No. 15

Varig Airlines, DC-8, PP-PEA, accident at Roberts International Airport, Charlesville, Marshall Territory, Liberia, on 5 March 1967. Summary of Aircraft Accident Report dated 13 September 1967, released by the Commission of Inquiry, Department of Commerce and Industry, Republic of Liberia

1. - Investigation

1.1 History of the flight

Flight RG 837 departed Rome/Fiumicino Airport, Italy, at 2108 hours GMT on 4 March 1967, on a scheduled international flight for Monrovia/Roberts, Liberia.

The flight was uneventful until the aircraft came overhead the Roberts VOR at FL 45 at 0249 hours GMT on 5 March 1967. The aircraft did not encounter any significant weather during climb to and cruising on the cleared cruising flight levels 310 and 350 nor on its initial descent to overhead Roberts VOR. At no time was there any reported malfunctioning of the engines or aircraft systems. Normal position reports were passed at the appropriate times over the mandatory reporting points en route.

A descent under visual meteorological conditions at 300 kt IAS at an average rate of descent of about 2 000 ft per minute was carried out from FL 350 from a range of 90 to 95 miles on the Roberts Airport DME at 0234 hours GMT approximately. At 0247:48 hours, the aircraft reported its position as 5 miles out at FL 45 when ATC for the second time passed the 0200 QNH of 1 009 mb, with a further descent clearance to 3 000 ft on the VOR. The QNH was read back correctly and the pilot-in-command and co-pilot confirmed that their altimeters were cross checked at FL 45. No reference was made by the crew of the further descent clearance from FL 45 to 3 000 ft and the pilot-in-command did not descend to the cleared altitude but maintained FL 45 overhead the VOR. During the descent and the approach, the pilot-in-command conducted the flight from the left-hand seat, with the co-pilot in the right-hand seat and the second officer occupying the jump seat behind the pilot-in-command.

After sighting the aerodrome runway lights from vertically overhead, the pilot-in-command informed the co-pilot that despite the fact that he had the runway completely in sight he would make an IFR/VOR procedure. A VOR/Locator instrument let-down was commenced from 4 500 ft QNH over the VOR at an indicated airspeed of 210 slowing to 170 kt, descending at a rate of between 500 to 700 ft per minute until the aircraft arrived at a point inbound over the coastline (see Figure 1) at 1 800 ft QNH on a heading of 047° M, gear down, 35° flaps for landing on runway 04. At this point the co-pilot reported: "Runway in sight a little to the left" and stated: "I saw the runway again observing the runway lights and the VASI lights completely white". He also reported informing the ATC: "Runway in sight and both VASI showing white" although this was not confirmed by the ATCO. (A flight test carried out during the investigation showed that the minimum altitude at this point to see the VASI lights all white is 1 800 ft.) The pilot-in-command stated that at this time: "I looked outside and saw part of the airport lights because the very beginning of the runway I could not see because of a bunch of clouds on my side view."

During the approach from the coast to the airport, the pilot-in-command did not make any use of the DME with which the airport and the aircraft were provided. He stated that he did not use it because he had the coastline indicated by radar.

After the procedure turn, the aircraft was on the correct VOR radial and a smooth approach was carried out during which the aircraft was flown manually. The pilot-in-command instructed the co-pilot and the second officers to look outside. Though the statements of the pilot-in-command and the co-pilot were not always coincident in respect to the speeds of the aircraft, it is likely that in the procedure turn the speed was reduced to about 140 kt (threshold speed was calculated to be 131 kt) and that this speed remained basically constant throughout the final approach.

After the procedure turn, the co-pilot called each 100 ft of altitude and the speed and he checked the indication of the vertical speed indicators. At an altitude of about 1 000 ft, flaps were put in the full down position and shortly thereafter, at an altitude of 800-700 ft, the aircraft entered some stratus and, further down, fog patches. When entering the stratus layer, the pilot-in-command told the co-pilot that it was no longer necessary to report altitude and speed and was instructed to look outside and to report as soon as he could see the runway. According to the co-pilot, this instruction was given when the aircraft was passing overhead the FR locator beacon.

The pilot-in-command observed that his altitude over FR was about 800 ft, whereas his correct altitude should have been 520 ft. He told the co-pilot: "I am a little high and I am descending to 550 ft" and instructed him to look outside for the runway, which was expected to be seen at any time, as the visibility according to the weather report was 10 km. He then increased his rate of descent to between 1 200-1 500 ft/min, by reduction of power and by pitching the nose of the aircraft down. About 15 seconds after passing FR the co-pilot reported runway in sight, saying also that the visibility was poor and that they were too low. This last information was based on the fact that he saw both VASI lights red, but he did not mention this to the pilot-in-command.

During the final phase of the flight, the second officer made several observations. The pertinent extracts from his statements, not necessarily in sequence, are as follows:

> "... when I saw the approach was beginning to become critical I looked at the altimeter and remarked that it was still above 500 ft."
>
> "... a few moments later I saw the lights that I suppose were of the VASI due to their intensity, a little to the left of the aircraft. I want to make it clear that the lights were only a shade. After these lights disappeared I felt the aircraft sinking. Immediately I looked at the altimeter and noticed the pointer passed 300 ft in a fast descent and immediately after the accident occurred."
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> "... I did not have time to warn. I remember slightly that it must have hit for the first time more or less below 100 ft."

The pilot-in-command stated that the aircraft and its systems, including the altimeter, had functioned properly up until the time of impact.

The first point of impact was at an elevation of 42 ft AMSL, 6 023 ft from the threshold of runway 04, 180 ft to the right of the runway extended centre line with the aircraft coming to rest after a ground slide of approximately 850 ft the ground slide being parallel to the extended centre line of runway 04.

The aircraft passed over power lines which run nearly perpendicular to centre line of the runway, 440 ft before the first point of impact with the gr[illegible] power lines remained undamaged; their height is 34 ft 2 in above ground level [illegible] 2 in AMSL). The angle between the first point of impact and the top of the power line was found to be 4.5°. Based on the above it was calculated that the rate of descent in the last two seconds of the approach could not have been less than 1 150 ft ft/min. The accident occurred at night at 0256 hours GMT.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1*	50	5
Non-fatal	16	7	
None	2	14	

* The flight engineer did not survive.

1.3 Damage to aircraft

The aircraft, with the exception of the tail assembly which was substantially damaged, was destroyed by ground impact and fire.

1.4 Other damage

Five other persons on the ground were fatally injured, two houses were completely destroyed and two others severely damaged.

1.5 Crew information

The crew of 19 consisted of a pilot-in-command, co-pilot, second officer, flight engineer, navigator/flight radio operator, seven stewards, three stewardesses with an additional four supernumerary crew members who had no operational duties.

The pilot-in-command, aged 45, held a valid airline transport pilot's licence with a valid type and instrument rating for DC-8. His total flying experience at the time of the accident was 17 718 hours including 1 787 hours in command of the DC-8. He had flown the same scheduled international flight three times during the six months preceding the accident. He satisfactorily passed his last DAC medical examination on 24 October 1966, without restrictions. In the 90 days immediately preceding the accident, he had flown 107 hours and enjoyed 3 days' rest in Rome prior to take-off.

The co-pilot, aged 41, held a valid airline transport pilot's licence with a valid type and instrument rating as co-pilot on DC-8. His total flying experience at the time of the accident was 15 911 hours including 408 hours as co-pilot on the DC-8. He satisfactorily passed his last DAC medical examination on 3 November 1966, without restrictions. In the 90 days immediately preceding the accident, he had flown 150 hours and enjoyed 3 days' rest in Rome prior to take-off.

The second officer, aged 33, held a valid commercial pilot's licence with no instrument rating with class and type rating for aeroplane single engine land Group A. His total flying experience at the time of the accident was 8 067 hours including 1 818 hours as second officer on the DC-8. He also held an expired flight engineer's licence rated for the DC-8. He satisfactorily passed his last DAC medical examination on 15 June 1966, without restrictions. In the 90 days immediately preceding the accident, he had flown 223 hours and enjoyed 3 days' rest in Rome prior to take-off.

The flight engineer, aged 62, held a valid flight engineer's licence rated as competent on DC-8 equipment. At the time of the accident he had accumulated 1 151 hours of flight time as flight engineer, of which 1 106 hours were on the DC-8. He also held a commercial pilot's licence with type rating for aeroplane single engine land Group A. He satisfactorily passed his last DAC medical examination on 26 October 1966, without restrictions. In the 30 days immediately preceding the accident, he had flown 40 hours and enjoyed 3 days' rest in Rome prior to take-off.

The navigator/flight radio operator, aged 39, held a valid navigator's and flight radio operator's licence rated as navigator on DC-8 equipment. He satisfactorily passed his last DAC medical examination on 31 May 1966. In the 30 days immediately preceding the accident, he had flown 83 hours 37 minutes.

1.6 Aircraft information

The aircraft's certificate of airworthiness, issued by the Brazilian Civil Aviation authorities was valid until 20 August 1967. The aircraft had been maintained in accordance with Varig Airlines' procedures and the Brazilian Civil Aviation authority directives. It had accumulated a total of 16 775 hours.

The centre of gravity was within the prescribed limits.

1.7 Meteorological information

Approximately 20 minutes before the time of the accident, Roberts Approach Control passed the following weather report to the aircraft for landing. This was the 0200 hours actual:

Surface wind: calm
Visibility: 8 km (5 statute miles)
Weather: hazy
Cloud: 2/8 Sc 1 200 ft
Temperature: 24°C
Dew-point: 23°C
QNH: 1 009.1 mb
QFE: 1 008.3 mb

Remarks: Patches of fog to the north. Ceiling unlimited. Transition level 45.

The actual weather at the time of the accident (this was the 0300 hours weather report taken between 0245 hours and 0250 hours) was:

Surface wind: 050°/2 kt
Visibility: 8 km (5 statute miles)
Weather: light fog; 3/8 k St 400 ft; 2/8 k St 1 200 ft
Temperature: 24°C
Dew-point: 23°C
QNH: 1 008.8 mb
QFE: 1 008.0 mb

Remarks: Ceiling unlimited. Transition level 45.

It was noted that the meteorological observer at Roberts has no night visual reference point beyond the Z marker which is located 1 150 m (3 772 ft) from the threshold of runway 04 and 3.15 km (1.97 statute miles) from the Met observer and the Duty ATCO.

The weather conditions at the alternate aerodromes before and at the time of the accident from observations at Dakar, Abidjan and Conakry included in the Dakar HF/RT Volmet broadcast all indicated 8 to 10 km (5 to 6¼ statute miles) and no significant clouds.

1.8 Aids to navigation

The following aids were available: VOR, DME, Locator NDB, Main NDB, Z-Marker.

Runway 04 is served by a VASI installation designed to provide by visual reference the same information that the glide slope unit of an ILS provides electronically.

An aerodrome beacon alternating Green/White is sited 2 000 ft east of the aerodrome.

1.9 Communications

All communications with the aircraft were normal. No automatic recording equipment is installed at Roberts and no record of radiotelephony is kept.

1.10 Aerodrome and ground facilities

Runway 04, 9 000 ft long and 150 ft wide, is equipped with medium intensity white runway lights and lead in approach lights of low intensity, variable brilliancy Amber incandescent centre line lights placed at 100-ft intervals extending 1 400 ft from the threshold with Amber cross-bar located at 1 000 ft from the runway threshold and a red threshold runway bar located 150 ft from the runway threshold.

1.11 Flight recorders

The flight recorder which was recovered from its housing in the fuselage under the tail assembly had sustained damage during impact. Examination of the recording medium carried out at the U.S. Civil Aeronautics Board, Flight Record Laboratory, Washington, revealed no recordings on the accident recording medium. Further examination revealed that a red plastic type material had been installed on the face of the platen as a substitute replacement for the teflon material normally used and recommended by the manufacturer.

The substitute material was found to have been folded on the face of the platen, which resulted in a ridge being formed that precluded proper scribing of the parameter styli on the medium.

1.12 Aircraft wreckage

The first point of impact showed the imprint of both main landing gears and the nose wheel. These imprints continued for a distance of 36 ft indicating down and locked position. Thereafter, the undercarriage failed due to the right main gear entering a hole. All flight control surfaces and all major components of all aircraft systems were found in the wreckage area, indicating no evidence of in-flight separation of the aircraft structure or components. Initial impact was at a stabilizer setting of 4° to 5° nose-up. Examination of the empennage controls and all four engines revealed no malfunction. All flight and engines instruments, radios and navigational receivers were either damaged severely or destroyed by impact forces and/or by fire.

1.13 Fire

The aircraft caught fire externally during its ground slide with the fire entering the fuselage through an overhead wing emergency exit which came open almost completely dividing the cabin at row 15. The fire progressed more rapidly toward the rear of the aircraft than the front.

Two crash trucks and one reserve water tender, manned by a total crew of five who were engaged in fighting the fire on each side of the nose section were unable to take rescue action in the area behind the wing.

1.14 Survival aspects

Within the fuselage, the forward life raft compartment door opened and partially obstructed the forward left-hand door. In addition, the contents of the forward galley were all over the floor indicating that the galley doors opened. Passengers from seat row 13 in the coach section and those in the first class section escaped through the forward left-hand passenger door. The forward right-hand passenger door was never opened. In the aft cabin, the forward life raft compartment door came open and permitted the life raft to fall to the floor hitting a crew member in seat 28D. The closet, just forward of the right-hand coat room, broke loose and fell across the aisle. The crew folding seat adjacent to the left aft passenger door broke and dropped the two attendants occupying the seat to the floor, obstructing the access way to the door. The seat belts on this seat did not break; however, seat belts did break at seats 2C and 25B.

In the front section from seat row 13 forward, there were 17 passengers and 14 crew members. Eleven passengers and 11 crew members escaped through the front passenger door, left side. The pilot-in-command and navigator escaped through the left side cockpit sliding window.

In the section rear of seat row 13, there were 54 passengers and 5 crew members. Ten passengers and 5 crew members escaped through the left side rear passenger door.

Cabin staff from the front section were unable to gain further access through the cabin to the rear due to fire which divided the cabin at row 15 rendering movement through it impossible.

Most of the bodies were found severely burned in the aft section of the economy class cabin, lying in the debris with the heads in the direction of the rear of the aircraft, pyramided between the last three rows of seats.

Failure of the cabin lights after first impact rendered evacuation action more difficult.

Whilst assistance was rendered by some of the cabin staff in the front section with the evacuation of some of the 11 surviving passengers from seat row 13 forward through the front left-hand door, the Commission notes that 6 passengers from seat row 11, who subsequently died, did not evacuate through the front section with the others. The intensity of the fire which started in the wing area, and dividing the fuselage into two separate sections at row 15, undoubtedly prevented the cabin staff from the front in rendering assistance to those passengers further in the rear.

The majority of the 44 passengers in the aft section rear of seat row 13 who did not survive and who did not receive ante-mortem fractures or traumatic injuries were capable of movement after the crash. The position of most of the bodies revealed that there was considerable movement in the rear of the cabin toward and in the direction of the rear door after the 10 passengers and 5 crew members had evacuated through the left rear passenger door. Considerable confusion and crowding in the narrow aisle must have existed in the darkness, and egress made extremely difficult by the number of obstructions, the presence of dense smoke and fumes and the intense heat of the rapidly spreading fire through the fuselage toward the rear and inordinate and alternate movement within the cabin.

Although the length of time taken for the fire to encompass completely the aircraft was not determined, the evidence indicates that this spread was definitely at a faster rate to the rear. And while the cabin attendants who were not incapacitated by injury assisted some of the surviving passengers after evacuating through the front and rear doors, the Commission believes that had further assistance been rendered to those still inside additional lives might possibly have been saved.

The work of the crash rescue services was carefully analysed. It must be concluded that the crew was fully alert when the aircraft approached the aerodrome and were ready for action when the alarm bell rang and ATC instructed them where to go. They immediately started to attack the fire by applying foam on the fuselage to keep it as cool as possible and extend the time for the fuselage to become consumed by fire. The Commission is of the opinion that a small crew of 5 manning two crash trucks could not, after a minimum elapse time of 7 minutes and 40 seconds to reach the scene of the accident, have rendered any valuable evacuation assistance at the rear. When the fire chief arrived shortly after the arrival of the fire crew, he ascertained himself by looking through the open frong left-hand door that nobody could be saved from the front part of the cabin. An eruption of a fuel tank prevented him from looking into the rear cabin at the rear door when he was about to do so. As the small fire crew was fully occupied by fighting the fire, it was beyond their physical capabilities to effect rescue.

The Commission therefore believes that more lives might have been saved in this accident if the crew members, who escaped relatively unhurt, had directed more effort in further evacuation and the crash rescue service had carried more manpower to effect immediate rescue.

2.- Analysis and Conclusions

2.1 Analysis

There was no structural, powerplant, systems, or navigational components on board the aircraft that contributed to the cause of this accident. The aircraft was currently certificated, and, as far as could be ascertained, airworthy, properly maintained and dispatched in accordance with the company operational procedures.

Testimony and investigation disclosed that all ground aids and navigational facilities were operating satisfactorily at the time of the accident.

All communications between aircraft and ATCO were normal.

During the descent, the flight encountered some stratus and further later down fog patches which had not been included in the meteorological information given to the pilots at between 0230 and 0235 hours (i.e. the 0200 hours weather observation). From the available evidence, it is clear that the actual conditions have materially contributed to the accident, but it is obvious that any pilot-in-command of a modern transport aircraft in any landing must be able to cope with these conditions in a safe way. The flight was not complicated by wind, turbulence or rain.

During the final approach, the pilot-in-command did not make use of all available navigational equipment. He had announced to the co-pilot that he would make an IFR approach, but in doing so he did not make any use of the DME equipment. Had he used same, he would have been able to detect at an earlier stage that he was too high. This would have avoided an incorrect altitude at a later critical stage.

In this respect, it is of importance that the pilot-in-command stated that his altitude over the coast was 1 500 ft. However, the co-pilot declared that in this position he saw the VASI lights all white. A flight test revealed that this is only possible if the minimum altitude at the coast amounts to 1 800 ft. From the available evidence it is clear that the pilot-in-command carried out a routine descent at the correct speed and the correct rate of descent, but not before he reached FR, did he discover that he was about 300 ft higher than he had supposed.

The Commission considers the failure of the pilot-in-command to make use of the DME a severe shortcoming.

At this stage, an accident could have been avoided had the pilot-in-command decided to abandon his approach, climbed to the prescribed altitude and made a new approach from the coast position. However, though he knew the field was not in sight, he decided to lose his excess altitude by increasing his rate of descent to 1 200-1 500 ft/min by reducing the engine power and simultaneously pitching the aircraft in a more nose-down altitude. This procedure is contrary to the operator's instructions which prohibit the use of a descent rate of greater than 1 000 ft per minute below an altitude of 2 000 ft.

A rapid sink developed, which the pilot-in-command intended to stop when the indicated altitude was exactly 500 ft. The rapid change of static pressure certainly will have caused a delay in indication of the static instruments, so that the real height at this moment must have been less. Whether the amount of power applied was the maximum

available power is not known; the second officer stated: "He only applied a small amount of power not enough to go around." Because a jet aircraft does not react immediately in a vertical sense when power is applied, as first the speed has to be increased, a considerable loss of altitude occurs before level flight is achieved. Evidence revealed that the final angle of descent was at least 4.5°, thereby indicating that the achievement of level flight was far from being realized. Also the impression of both main landing gear and the nose gear at the first point of impact indicated that the aircraft was in a nose-down attitude at impact.

2.2 Conclusions

(a) Findings

Based on the foregoing, the Commission believes the following conclusions are justified:

No factors apart from those mentioned below have been found which may have contributed to the accident.

The captain did not make use of the available navigational aids by disregarding the indications of his distance measuring equipment during final approach.

At an altitude below 1 000 ft, the aircraft entered a stratus layer, which at that time completely obscured the runway.

At the FR, positioned 1.7 NM before the runway threshold, the pilot-in-command saw that his altitude was 800 ft, whereas the correct altitude should have been 520 ft. Contrary to company instructions, he increased his rate of descent to between 1 200-1 500 ft/min by reducing engine power and pitching the nose of the aircraft down, with the intention to arrest his descent at about 500 ft.

The attempt to level off was insufficient and/or too late, with the result that the aircraft touched the ground some 6 000 ft before the runway threshold when his glide path angle must have been 4.5° or more.

During impact and the subsequent ground slide of about 850 ft, the aircraft broke up and caught fire.

Those crew members who escaped relatively unhurt, once outside, might have directed more effort in further evacuation.

The fire crew acted promptly, but its limited force and the necessary elapse time to reach the scene of the accident prevented them from saving people who might not yet have died.

(b) Cause or Probable cause(s)

The probable cause of this accident was the failure of the pilot-in-command to arrest in time the fast descent at a low altitude upon which he had erroneously decided, instead of executing a missed approach when he found himself too high over the locator beacon.

Scheduled international
Landing
Undershoot
Pilot misjudged distance

ICAO Ref: AR/002/67