case of the NDB let down and 6.25 nm in the case of the VOR, the height may be reduced such that on completion of the procedure turn, the aircraft is no lower than 1,200 feet above mean sea level. Thereafter the height may be reduced to the Obstacle Clearance Limit (OCL) of 532 feet above mean sea level or 400 feet above airfield level (the height of the airfield being 132 feet amsl). Thus in the case of an aircraft carrying out the correct procedure, the OCL would not normally be reached at a distance greater than 5 nm from the airfield.

1.16.2 Relevant aircraft operating procedures

(a) Use of Doppler. The Company Flying Manual specifically prohibits the use of Doppler distance information for establishing a glide slope in Instrument Meteorological Conditions (IMC).

(b) Landing Checks. The Company Flying Manual advises that "landing drills should be completed by, at the latest, 1,500 feet on the (instrument) approach to ensure both pilots are as free as possible to concentrate on the final approach". Further advice is given later in the same section on the subject of landing checks, namely, "When carrying out an ADF procedure the approach and landing checks should be completed before commencing the approach".

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

2.1.1 Summary of evidence

Due to the absence of any information from the Flight Data Recorder and the R/T recording, the behaviour of the aircraft during the last few minutes of flight has to be deduced from the most significant features of the other evidence which has been collected, namely:-

(a) The position of the initial impact point and the aircraft's descent angle of 6^{o} through the trees and thereafter 4^{o} to the main accident site.

(b) The distance of 2,025 feet travelled by the aircraft through the trees to final impact.

(c) The configuration of the aircraft.

(d) The absence of any indication of pre-crash mechanical or technical defect; or the effects of sabotage.

(e) The local weather.

(f) The last radio message from the aircraft and the failure to reply to Lagos approximately $1\frac{1}{2}$ minutes later.

(g) The position of the right hand spill and stop valves at final impact.

(h) First Officer's voice on the aircraft R/T transmissions.

2.1.2 Aircraft situation at impact

A study of this evidence indicates that at the time of first impact

with the trees:-

(a) The aircraft was descending at 1,800 feet per minute through fog on a magnetic heading of 188°(M) and almost on the 014° VOR radial. At the time the attitude of the aircraft was slightly nose up.

(b) The undercarriage was down and the flaps were set to the Approach (35°) position.

(c) The aircraft was serviceable inasmuch as all the engines and systems were functioning normally; the flying controls were operable; and the aircraft was structurally complete. The last transmission from the aircraft did not indicate any abnormality with the flight at that stage.

(d) The aircraft was being flown by the Commander.

2.1.3 Position of the right hand spill and stop valves

The positions of the right hand spill and stop valves at final impact with the ground were of particular significance. The spill valve was found in the fully open position and the stop valve was approximately half closed. These positions would have been reached some 25 seconds after the right hand spill valve had been selected to SPILL, either manually by the flight engineer or automatically by the duct overheat senser. As there was little likelihood of any overheating occurring after a prolonged descent at low power, it is assumed that the position of these valves were the result of a selection by the flight engineer. He would have made this selection either as part of the landing check or to disperse smoke from the flight deck which could occur as a result of a fault in the airconditioning system. An examination of the right hand spill and stop valves did not reveal any sign of the heavy deposits of soot normally associated with such a defect, and thus it appears probable that the selection to SPILL was in association with the flight engineer's landing check. Further support for the conclusion that the landing check was in progress was that the undercarriage was down at impact.

The time taken for the aircraft to come to rest after it first hit the trees has been calculated as being 12.8 seconds. As the deceleration was probably not absolutely uniform, this time has been reduced for the purpose of this analysis to 10 seconds. If this time is subtracted from the spill/stop valve running time of 25 seconds, it seems reasonable to conclude that 15 seconds before the initial impact, the flight engineer began his landing check.

2.1.4 Distance of the aircraft from touch down at the time of the last transmission

Air Traffic Control estimated that the time interval between the aircraft's last transmission and their next attempt to contact it on 118.1 Mc/s was between 1-1½ minutes. Unfortunately, the failure of the R/T recording some 20 minutes before the accident did not enable this timing to be checked. However, it is consistent with the position where the aircraft first hit the trees 8 miles from touchdown because in 1½ minutes the aircraft would have travelled 4 miles at the normal initial approach speed of 160 knots. This would, therefore, suggest that the aircraft was very close to being 12 miles from touchdown at the time

of the last transmission and would seem to rule out any real likelihood of a substantial error in range having been made by the crew.

It was concluded in the paragraph 2.1.3 that the landing check was most probably commenced some 15 seconds before impact with the trees. This would suggest, therefore, that for a period of at least 1¼ minutes after the last transmission, all conditions aboard the aircraft were normal as it is unlikely that a routine activity of this nature would have been undertaken had an emergency situation arisen in the meantime, due either to some serious technical failure or some other distraction such as a disturbance on the flight deck. Thus at the moment when the flight engineer began his landing check, the aircraft would have been approximately 8¾ miles from the airfield and ¾ mile from the point of first impact.

2.1.5 Height of the aircraft

From a study of similar accidents in the past, it is reasonable to conclude that the aircraft's angle of descent immediately prior to first impact would have been the same as the angle of its descent path through the trees in the initial impact area, namely 6°. If the aircraft had descended steadily at this angle of descent for the last 4 miles of its flight path, then it would have been at approximately 2,700 feet at 12 miles range from the airfield. This is fairly consistent with the height reported by the aircraft at that distance when it called "approaching 2,200 feet", if an allowance is made for variations in the actual rate of descent and the amount by which the cleared height was anticipated when the call was made. At the assumed speed of 160 knots (ie Vat 40) an angle of descent of 6° represents a rate of descent of 1,800 feet per minute. If it is assumed that this rate of descent remained constant throughout, then when the flight engineer began his landing check 15 seconds prior to impact with the trees, the aircraft would have been at 450 feet above the ground.

The possibility of some violent upset occurring during the last 15 seconds of flight has to be considered. It has already been concluded that nothing untoward occurred prior to that point. The simulator tests showed that had full nose-down elevator been applied for any reason the highest that this could have occurred to be consistent with the circumstances of this accident, was between 300 and 400 feet and no earlier than approximately 6 seconds before impact. Had such an upset occurred at a height greater than this, the aircraft could not have hit the trees in a slight nose-up attitude on a 6° descent path. In conclusion, therefore, it appears probable that the height of the aircraft at 12 miles was close to the reported altitude of 2,200 feet, and that by the time the aircraft had reached the 8¾ mile point, that is 15 seconds before impact, its height was between 300 feet (assuming an upset and partial recovery) and 450 feet (assuming a constant descent), both heights being above ground level.

2.1.6 Courses of action open to the Commander (See Appendix 4)

When the aircraft called that it was "approaching 2,200 feet" at 12 miles range on a straight in approach, there would appear to have been four courses of action open to the Commander. These were as follows:-

A. To have maintained a minimum height of 2,000 feet until sighting the airfield from which point a direct approach to land could have been made; or if the aircraft was too high at that stage, to have carried out a circling approach to either runway 19 or 01. Having elected to make a straight in approach to land, this course of action would have been in accordance with the correct procedure.

B. To have continued at 2,000-2,200 feet until intercepting a 3^{o} approach path. Based on a descent of 300 feet per mile this would have been at approximately 7 miles range. From this point an instrument approach to land could have been made. This would have involved the use of doppler for establishing a glide path, a practice specifically prohibited in the Company Flying Manual.

C. To have allowed the aircraft to drift down so as to intercept the 3^{o} approach path closer in, say at 1,500 feet at 5 miles. Though the same conditions as regards the use of doppler would still have applied, in the event the crew would have sighted the airfield at the point of interception with the approach path, as the visibility at the time had improved to 5 miles. However, the crew would have been unaware of this improvement as the last report they had received was based on the 0700 hrs observation when the visibility was given as 3 miles in mist.

D. To have made an early descent to the Obstacle Clearance Limit (OCL) of 532 feet amsl or 400 feet agl and to have held this height until reaching a point $\frac{1}{2}$ mile short of the LA beacon from which point a landing could have been attempted.

2.1.7 Discussion of the most probable course of action

Any discussion of the most probable course of action which the Commander attempted to follow has to be related to the presumed position of the aircraft immediately prior to impact, namely $8\frac{3}{4}$ miles from touch-down and below an altitude of 450 feet.

2.1.7.1 Alternatives A, B and C

Only 'A' was the correct procedure. Alternatives B and C would have been contrary to the ATC clearance issued and would also have involved the unauthorised application of doppler unless the Commander had other range information, either a ground pinpoint - unlikely in view of the weather - or from the weather radar, which is not normally used at this stage.

Had the Commander attempted any of these alternatives the lowest the aircraft would have been as it passed the $8\frac{3}{4}$ mile point was 2,000 feet. It has already been shown that it was impossible for the aircraft to have lost this amount of height during the last 15 seconds of flight, and furthermore that nothing untoward had occurred earlier than that. Therefore the only conclusion that can be drawn is that none of those alternatives was being followed.

2.1.7.2 Alternative D

This alternative was also contrary to the ATC clearance. In following it the Commander had the choice of reducing height at a rate between that required to intercept the OCL at about 5 nm and that achievable by fully throttling the engines with 35^{o} of flap (ie as shown by the lines D and D' on the diagram at Appendix 4). It has been already noted

that with flight idle power the aircraft would have descended at 1,800 feet per minute and that this rate of descent was equivalent to a 6° glide path at 160 knots. This angle of descent is coincident with actual descent angle of the aircraft through the trees in the initial impact area, and also with a steady descent from approximately 2,700 feet at 12 miles.

From the foregoing it seems probable that the Commander adopted this particular alternative and that after leaving 2,700 feet or thereabouts, he either initiated or continued a descent of 1,800 feet per minute with flight idle power set. Furthermore, it would seem that it was his deliberate intention to establish this rate of descent by virtue of the fact that he had selected 35° of flap. It is considered unlikely that he would have set this amount of flap had he wished to make a more gradual descent.

It would seem that the only reasons the Commander could have had for descending so far out from the airfield is that he wished to establish visual contact with the ground as soon as possible. In considering this course of action, the Commander may have assumed that the cloud base in the area over which he was flying was the same as that at the airfield, namely 1,000 feet.

2.1.8 Possible reasons for the aircraft's descent below the Obstacle Clearance Limit

The descent of the aircraft below the OCL of 400 feet agl could have been for one or more of the following reasons:-

(a) An unintentional dive following an inadvertent deflection of the elevators in the nose-down sense.

(b) Altimeter sub scale setting datum.

(c) Misreading of the altimeter(s).

(d) Altitude unawareness.

2.1.8.1 Unintentional dive

It has been shown that to be consistent with the wreckage trail, an upset in the nose-down sense could only have occurred 6 seconds before impact when the aircraft was already at or below 400 feet. It is considered that for an upset to have occurred at the only point in the descent from which a partial recovery could have been made so that when the aircraft hit the trees it was in the same attitude and on the same flight path as that required for a straight descent of 1,800 feet per minute would have been exceptional coincidence. It is, therefore, concluded that it is highly improbable that the accident was due to a gross upset in the nose-down sense for whatever reason.

2.1.8.2 Altimeter Subscale setting

Consideration has been given to the possibility that the Commander may have been reading his altimeter in the mistaken belief that it was already set to the QFE, whereas the evidence suggests that the altimeters were still set to the QNH. Had he done this he would still have levelled off at about 250 feet agl whilst his altimeter was indicating 400 feet (the OCL), and, therefore, it is not thought that the accident could be directly attributable to an error of this nature.

2.1.8.3 Misreading of the Altimeter

There would seem to be little doubt that the aircraft was close to the reported altitude of 2,200 feet when at 12 miles range. Therefore, if the accident occurred as the result of altimeter misreading, then the error was made during the last 1½ minutes of flight. Had the altimeter been overread by 1,000 feet at any stage, then at the moment when the crew were commencing their landing check, they could have believed the height to be about 1,500 feet and not 500 feet as was actually the case. The only support for this possibility is that the Flying Manual requires that all landing checks be completed by 1,500 feet. The fact that the landing check appears to have been started as late as 500 feet tends to suggest that the aircraft was a good deal lower at that stage than the crew believed it to be.

There have been no previously reported instances of misreading the digital pointer type of altimeter, which was specifically designed to prevent errors of this nature. Though it is, therefore, considered highly unlikely that altimeter misreading was responsible for the aircraft's descent below the OCL, it must always remain a possibility.

2.1.8.4 Height unawareness

The aircraft's descent below the OCL may have been simply due to insufficient attention being paid to the altimeter indications by the crew because of their preoccupation with other matters. It is known that during the latter part of the descent the landing check was in progress and it is thus likely that at least the co-pilot and the flight engineer would have been fully engaged in performing their respective drills and that only the Commander would have been directly concerned with flying the aircraft. If he was expecting to break out below cloud at any time, his attention to the flight instruments could have been frequently interrupted by his attempts to establish visual contact with the ground. As stated earlier, the routine nature of the flight engineer's activity immediately prior to impact argues strongly against the crew being totally preoccupied with some unexpected emergency.

Nevertheless it is hard to accept that a crew whose collective experience exceeded 45,000 hours flying could have made an elementary mistake of this nature. It is possible that they could have been somewhat less alert than normal as it is worth noting that when the aircraft was approaching Lagos there was no other traffic in the area and the approach frequency was relatively quiet. In such circumstances it is possible that the crew's concentration may have been more relaxed than it might otherwise have been in a busy control area. In addition they were coming to the end of a long overnight flight involving three sectors and short term fatigue could well have been a contributory factor.

2.1.9 Failure of the Flight Data Recorder (EFDAS)

It was of some concern that the EFDAS produced no useable information and enquiries were instituted with BOAC to establish the current serviceability of this equipment. It was revealed that EFDAS faults not detected immediately constitute about 50% of the total number of failures. The total failure rate has been of the order of 5%. In view of this efforts are now being made to improve this rate by instituting checks at every base transit (approximately every 100 hours) instead of every 500 hours as hitherto.

2.1.10 Cockpit voice recorder

No cockpit voice recorder was fitted to the aircraft. The investigation would have benefited considerably had the evidence from this type of equipment been available. It would have provided much of the evidence lost due to the failure of the flight recorder.

2.2 Conclusions

(a) Findings

1. The documentation of the aircraft was in order and the aircraft was properly loaded.

2. The aircraft was maintained in accordance with an approved maintenance schedule.

3. The crew were properly licensed and adequately experienced.

4. Otherthan the Flight Data Recorder, an examination of the wreckage of the aircraft revealed no evidence of pre-crash mechanical failure or defect or signs of sabotage.

5. The Flight Data Recorder had been unserviceable for at least 70 hours flying time before the accident occurred.

6. The aircraft was cleared to establish the 014 radial for a straight in approach to runway 19 at Lagos Airport.

7. Although the airport itself was clear, fog prevailed up to a height of approximately 1,200 feet in the area over which the aircraft was approaching.

8. The Commander allowed the aircraft to come below the Sector Safe Altitude of 2,000 feet when not in visual contact with the airfield.

9. The Commander unintentionally allowed the aircraft to come below the Obstacle Clearance Limit of 532 feet above mean sea level without visual reference to the ground.

10. The aircraft collided with trees 8 miles north of the airport at a position where the ground is 8 feet below airfield level.

(b) Cause

The cause of the accident cannot be established with certainty, but it appears probable that it was due to the pilot being unaware of the altitude and allowing his aircraft to come below a safe height when not in visual contact with the ground.

3. RECOMMENDATIONS

It is recommended that:

(a) The practice of allowing aircraft to carry out straight in approaches in Instrument Meteorological Conditions to Lagos Airport should be discontinued for as long as the airfield lacks adequate glide path guidance and compatible Distance Measuring Equipment.

(b) The installation of an Instrument Landing System and compatible Distance Measuring Equipment at Lagos Airport should be accorded as much priority as possible.

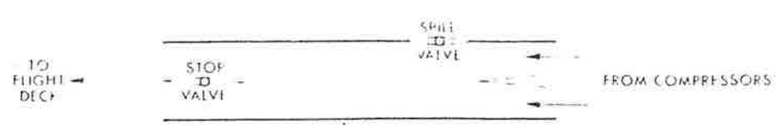
(c) Further research should be undertaken to develop an Altitude Alerting Device associated specifically with the approach and landing phase of the flight.

(d) Consideration should be given to including a cross check on the altimeters in the Field Approach Check List.

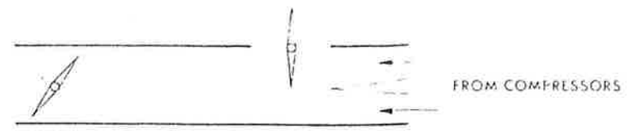
APPENDIX 1
TO CA04/151/C

DIAGRAMATIC REPRESENTATION OF THE STOP / SPILL VALVE SEQUENCE

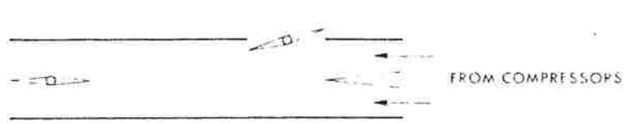
[REF. PARA. 1-6(C)]



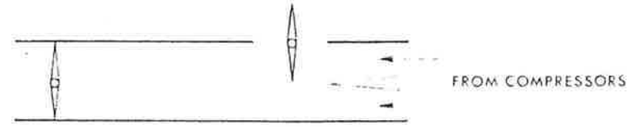
SPILL VALVE SHUT
STOP VALVE OPEN
NORMAL IN FLIGHT POSITIONS



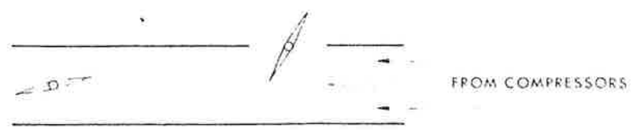
SPILL VALVE FULLY OPEN
STOP VALVE AT 50 DEGREES
CRASH POSITION
TIME 22½ SECS. (STATIC CONDITIONS)



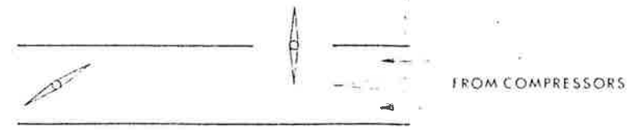
SPILL VALVE SELECTED TO SPILL
SPILL VALVE STARTS TO OPEN
TIME = 0 SECONDS



SPILL VALVE FULLY OPEN
STOP VALVE FULLY CLOSED
TAKE OFF AND LANDING POSITION



SPILL VALVE ALMOST FULLY OPEN
STOP VALVE STARTS TO CLOSE
TIME 16½ SECS.(STATIC CONDITIONS)



SPILL VALVE FULLY OPEN
STOP VALVE HALF SHUT(45°)
REFRIG. RANGE SELECTED
AND AIRCRAFT ON GROUND

BOT (C A Dept) C Ops 10 D O Drg No 6052 11 3 70

APPENDIX 2
TO CA 04/151/C

ACCIDENT TO NIGERIA AIRWAYS VC10 5N-ABD LAGOS

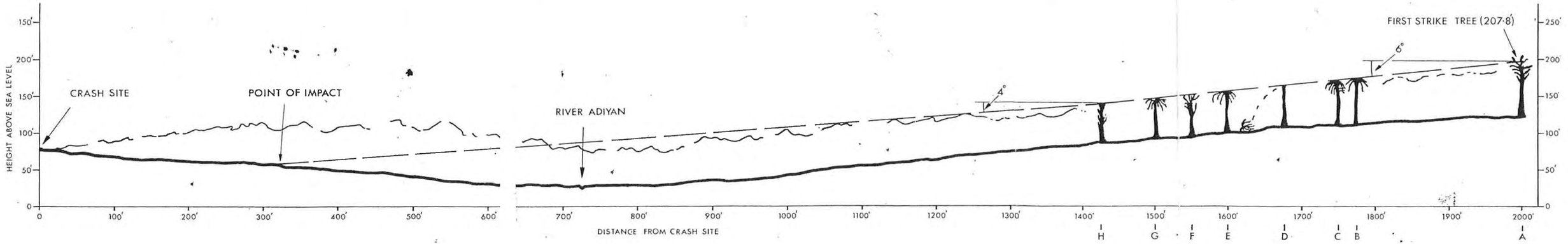
PROFILE DRAWN FROM PLAN SHOWING DETAIL SURVEY OF CRASH SITE AT MATOGBUN VILLAGE, AGEGE, LAGOS STATE.

PLAN No L3783

TRACING No FS4306

KEY

		HEIGHT OF TREE TOP
A :-	IROKO TREE (FIRST STRIKE PORT FLAPS-GEAR DOOR)	207·8′
B :-	PALM TREE (HEAD BRUSHED)	174·6′
C :-	PALM TREE (HEAD BRUSHED)	173·0′
D :-	PALM TREE (CUT 12′ FROM TOP)	175·1′
E :-	PALM TREE (HEAD CUT)	156·5′
F :-	IROKO TREE (HEAD CUT) STBD. FLAPS-GEAR DOOR	153·9′
G :-	PALM TREE (HEAD BRUSHED)	147·2′
H :-	IROKO TREE (HEAD CUT OFF)	140·5′



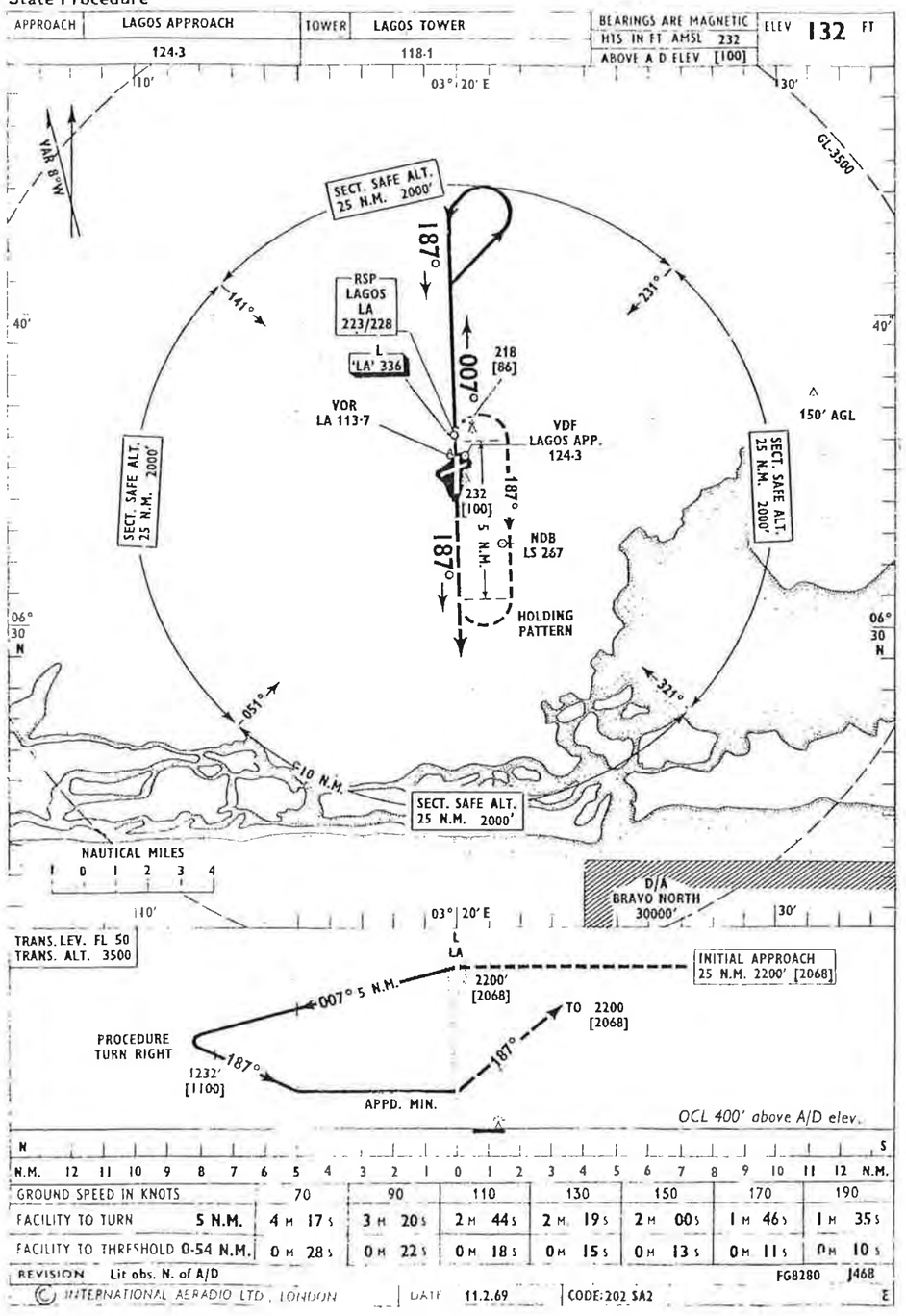
B.O.T. (C.A.Dept.) C.Ops.10.D.O. Drg No. 6114 18·6·70.

L 'LA' R/W 19

State Procedure

D3 LAGOS APT.

APPROACH	LAGOS APPROACH	TOWER	LAGOS TOWER	BEARINGS ARE MAGNETIC	ELEV 132 FT
	124.3		118.1	HTS IN FT AMSL 232	
				ABOVE A D ELEV [100]	



N.M.	12	11	10	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	N.M.
GROUND SPEED IN KNOTS							70			90			110			130			150			170			190	
FACILITY TO TURN 5 N.M.							4 M 17 S			3 M 20 S			2 M 44 S			2 M 19 S			2 M 00 S			1 M 46 S			1 M 35 S
FACILITY TO THRESHOLD 0·54 N.M.							0 M 28 S			0 M 22 S			0 M 18 S			0 M 15 S			0 M 13 S			0 M 11 S			0 M 10 S

REVISION Lit obs. N. of A/D — FG8280 J468

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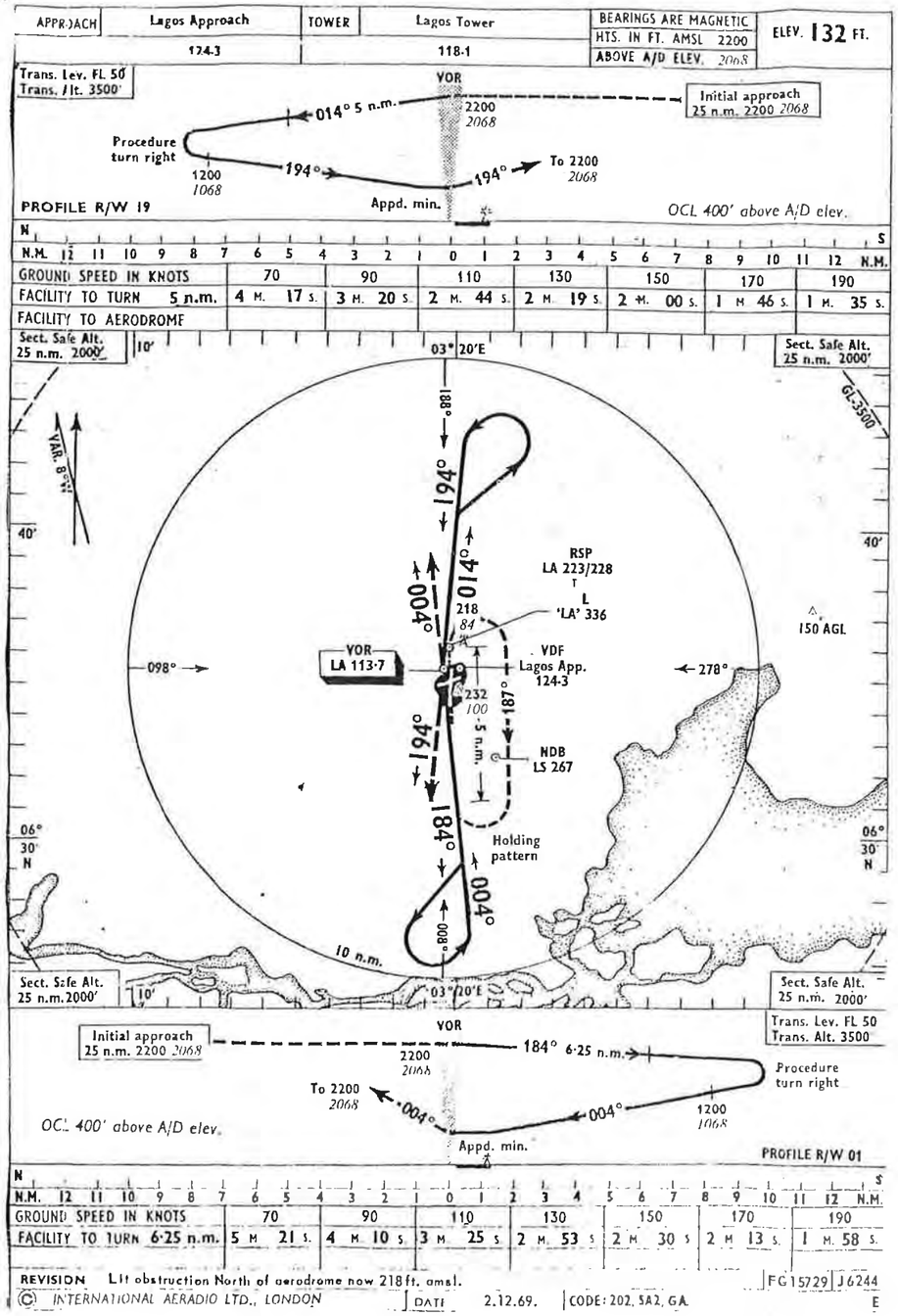
VOR R/W's 01 & 19

State Procedure

C1 LAGOS APT.

APPROACH	Lagos Approach	TOWER	Lagos Tower	BEARINGS ARE MAGNETIC	ELEV. 132 FT.
	124.3		118.1	HTS. IN FT. AMSL 2200	
				ABOVE A/D ELEV. 2068	



N.M.	12	11	10	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	N.M.
GROUND SPEED IN KNOTS							70			90			110			130			150			170			190	
FACILITY TO TURN 6·25 n.m.							5 M 21 S.			4 M 10 S.			3 M 25 S.			2 M. 53 S.			2 M 30 S.			2 M 13 S.			1 M. 58 S.

REVISION Lit obstruction North of aerodrome now 218 ft. amsl. — FG15729 J6244

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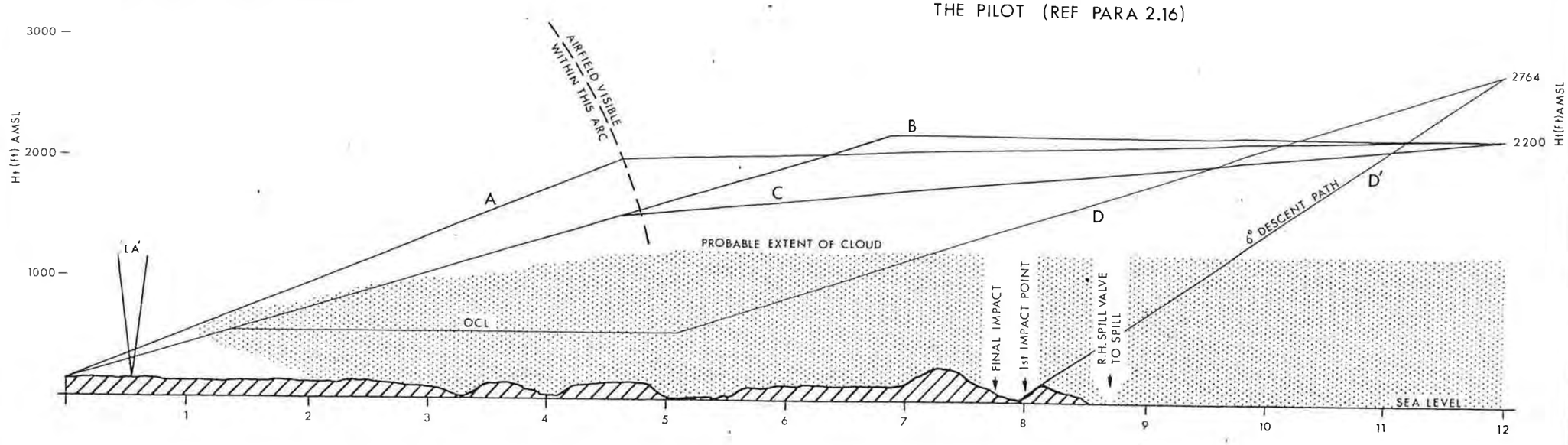
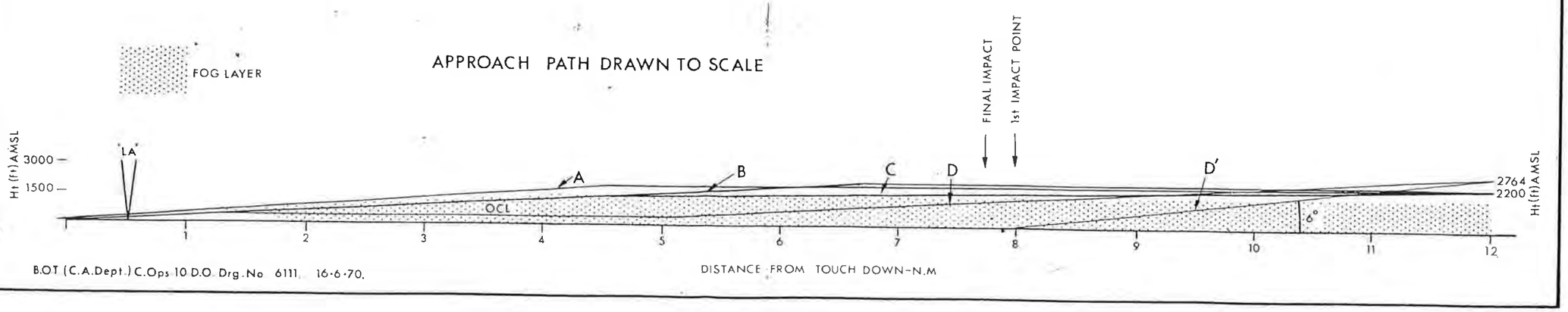
APPENDIX 4
TO CA 04/151/C

ACCIDENT TO NIGERIA AIRWAYS VC 10
5N-ABD

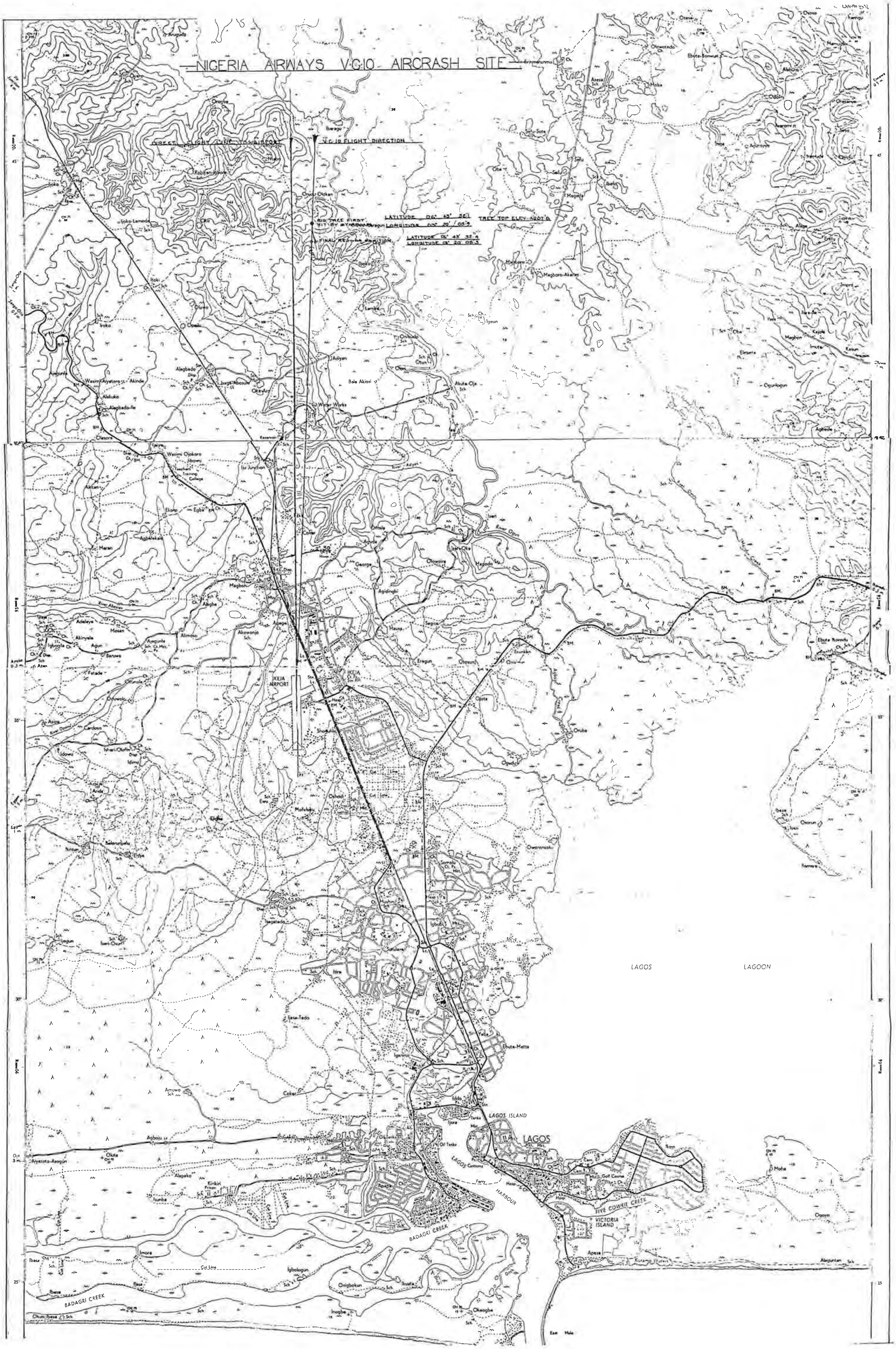
GRAPH SHOWING VERTICAL CROSS SECTION OF THE APPROACH TO RUNWAY 19 AND THE VARIOUS COURSES OF ACTION OPEN TO THE PILOT (REF PARA 2.16)

EXPANDED HEIGHT SCALE





B.O.T (C.A.Dept.) C.Ops 10 D.O. Drg. No 6111 16·6·70.


NIGERIA AIRWAYS V.C.10 AIRCRASH SITE
V.C.10 FLIGHT DIRECTION
LATITUDE 06° 43' 56"·1
LONGITUDE 03° 20' 05"·9
TREE TOP ELEV. 420 FT
LATITUDE 06° 43' 32"·4
LONGITUDE 03° 20' 08"·3
IKEJA AIRPORT
LAGOS LAGOON
LAGOS ISLAND
LAGOS
HARBOUR
FIVE COWRIE CREEK
VICTORIA ISLAND
BADAGRI CREEK

Abbreviations Used in This Report

AIB	United Kingdom Accidents Investigation Branch
ADF	Automatic Direction Finding
AGL	Above ground level
AMSL	Above mean sea level
ATC	Air Traffic Control
Cs	Cirro Stratus
DME	Distance Measuring Equipment
EFDAS	Epsylon Flight Data Acquisition System (Flight Recorder)
ETA	Estimated Time of Arrival
FL	Flight Level
GMT	Greenwich Mean Time
Gradu	Gradually
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
Kgs	Kilogrammes
Km	Kilometres
m	Metres
M/cs	Megacycles
^{o}M	Degrees Magnetic
OCL	Obstacle Clearance Limit
PFCU	Powered Flying Control Unit
Sc	Strato Cumulus
Tempo	Temporarily
Vat	Target Threshold Speed
VOR	Visual Omni-Directional Range VHF