No. 13

Pan American World Airways, Boeing 707-321C, N-446 PA, accident at Tinga-Tinga, Bali, Indonesia, on 22 April 1974. Report dated 20 March 1975, released by the Ministry of Transport, Communications and Tourism, Indonesia.

1.- Investigation

1.1 History of the flight

Flight PA-812 was a scheduled international flight from Hong Kong to Sydney with an intermediate stop at Denpasar, Bali. The aircraft took off from Hong Kong at 1108 hours* on an IFR flight plan via A-83 GYM B-67 BTT B-91 GPR B-61 VJN and Denpasar with an estimated en-route time between Hong Kong and Denpasar (Bali) of 4:23 hours.

Flight PA-812 was allocated flight level 330 from Hong Kong until BTT and thence proceeded at flight level 350 until Denpasar. The flight proceeded normally and position reports while in Indonesian UIR were carried out through Jakarta Radio on frequency 5 673 kHz.

At 1428 PA-812 was cleared by Jakarta Area Control Centre to descend to flight level 280. PA-812 established its first contact with Bali Tower at 1506 through Tower Frequency 118.1 MHz and was instructed by Tower to contact Bali control on frequency 128.3 kHz.

At 1508 PA-812 informed Bali Control of revised ETA 1527. A clearance to descend to flight level 100 was given by Bali Control and at 1509 a request was made by the aircraft for active runway. Runway in use 09 was passed on by Bali Control to the aircraft.

During descent to flight level 120, after observing that one of the ADF needles swung, at 1519 PA-812 reported over the station turning outbound and was subsequently instructed to contact Bali Tower. Twenty-five seconds later PA-812 established contact with Bali Tower informing outbound procedure, followed by a request for lower altitude.

Clearance was then given to descend to 2 500 ft and PA-812 was instructed to report reaching 2 500. At 1523 the aircraft reported reaching 2 500 ft and Bali Tower gave instructions to continue approach and to report when runway was in sight. Acknowledgement was made by PA-812 by saying "Check inbound". At 1526 the pilot-in-command requested the visibility by calling "Hey - Tower, what is your visibility out there now?".

However, according to the transcription of Air Traffic Control voice recorder this message was never received by Bali Tower. Apparently this was the last message transmitted by the aircraft. Bali Tower kept trying to contact the aircraft by calling "Clipper eight one two, Bali Tower" and "Clipper eight one two, Bali Tower, how do you read" several times. However, no answer was received from the aircraft. It was subsequently found that the aircraft hit a mountain approximately 37 NM North-West of Ngurah Rai Airport, Bali.

* All times herein are in GMT based on 24 hours.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	11	96	-
Non-fatal	-	-	-
None	-	-	

No identification and toxicological examination of the victims could be made. The number of victims stated above was based on the passenger manifest and the crew list.

1.3 Damage to aircraft

The aircraft was totally destroyed.

1.4 Other damage

Other damage was confined to the forest at the crash site.

1.5 Crew information

The pilot-in-command, aged 52, held a valid airline transport pilot's licence endorsed for Douglas DC-4 and Boeing 707/720.

At the time of the accident he had flown a total of 18 247 hours including 7 192 hours in Boeing 707/720 aircraft. His last FAA medical examination took place on 13 December 1973, with a limitation to wear glasses while flying an aircraft. He had flown 33 hours during the last 30 days and 3:40 hours during the 24 hours prior to the accident. His last proficiency check was carried out on 24 October 1973. His last entry to Denpasar was on 16 May 1973 on flight PA-811 from Sydney to Hong Kong via Denpasar.

The first officer, aged 40, held a valid ATPL endorsed for Boeing 707/720. At the time of the accident he had flown a total of 6 312 hours including 4 776 hours in Boeing 707/720 aircraft. His last FAA medical examination took place on 5 December 1973 and there were no limitations imposed. He had flown 40 hours during the last 30 days and 3:40 hours during the 24 hours prior to the accident. His last proficiency check was carried out on 7 December 1973. His last entry to Denpasar was on 16 July 1973 on flight PA-812 from Hong Kong to Sydney via Depensar.

The second officer, aged 38, held a valid Commercial pilot's licence and a current instrument rating. At the time of the accident he had flown a total of 4 255 hours including 3 964 hours in Boeing 707/720 aircraft. His last FAA medical examination took place on 8 March 1974 with no limitations imposed. He had flown 74:27 hours during the last 30 days and 3:40 hours during the 24 hours preceding the accident. His last proficiency check was carried out on 15 February 1974. His last entry to Denpasar was on 27 February 1974 on flight PA-812 from Sydney to Hong Kong via Denpasar.

The flight engineer, aged 48, held a valid flight engineer's licence. At the time of the accident he had flown a total of 14 375 hours including 7 175 hours in Boeing 707/720 aircraft. His last FAA medical examination took place on 5 November 1973 with a limitation to wear glasses while on duty in the aircraft. He had flown 26 hours during the last 30 days and 3:40 hours during the 24 hours preceding the accident. His last proficiency check ride was carried out on 21 March 1974. His last entry to Denpasar was on 17 December 1973 on flight PA-812 from Hong Kong to Sydney via Denpasar. The second flight engineer, aged 43, held a valid flight engineer's licence. At the time of the accident he had flown a total of 7 986 hours including 4 965 hours in Boeing 707/720 aircraft. His last FAA medical examination took place on 6 August 1973 with a limitation to wear glasses while on duty in the aircraft. He had flown 32 hours during the last 30 days and 3:40 hours during the 24 hours prior to the accident. His last proficiency check ride was carried out on 8 January 1974. His last entry to Denpensar was on 16 January 1974 on flight PA-811 from Sydney to Hong Kong via Denpasar.

1.6 Aircraft information

The aircraft, a Boeing 707-321 C having serial number 19268, was delivered to Pan American World Airways on 16 December 1966. The aircraft was received and operated in a passenger configuration. The total airframe hours since new until the last recorded maintenance was 27 943 hours. The total landings (cycles) were 9 123 up to the last recorded maintenance. The last recorded maintenance was accomplished at Hong Kong Airport at the termination of flight number 811 on 22 April 1974. The Certificate of Airworthiness of the aircraft was valid and the aircraft had been maintained in accordance with a continuous programme.

From the aircraft maintenance log it appeared that all actions to correct discrepancies had been taken and properly accomplished. All Airworthiness Directives, Engineering Authorizations and Quality Control Authorizations had been complied with. The last "A" check was accomplished at a ship time of 27 943 hours on 22 April 1974 at Hong Kong Airport, whereas the last "B" check was accomplished on 13 April 1974 at total aircraft time of 27 838 hours.

The powerplants were four Pratt and Whitney JT3D model 3 BAB engines.

Engine serial number 668583 was installed on N 446 PA on 9 April 1973 in the number one position. At the time of the last recorded maintenance accomplished at the termination of flight number 811/20 at Hong Kong Airport, the total engine time was 15 133 hours and the time since last overhaul was 15 133 hours, the total engine cycles were 5 590. The last combustion area inspection at TSO (time since last overhaul) 11 332, was done at a Periodic/Shop Visit on 24 July 1972. The test cell run was made on 15 September 1972.

Engine serial number ------ was installed on N 446 PA on ---------- in the* number two position. At the time of the last recorded maintenance at the termination of flight number 811/20 at Hong Kong Airport, the total engine time was 18 475 hours and the time since last overhaul was 16 248 hours. The total engine cycles were 6 815. The last combustion area inspection at TSO 15 320, was done on a Periodic/Shop Visit on 31 July 1973. The test cell run was made on 19 September 1973.

* ICAO Note: The preceding words were added by ICAO as one line was apparently missing in the report.

Engine serial number 644755 was installed on N 446 PA on 4 March 1974 in the number three position. At the time of the last recorded maintenance at the termination of flight number 811/20 at Hong Kong Airport, the total engine time was 28 409 hours and the time since last overhaul was 10 596 hours. The total engine cycles were 9 388. The last combustion area inspection at TSO 9 723, was done on a Periodic/Shop Visit on 19 July 1973. The test cell run was made on 13 August 1973.

Engine serial number 667727 was installed on N 446 PA on 18 April 1974 in the number four position. At the time of the last recorded maintenance at the termination of flight number 811/20 at Hong Kong Airport the total engine time was 20 049 hours. The total engine cycles were 6 040. The last combustion area inspection at TSO 19 999, was done on a Periodic/Shop Visit on 5 July 1973. The test cell run was made on 2 April 1974.

1.7 Meteorological information

Advisory route forecast issued for PA-812 was sent to Hong Kong by Ngurah Rai Airport at 0415 hours 22 April 1974.

According to the transcript of the Cockpit Voice Recorder, at 1519:42 Bali Tower informed PA-812 that the surface weather at Bali Airport was as follows: wind 110/5 kt, altimeter setting 29.87 in Hg.

According to the meteorological report for take-off and landing made by the meteorological officer at Bali Airport at 1500, the surface weather at Bali Airport was as follows:

Date and time	:	22 April 1974, 1500.
Surface wind	:	110/5 kt.
Horizontal visibility	:	8 NM.
Cloud	:	1 Oktas Cu 2 000 ft.
Altimeter setting	:	1 011.6 mb or 29.87 in Hg.
Pressure at aerodrome elevation:		1 011.1 mb or 29.86 in Hg.

According to eyewitness observations, the weather at the accident site was clear (cloudless), the stars were bright and it was moonless.

1.8 Aids to Navigation

The Denpasar VOR (DPS - 115.5 MHz) is located approximately 10 kilometres South of the runway, having dual 200 Watts transmitters. The first commissioning check was carried out by the Federal Aviation Administration in July 1969. The last routine flight check, prior to the date of the accident, was carried out in February 1974. No significant troubles and/or repairs had been noted during March/April 1974. This was also stated in the maintenance log as well as in pilots' debriefings. Ngurah Rai International Airport is also equipped with an NDB (OR - 230 kHz). This is a high range beacon (300 NM) with dual transmitters. No significant troubles and/or repairs had been logged during March/April 1974. The NDB was reported functioning normally. Pilots' debriefing log was maintained and no discrepancies were reported.

1.9 Communications

At 1500 PA-812 attempted several times to establish contact with Bali Approach on 119.7 MHz and Bali Tower on 118.1 MHz but to no avail.

Contact was finally established at 1506 with Bali Tower on 118.1 MHz and PA-812 was then instructed to contact Bali Control on 128.3 MHz. Subsequently the communication between the aircraft and the ground was normal. No message indicating evidence of either distress or emergency was received by Bali Air Traffic Control prior to the accident.

1.10 Aerodrome and ground facilities

The aerodrome obtains its electric power from the main city electric power supply, however standby generators are available.

It is equipped with runway lights, threshold lights, taxiway lights, VASI, rotating light beacon and landing tee. The rotating light beacon was unserviceable during the time of the accident.

No failure of electric power supply was experienced at the time of the accident.

1.11 Flight recorders

The aircraft was equipped with a flight data recorder and a cockpit voice recorder. Both recorders were found on 16 and 18 July 1974 respectively after an intensive two-week search at the crash site. The flight data recorder having serial number 443 and the cockpit voice recorder having serial number 870 were sent to the National Transportation Safety Board, USA, for read-out and evaluation.

a) Flight data recorder

The flight data recorder was a LAS 169-C model having serial number 443. Examination of the cassette showed minor mechanical damage. The foil recording medium was removed from the cassette and found to have several mechanical tears and deformation due to impact, apparently as a result of the accident. No evidence of fire or heat damage was noted on the cassette or foil. It was noted that all parameter traces had been recording at the time of the accident. Basic reference measurements disclosed that the recorder had been operating in a manner consistent with the current calibration with no evidence of recorder malfunction or recording abnormalities. The read-out done by the NTSB laboratory was started at a point when the aircraft was at cruising altitude of 34 000 ft pressure altitude and covered the last 39 minutes and 30 seconds of recorder operations. The read-out covers a period of several seconds after impact, however, the exact point of impact was not definitely established.

b) Cockpit voice recorder

The cockpit voice recorder was also recovered and sent to the U.S. National Transportation Safety Board for evaluation. It yielded a good readable tape and a transcription was made of the last thirty minutes of the flight. The NTSB's comprehensive read-out indicated that evaluation started at cockpit voice recorder time of 1456:14 and the read-out indicated that the impact occurred at 1526:42.9. A review of the tape revealed that the cockpit voice recorder had been operating satisfactorily up to the time of the accident.

1.12 Wreckage

The accident occurred in rough mountainous terrain with trees 20 to 30 m high. The crash site is located at an elevation of approximately 3 000 ft above mean sea level and approximately 37 NM North-West of Ngurah Rai Airport. Judging from the cuts of the trees the aircraft's heading prior to impact was estimated to be between 155 and 160 degrees. It appeared from the cuts of the trees that the aircraft hit the mountain in a banked position.

The aircraft disintegrated after its final impact and the wreckage was scattered within a radius of 50 m from the point of impact.

Thorough investigation at the crash site revealed that no fire broke out prior to the accident.

The burnt area at the place of aircraft impact, which showed signs of fire from below towards the top of the trees, led to the belief that fire only occurred after the aircraft hit the ground. Further examination of the wreckage revealed that the main and nose landing gears were in down and locked positions. It was found that the right-hand wing tip struck several trees first at approximately 50 m from the impact point and then the aircraft entered a gap approximately 100 ft wide between two large trees. The right hand wing was sheared off at its root and broken into four parts. The left hand wing struck a ridge and was broken into three separate parts. It was observed that a burnt area was shown close to the main impact area, which indicated that fire broke out immediately after impact. From the distribution of the wreckage no evidence of in-flight explosion could be found.

2.- Analysis and Conclusions

2.1 Analysis

Examination on the disposition of the wreckage and inspection of the site indicated that no structural failure of the aircraft occurred before impact. No indication of any malfunctioning of engines or break up prior to impact of the aircraft with the ground was found. The Board did not find any evidence that may indicate that the aircraft was not in an airworthy condition at the time of the accident. Examination of the cockpit voice recorder revealed that the pilot-in-command of the aircraft experienced some difficulties in establishing contact with Bali Air Traffic Control. First contact between the aircraft and Bali Tower was established at 1506 whereupon Bali Tower instructed PA-812 to contact Bali Control on frequency 128.3 MHz, because the aircraft was still within the jurisdiction area of Bali Control. This was acknowledged by PA-812 accordingly. Subsequently communication between the aircraft and the ground was normal.

The cockpit voice recorder further disclosed that the pilot-in-command had encountered no difficulty with the procedures to land at Bali Airport, in which it was mentioned to maintain at 12 000 ft until the beacon and then to execute the full ADF let-down procedure. The cockpit voice recorder also disclosed that the pilots were aware of the existence of a 7 500 ft mountain 26 miles North of Bali Airport, another 10 000 ft mountain north-north-east of the airport and that flight level 120 would clear them from the mountains mentioned above. From the conversation amongst flight crew members it was further disclosed that the estimated time of arrival was 1527, which was subsequently passed to Bali Control. It was further disclosed that the pilot intended to make a right hand turn within 25 miles from the beacon for a track out on 263 degrees, descending to 1 500 ft followed by a procedure turn over the water for final approach on Runway 09 which was the runway in use given by Bali Control.

As recorded by the cockpit voice recorder at approximately 1518 the crew observed that ADF number one was swinging while ADF number two remained steady. A few seconds later at 1519 PA-812 reported to Bali Control that he was over the station turning outbound descending to flight level 120. This was acknowledged by Bali Control and PA-812 was then instructed to change over to Bali Tower. Having established contact with Bali Tower, PA-812 reported making outbound procedure flight level 110 and requested lower altitude. Clearance was given by Bali Tower to descend to 2 500 ft, with instructions to report at that height. At 1523 PA-812 reported reaching 2 500 ft.

The Board is of the opinion that the crew in an attempt to expedite their approach into Bali Airport, elected to execute an early right hand turn for track out on 263 degrees. By using this type of approach they were prevented from knowing their exact position. Such an early turn would necessitate the pilot's obtaining an early indication on the ADF that the was nearing the NDB. Evidently the right hand turn was made at the time when only one of the ADF needles swung. According to the reconstruction of the flight path, based on information obtained from the flight recorder, it is evident that the right hand turn was made at a position approximately 30 NM North of the beacon.

Although several attempts were made to regain proper indication on the ADFs after the turn, the Board believes that this would not have been possible since the aircraft would be shielded by the mountain range. However, the approach was continued as planned resulting in a collision with high ground.

The flight data recorder and cockpit voice recorder read-outs revealed no evidence of any aircraft abnormality during any part of the flight prior to the accident.

2.2 Conclusions

a) Findings

1) The aircraft was properly certificated and airworthy at the time of accident.

2) There was no sign of explosion prior to impact.

3) There was no evidence of any break up in flight.

4) There was also no sign that may have indicated a possible fire prior to the impact.

5) The flight crew was properly licensed and experienced to carry out the flight. However, from the available data, the Board was led to believe that the pilot-in-command was not very familiar with the Indonesian Aeronautical Information Publication, specifically related to local procedures at Bali International Airport.

6) The weight and centre of gravity of the aircraft were within allowable limits at the time of the accident.

7) One of the ADFs swung while the other remained steady when the aircraft was still about 30 NM North of the beacon.

8) At this point the pilot initiated a let-down procedure by making a right hand turn for track out on 263 degrees, assuming that he was nearing the NDB.

9) No evidence was found regarding the possibility of interference to the ADF induced by radio broadcasting station.

10) The Board has not succeeded in determining the cause of the needle swing of one of the ADFs. It may have been caused by either external or internal interference.

b) Cause or Probable cause(s)

The Board determined that the probable cause of this accident was the premature execution of a right hand turn to join the 263 degrees outbound track which was based on the indication given by only one of the ADFs while the other one was still in steady condition.

3.- Recommendations

The Board submits the following recommendations:

1. Operators should encourage pilots towards a more thorough knowledge of the aeronautical information published in the Operations Manual for a certain airport, to avoid the possibility of divided attention during the critical stages of the approach.

2. Vigilant observation by the Operator's Flight Safety Officer to help them avoid accidents due to human error during a possible accident prone stage in the course of their career would be welcomed by even highly experienced pilots.

3. Although it has no bearing on this particular accident, the installation of a DME in addition to the existing VOR at Denpasar would be of great help to aircraft.

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