

CIVIL AVIATION AUTHORITY
KARACHI, PAKISTAN
AIRCRAFT ACCIDENT INVESTIGATION REPORT

LANDING ACCIDENT AT KARACHI INTERNATIONAL AIRPORT
ON 4TH AUGUST, 1983 INVOLVING PAN AMERICAN AIRWAYS
BOEING 747-100 REGISTRATION N738 PA WHILST OPERATING
SCHEDULED PASSENGER FLIGHT NO. PA 073 FROM DELHI
TO NEW YORK VIA KARACHI AND FRANKFURT

Authority:- Director General, Civil Aviation Authority,
Pakistan Memorandum NO.HQ CAA/1901/21/FS.
dated 4th August, 1983 (Appendix "A")

SYNOPSIS

At about 23:38 hrs G.M.T. on 3rd August 1983 (0438 hrs Pakistan Standard time on 4th August 1983) PAN AMERICAN WORLD AIRWAYS, Flight PA 073, a Boeing 747-100 aircraft Registration N738 PA, whilst landing at Karachi International Airport Karachi, Pakistan veered to the left and off runway 25R. The aircraft ran into soft earth and sustained damage beyond economical repair. The 227 passengers and 16 crew members evacuated the aircraft safely. There was no injury to passengers and crew. There was no fire. The No4 engine thrust reverser was inoperative at the time of landing and had been deactivated electrically. The flight crew were aware of this condition.

The Civil Aviation Authority, Pakistan determines that the probable cause of this accident was the inadvertent application of forward thrust on No4 engine by the pilot at the time he was coming out of reverse on No.1,2 and 3 engines, and subsequent failure of the crew to monitor and recognise this asymmetric power condition. Contributing was the failure of the crew to employ recommended procedures during the landing.

1. AIRCRAFT INFORMATION

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| 1.1. Aircraft Type and Serial Number | Boeing 747-100 S.NO.19645 |
| 1.2. Classification of aircraft. | Transport. |
| 1.3. Weight Category | "D" |
| 1.4. Registration Marking | N 738 PA |
| 1.5. Engine type, installation & serial numbers | Four JT-9D-7A PRATT & WHITNEY engine installed in pods, two under each wing. |

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	No.1	S.No:662499
	No.2	S.NO:662353
	No.3	S.No:662220
	No.4	S.No:662420
1.6. Certificate of Airworthiness	No: DMIR 7003 issued by FAA on February 2, 1970	
1.7. Date of Construction of Airframe.	1970	
1.8. Owner	Pan American Airways	
1.9. Weight at time of Accident	550000 lbs	
1.10. C of G	22% MAC (within limits)	
1.11. Airframe History.	53324 hours	
1.11.1. Hours since new	All mandatory modifications complied.	
1.11.2. Modifications		
1.12. Engines History		
1.12.1. Hours since new	No.1	39044 hours
	No.2	39696 hours
	No.3	41421 hours
	No.4	40424 hours
1.12.2 Hours since Overhaul.	No.1	7698 hours
	No.2	3152 hours
	No.3	5441 hours
	No.4	7350 hours
1.12.3. Modifications	All mandatory modifications complied.	
1.13. Defects having a bearing on the accident.	The maintenance log for July/August indicates that on July 6 at NBO "number 4 throttle would not go past the interlock blocks." The item was cleared and signed off at NBO on the same day. "Gained access to sequence motor and manually cleared throttle travel - Ok No.4 cowl closed." On August 4 at MIA "No.4 throttle would not pass through the reverse thrust interlock after start up." The corrective action at MIA "deactivated electrically transfer to OCI 1334." The No.4 thrust reverser was inoperative at the time of the accident. The flight crew were aware of this discrepancy.	

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2. CREW INFORMATION

2.1.	Pilot at controls	F.O. M.D. NEWTON Co-pilot
2.2.	Pilot in Command	
2.2.1.	Name	Captain ROBERT E.LAINE
2.2.2.	Age	54 Years
2.2.3.	Licence Number	ATP 1275813
2.2.4.	Instrument	Last check Dec 15, 1982
2.2.5.	Total Flight experience	16785 hours
2.2.6.	Flight Experience on type	2256 hours
2.2.7.	Flight time last 90 days	106 hours
2.2.8.	Medical	June 1983 FAA FIRST CLASS Corrective Lens for Near Vision
2.3.	Co-Pilot	
2.3.1.	Name	F.O.MARVIN D.NEWTON
2.3.2.	Age	41 Years
2.3.3.	Licence No.	ATP 1660519
2.3.4.	Instrument	Last check January, 1983
2.3.5.	Total Flight experience	9443 hours
2.3.6.	Flight Experience on type	1506 hours
2.3.7.	Flight time last 90 days	124 hours
2.3.8.	Medical	May 1983 FAA First Class No restrictions.
2.4.	Flight Engineer	
2.4.1.	Name	F/E THOMAS B.WARD
2.4.2.	Age	45 years
2.4.3.	Licence No.	Flight Engineer 1725051
2.4.4.	Total Flight experience	8322 hours
2.4.5.	Flight experience on type	77 hours
2.4.6.	Medical	October 1982 F.A.A. Second Class - No restrictions

3. HISTORY OF THE FLIGHT

3.1. Pan American Airways scheduled passenger flight No.PA 073 operated by Boeing 747 Registration N738 PA from Delhi to Karachi for onward flight to Frankfurt and New York, after an uneventful flight from Delhi to Karachi touched down on runway 25R at Karachi International Airport at 23:37:46 G.M.T. (0437:46 Pakistan Standard Time on 4th August, 1983). Light condition was night. The airfield co-ordinates are lat 24°54'29.3" long. 67°09'34.2". Touch down was in the landing zone and after rolling 7000 feet the aircraft deviated to the left of the center line of the runway and departed the load bearing surface of the runway to the left (Southern) side of runway 25R at 8000 feet from the approach end of the runway at 2338:25 G.M.T. (0438:25 PST), some

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39 seconds after touch down. It was drizzling over the airfield at the time of the accident and the runway surface was wet. Earlier at 2322 G.M.T. a Boeing 720 reported braking action on the runway to be medium. This information was immediately passed to other aircraft including PA 073 who acknowledged. At 2337:09 G.M.T. Tower whilst clearing PA 073 to land again cautioned for runway wet braking action medium and PA 073 acknowledged. The wind reported prior to landing was 140°/05 Knots. The landing weight of PA 073 was 550000 lbs and landing was reported by the crew as normal in the touch down zone. The approach speed just prior to touch down as calculated from the DFDR read out was 152.4 Knots. The crew stated that after touch down reverse thrust was applied on Nos.2 and 3 engines, No.1 was left in idle reverse and No.4 which had an unserviceable reverser was left in forward idle. However, the DFDR read out indicates that reverse thrust was applied on engines No.1,2 and 3 and No.4 remained in forward idle. Application of reverse thrust on engines No.1,2 and 3 was also confirmed by the Captain's statement from the C.V.R. read out. Seventy Knots was called at 2338:14 G.M.T. (DFDR time) and some three seconds later reverse power was decreased. At this stage EPR on No.4 engine increased rapidly. The aircraft veered to the left of the center line at about 7400 feet from the approach end of runway 25 R and departed the runway edge at 8000 feet from the approach end of runway 25R with 2500 feet of runway remaining. Shortly before the aircraft departed the runway, the pilot flying (Co-pilot) reported that he had no brakes and no nose wheel steering. The Captain stated that he got on the brakes and tiller at this time to assist. After departing the runway surface the aircraft travelled 380 feet through soft mud before it came to rest at a point about 2100 feet from the end of runway 25R, heading about 160 degrees on the Southern side of the runway with the tail of the aircraft 120 feet from the runway edge. Shortly after the aircraft departed the runway, the nose gear struck a VASI light installation and its concrete base causing the nose gear to collapse backwards and to the left, resulting in total destruction of the VASI light installation and damage to the forward cargo hold, floor of the first class section and the stairway leading to the upper deck. Damage to the aircraft was substantial. Just prior to coming to rest, the aircraft slewed sharply to the left and the No.3 engine pod contacted rising ground resulting in damage to the engine pylon

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at the forward attachment. No fire occurred. The Crash Fire Rescue Services were prompt and reached the accident site almost immediately. All 227 passengers and 16 crew members survived the accident without injury. Evacuation was accomplished via the emergency slides and was reported by the Crash Fire Crew Chief to have taken 7-8 minutes before all persons were out of the aircraft.

4. INJURY TO PERSONS

- 4.1. No injuries were sustained by the 227 passengers and 16 crew members, nor were injuries sustained by any other person as a result of the accident.

5. DAMAGE TO AIRCRAFT

- 5.1. The aircraft Boeing 747-100 Registration N 738 PA sustained substantial damage to its forward section ahead of the wing leading edges (See damage report by Mr. Vincent P. Flury of Pan Am Appendix "B").

6. OTHER DAMAGE

- 6.1. Two VASI light units were smashed and the concrete base was destroyed as a result of the accident. This damage rendered the complete VASI, unit at runway 07L inoperable, requiring repair/replacement of damaged parts. In addition some earth work was required to repair the damaged fair weather strip.

7. METEOROLOGICAL CONDITIONS

- 7.1. Karachi Airport had experienced rain since 0324 z on 3rd August 1983. Moderate rain was experienced at 1910 z on the same day and drizzle commenced at 2305 z. The drizzle was off and on, and at the time of the accident it was drizzling over the airport. Due to this drizzling the runway surface was wet, drain off is good and there was no accumulation of water on the runway surface. Due to the earlier rain the area surrounding the runway was soggy and soft. The weather forecast at the time of the accident was chances of rain and thunder showers (Meteorological reports Appendices "C1" "C2" "C3" "C4").

- 7.2. Weather passed to the aircraft prior to its landing was as follows:-

"Karachi weather. Surface wind calm, visibility 7000 meters, cloud 3 Octa Sc Cu 2000 feet, 4 Octa As Ac 10000 feet, 1 Octa CB at 3500 feet. QNH 997 Temp. 28°C"

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7.3. Just prior to landing at time 2337 z the Tower informed the Approach Control "light drizzle on airfield"

7.4. Whilst PA 073 was on the final approach for landing on runway 25R, Tower transmitted the following to the aircraft which was acknowledged:-

"Check wheels down and locked. Surface wind 140/05 Kts Cleared to land runway 25R. Caution for runway wet. Braking action medium".

8. AIDS TO NAVIGATION

8.1. V.O.R. and VASI. These were functioning normally and were serviceable. The ILS was off the air due to cable breakdown, and had been notamized vide NOTAM No.: 296/August, 83 031705.

9. COMMUNICATION

9.1. Communication between the control and the aircraft was normal (See Transcript of ATC Tape, and Voice Recorder Transcript. Appendix "D" and "E").

10. AERODROME AND GROUND FACILITIES

10.1. The runway at Karachi International Airport is cement concrete laid in 1960. The runway length is 10500 feet and the width 150 feet. The runway direction is 25R/07L. At the 25 end there is a stopway of 1000 feet and at the 07 end a stopway of 950 feet. Runway 25R was in use. Co-ordinates for center of runway 25R/07L are lat. 24°54'29.3" and Long. 67°09'34.2".

10.2. Karachi International Airport was functioning normally and the facilities including Approach/VASIS/Aeronautical Ground Lights, Rescue and Fire service were all serviceable. Runway edge (side strip) marking was provided and clearly visible.

10.3. Crash Fire & Rescue Services reached the accident site immediately.

10.4. Cleaning of rubber deposits on runway 25R/07L was completed on 27th February, 1983 about five months before the accident.

10.5. The runway surface is not grooved.

11. FLIGHT RECORDERS

11.1. Fairchild cockpit Voice Recorder (C.V.R.) Model No.A-100 Serial No.5520 and Digital Flight Data Recorder (D.F.D.R.) Lockheed Aircraft Service Company Model 209 Serial No.368 were removed from the aircraft after the accident.

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- 11.2. Read out of the C.V.R. tape was accomplished by the National Transportation Safety Board. The quality of the recording was very good and was easily transcribed. Only the last 6 minutes of the 31 minutes of CVR tape were transcribed. The transcription starts with the crew performing the approach to landing checklist and continues until the CVR lost power. The CVR zulu times are five seconds slower than the DFDR zulu times (See Appendix "E").
- 11.3. Read out of the DFDR was accomplished by the National Transportation Safety Board. Using data provided by the N.T.S.B. the Boeing Commercial Airplane Company carried out an analysis, and responded to questions by both the N.T.S.B. and Pan American Airways. For purposes of this report graphs prepared in answer to requests by Pan Am flight Safety are included (Appendices "F1" "F2" "F3" "F4" "F5").

12. WRECKAGE

- 12.1. Pan American Airways Boeing 747-100 Registration N 738 PA was located at a position South of runway 25R about 2100 feet from the end of the runway, heading about 160 degrees with the tail of the aircraft 120 feet from the runway edge. The nose wheel gear had collapsed and the forward fuselage was resting on the ground. The main gear wheels were bogged in soft wet mud. The Nos. 1,2 and 4 engines were clear of the ground and appeared to be undamaged No.3 engine was resting on the ground, and ground marks indicated that it struck the ground just prior to the aircraft coming to rest. Damage to the forward attachment of the pylon to engine was obvious. Signs indicate that all four engines had ingested mud. Major damage to the airframe was confined to the bottom surface of the fuselage ahead of the wing leading edge at the fuselage. The floor in zone "A" and the stairs leading to the upper deck were damaged as the result of upward forces from below. (See Appendix "B" for damage and Appendix "G" for location on the airfield).
- 12.2. At the time of landing fuel quantity aboard the aircraft was approximately 125000 lbs. After the accident the aircraft was partially defuelled in situ by Pakistan State Oil and 85000 lbs of Jet fuel JP-1 was defuelled.

13. FIRE

- 13.1. No fire occurred. Crash Fire Rescue Services reached the scene of the accident almost immediately.

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14. SURVIVAL ASPECTS

- 14.1. The accident was survivable and there was no injury sustained by any passenger or crew member.
- 14.2. The senior purser estimated that the total time for evacuation was two minutes, however, the Crash Rescue Fire Leader estimated the time of evacuation of all persons on board to be 7 to 8 minutes. Had there been a fire, the serviceability of slides could have been a factor jeopardising survival.
- 14.3. The reason for ripping off of the R4 slide at its girt bar during evacuation needs further investigation, so that remedial measures can be introduced to ensure such failures do not occur in future.

15. TEST & RESEARCH

- 15.1. Nil.

16. OBSERVATIONS

- 16.1. The Pan Am authorities co-operated with the Investigator in Charge and provided information requested by him. Information provided also included a statement by the Senior Purser, and a damage report by the Pan Am recovery team. This information has been used by the Investigator during his analysis of the evidence.
- 16.2. An Investigator from FAA Frankfurt, came out to Karachi two days after the accident occurred. He interviewed the Flight deck crew, and a cassette of the interview was provided to the Investigator in Charge by the Pan Am Authorities. The information on this tape was inadequate and has not been used as evidence in this investigation report.

17. INVESTIGATION

- 17.1. The investigator in Charge was informed about the accident by the Airport Authorities at about 2354 z (0454 Local Time on 4th August, 1983). The Investigator in Charge arrived at the scene of the accident at 0730 Local Time and immediately commenced investigation. The scene of the accident and tyre marks on the runway were examined. The Investigator was present at the scene of the accident from that time during all periods whilst retrieval work was in progress by Pan Am personnel until the aircraft was moved and parked on Taxiway No.1 clear of the runway at 1758 z (2258 Local Time) on 8th August, 1983.

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7.1. Photographs of the aircraft in situ were taken by the Investigator. It was raining off and on at this time and the light was extremely poor. However the photographs taken at this time show the slides employed. Photographs APPENDICES "H" "I" "J" and "K". The slides employed were 11, 12, 13, 14, 15, 16 and 17. Slide 14 ripped off the gun bar during evacuation. The crew reported that evacuation was accomplished using slides 11, 12, 13, 14 till slide ripped off gun bar, and 15. The senior purser estimated that evacuation was completed in may be two minutes. The Fire Rescue Unit who attended the accident estimated it took 1 - 2 minutes for all persons to evacuate the aircraft.

7.2. Wheel tracks left by the aircraft were identified, measured and examined. Clear tracks of all main landing gear types were observed to impact the left edge of the runway at an angle of about 11 degrees. These tracks were traced back to the center line of the runway and it was noted that divergence from the center line of runway 15H occurred at a point 7400 feet from the beginning of runway 15H. See sketch APPENDIX "L". The nose wheel track could be seen just before the aircraft departed the runway. The left main body gear tracks were superimposed over the nose wheel tracks. It was obvious from the nose wheel tracks that the nose wheel was turned well over to the right as the aircraft approached the left edge of the runway. Initially two separate tracks of the nose wheel types could be seen, with a space between them of two to three inches. This space gradually narrowed till the separate tracks merged and there was only one broad track of the nose wheel as it left the concrete shoulder of the runway. (See Appendix "Y"). This and the statement of the crew indicated the direction of nose wheel steering.

7.3. The wheel tracks were first observed whilst the runway surface was wet at which time they could be seen clearly. At this time because of the scrubbed whitish appearance of the tracks, aquaplaning (Hydroplaning) was suspected. However, later detailed inspection of these tracks revealed that there were traces of rubber deposits along the tracks, and that where the tracks crossed other wheel tracks on the runway the old rubber had been cleaned. The Boeing Airplane Company on examination of the photographs of the wheel tracks discounted aquaplaning believing that a certain amount of cleaning action is inevitable when a heavy aircraft is decelerating with maximum brakes applied.

Examination of DFDR data indicates that brakes were being applied and antiskid was in operation. No signs of loss of friction were evident from the data retrieved from the DFDR that would indicate aquaplaning (hydroplaning). In fact for the first ten seconds of braking, the deceleration achieved was normal for medium braking with the auto brake operating. At the end of this period manual braking was reverted to by the pilot, and though the braking friction was reduced, there was no indication of loss of friction as would occur in a case of aquaplaning (hydroplaning). No signs of locked wheels were evident from the tyre tracks, nor were there any flat spots on the tyres. As the wheels left the runway, rubber deposits on the rougher surface of the runway shoulder were similar for all wheels indicating that brakes were being applied evenly without any differential braking at this stage. The tracks departed the shoulder at a point just after passing 8000 feet from the threshold of runway 25R.

- 17.5. After leaving the runway, the wheel tracks continued for a further 380 feet. These tracks were through wet mud and were about 2 to 3 feet deep. During this time, the nose gear struck a VASI light unit totally destroying it and its concrete base.
- 17.6. The aircraft just prior to its coming to rest turned sharply to the left and at this stage the No.3 engine pod contacted the ground and its pylon was damaged. The S.I.T.O. reported to the investigator that a large quantity of soft wet mud had to be cleaned off the runway between the point the aircraft departed the shoulder and in line with the tail of the aircraft. The distance travelled by the aircraft after leaving the runway, and the mud thrown onto the runway suggested that an engine or engines was/were operating with considerable forward thrust whilst the aircraft was traversing through the mud. The DFDR data indicates high forward thrust on No.4 engine at this stage.
- 17.7. The aircraft Boeing 747-100 Registration N 738 PA came to rest with the nose gear collapsed rearward at a point about 1100 feet from the end of runway 25R on the southern side of the runway, heading about 160 degrees with the tail of the aircraft 120 feet from the runway edge. Main body/wing gears were submerged in soft wet mud with the fuselage resting on the lower forward lobe. Major damage was located in the fuselage forward lower lobe sections and No.3 engine pylon (See Appendix "G" and Appendix "H").
- 17.8. The following collared circuit breakers had been pulled:

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Sat Com 1
Sat Com 2

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VHF 1
Grd prox warn lights comp.
Capt Flt inst sw relays INB
F/O flt inst sw relays INB
Over rot
Inph main alt source

P-12 Panel

Proj. 3
Body gear steer
Proj. 1+2
Proj. 4

P-6 Panel

Aural	Warn
Tr	3
Tr	2
Tr	1

17.9. The following information was recorded at the flight deck:-

- 17.9.1. All hydraulic quantity indicators in Green Zone.
- 17.9.2. Inboard Flaps indicated 22 degrees.
Outboard Flaps indicated 0 degrees.
The actual position of flaps was as indicated.
- 17.9.3. Fuel remaining 132000
- 17.9.4. Flaps lever at zero degrees.
- 17.9.5. Speed brake down.
- 17.9.6. Star trim 8.45
- 17.9.7. Brake hydraulic pressure zero
- 17.9.8. Start levers at idle detent.
- 17.9.9. Nose wheel tiller left.

17.10. Fairchild CVR Model No.A 100 Ser.No.5520 and Lockheed Aircraft Service Company Digital Flight Data Recorder Model 209 Ser.No.368 were removed from the aircraft. Both recorders externally appeared to be in good condition. Read out of both recorders was accomplished by the National Transportation Safety Board, Washington D.C. U.S.A. (See Appendices "E" and "L1" and "L2")

17.11. Tyre pressures were checked after the aircraft was moved to Bay No.16 and were as follows:-

Nose Wheel	Left 240 p.s.i.
	Right 245 p.s.i.
Left Wing Gear	No.1 235 p.s.i.
	No.2 225 p.s.i.
	No.3 210 p.s.i.
	No.4 235 p.s.i.

Left Body gear	No.5	235 p.s.i.
	No.6	225 p.s.i.
	No.7	220 p.s.i.
	No.8	245 p.s.i.

Right Body gear	No.9	215 p.s.i.
	No.10	210 p.s.i.
	No.11	205 p.s.i.
	No.12	225 p.s.i.

Right Wing gear	No.13	225 p.s.i.
	No.14	220 p.s.i.
	No.15	225 p.s.i.
	No.16	225 p.s.i.

Note: These pressures were checked nine days after the accident i.e., on 13th August, 1983.

17.12. The tyres were checked for flat spots, damage and reverted rubber signs. No flat spots or reverted rubber signs were found on any of the tyres. Checks of the tyre tracks shortly after the accident did not reveal any signs of reverted rubber in the tracks.

17.13. The tyres were checked for tread depth and condition. They were as follows:-

Nose gear left.	3/8"	Deep cuts
Nose gear right	3/8"	Deep cuts
No.1	1/32"	No cuts
No.2	1/16"	No cuts
No.3	1/4"	No cuts
No.4	3/8"	No cuts
No.5	1/16"	No cuts
No.6	1/16"	Deep cut
No.7	3/8"	Deep cut
No.8	3/8"	No cuts
No.9	1/32"	No cuts
No.10	1/32"	No cuts
No.11	1/32"	No cuts
No.12	3/16"	Deep cut
No.13	1/4"	Deep cut
No.14	3/16"	No cuts
No.15	1/16"	No cuts
No.16	3/16"	No cuts

Note:- The cuts and marks on the tyres were caused during the incident. No flat spots, skid marks or reverted rubber were found on the tyres.

17.14. The No.1, No.2, No.3 and NO.4 engine condition motors were checked and found to be in the ground idle position.

17.15. The anti-skid system could not be functionally checked because of damage to electrical cables. However, the Boeing Airplane Company who were requested to carry out an analysis of the D.F.D.R. data were of the opinion from this data and from

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their examination of the photographs of the wheel tracks that the anti-skid system was operating as designed. The rubber observed along the wheel tracks are indicative that the aircraft wheels were in the rolling mode with the brakes applied to the optimum and skidding/wheel locking had not occurred. This is supported by the D.F.D.R. data derived friction coefficient. The maintenance log was reviewed for July/August, specifically for the anti-skid system, there were no write ups during this period.

- 17.16. No friction measuring equipment is available at Karachi International Airport. However, it was ascertained that C.A.A. Pakistan had already taken steps to acquire a Mu-Meter for the purpose of checking runway condition.

18. DISCUSSION

- 18.1. Runway Condition. Runway 25R/07L at Karachi Airport was constructed in the year 1960. The runway surface is cement concrete and the texturing of the surface appears to be a heavy burlap drag finish. The runway is not grooved. Rubber deposits on the entire runway were removed earlier in the year 1983, the work being completed on 27th February, 1983 which is about five months prior to this accident. Rubber contamination of the runway surface is not considered to be a cause factor in this accident.
- 18.2. Runway Grooving. Runway 25R/07L at Karachi Airport is not grooved, however, in the circumstances of this accident lack of grooving is not considered to be a cause factor. Nevertheless since it has been established that runway grooving improves the drain off and friction characteristics, reducing the conditions for aquaplaning (hydroplaning), it is considered advisable that grooving should be done on all future runways built in Pakistan for Civil Operation. Consideration also needs to be given to the advisability of grooving existing runways to make them more skid resistant.
- 18.3. Braking Conditions. When Pan Am Flight 073 landed at Karachi Airport it was drizzling and the runway surface was wet, but there was no accumulation of water. The crew of a Boeing 720 of P.I.A. after landing on Runway 25R advised the Tower at 1312 Z (04:22 hrs Local Time) that braking action on the runway was medium. From the charts in the FAA Flight Manual a Boeing 747-100 at a landing weight of 550000 lbs, at an approach speed of 151.5 knots (approx) in the existing conditions with a medium auto brake setting employed throughout the landing roll, should stop in 5,558 feet (approx). The Flight Manual, however, cautions that actual wet conditions which may be variable from the representative conditions used in the Flight Manual

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can result in longer landing distances. For the medium brake auto setting used throughout the landing roll the stopping distances in the manual are valid with or without reverse thrust. In the case of Pan Am Flight 073 at the landing weight and approach speed quoted above, the actual distance travelled after touch down of the aircraft has been computed using DPDR data, as 7000 feet before the aircraft departed the runway surface. Medium auto brake was not employed continuously throughout the landing roll, the pilot flying having reverted to manual brakes after 4000 feet and at a speed of 80 knots. The Boeing Airplane Company established, through analysis of D.P.D.R. data provided to them by N.T.S.B., that prior to reversion to manual brakes, the auto brakes achieved the target deceleration of 6FT/Sec^2 for a period of 10 seconds, indicating that auto brakes were operating normally. They were of the opinion that "A lack of deceleration during the first 1-15 seconds after touch down, may be a result of a delayed nose wheel touch down evident from the aircraft pitch angle. The increased lift, generated by the wing at higher angle of attack relative to taxi attitude, will decrease normal force on the main gear tyres, thereby reducing the braking force and deceleration." The Boeing Company were of the opinion that "lack of deceleration in the latter portion of roll out where manual braking was being used is believed due to an adverse runway condition." The derived braking coefficient (μ) was between .10 - .15 which is indicative of a slippery runway. This investigator is not in agreement with this opinion concerning the deceleration in the latter portion of the roll out. The forward thrust being developed by No.4 engine at this stage does not seem to have been considered, and this is believed to be the major cause for lack of deceleration and not as opined by Boeing the runway condition.

- 18.4. Reverse Thrust No.4 engine reverser had been electrically deactivated. The cockpit crew were aware that the No.4 engine reverser was not available. The Boeing Operations Manual recommends use of symmetrical reverse thrust on landing. The flight crew were aware of this as indicated by the fact that during the approach at 23:36:51 (DPDR Zulu Time) the Flight Engineer advised "Reverse inboards only." The crew in their statements indicated they

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to the investigator, is also indicative of high power on an engine or engines when the aircraft left the runway surface. Pan Am 747 Aircraft Operating Manual (206 116 P4) requires on landing that:- "The flight engineer is to monitor the EGT during reverse and for at least 15 seconds after returning to forward thrust. He should have his hand on the start levers during this period." The increase in power on No.4 engine is considered to be the main factor for loss of directional control and subsequent departure of the aircraft from the runway surface.

- 18.6. Differential Braking. The tyre track marks on the runway do not indicate that differential braking was employed during the roll out till the aircraft departed the runway shoulder. Boeing Company in their reply to a question raised by Pan Am concerning differential braking replied. "Differential braking is possible with the anti-skid system operative. During anti skid limiting conditions, the most effective method of differential braking is to completely release the brake pedal force on one side while applying the other brake pedal. The anti-skid system will limit the brake force available to the latter side brakes, but the maximum yawing moment will be achieved. Pedal forces can be modulated to have unequal force levels, however, the pedal with the lesser force should not be in the range where maximum brake force is being applied. Note that a nominal brake pedal force of 70 pounds commands the maximum pressure (3000 psi) applied to the brakes." The Captain stated "The landing was normal to 70 knots when the engines were brought out of reverse, the aircraft was decelerating normally, maintaining center line. Shortly thereafter the aircraft veered to the left. We were still close to the center line and I expected 1st officer Newton to return the aircraft to the center line, speed was approximately 40 to 60 knots. When he did not immediately effect the return to the center line I asked him what was wrong. He replied that he was getting no braking, no rudder control, and no nose wheel steering. Immediately assisted him in braking and nose wheel steering. No change of direction was accomplished. The FEO Reported no anti-skid releasing." In the circumstances it is most unlikely that differential braking was used.

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18.1. Skid or Loss of Directional Control. Boeing Airplane Company recommend the following procedures in the event of skid or loss of directional control during the landing roll out:-

1. Immediately release brake pressure.
2. Return to reverse idle (Remark -Prevent requirement to go through full reverse cycle) (Note in case of this incident engines were out of reverse and should have all been in forward idle. This should have been monitored).
3. Use rudder, steering and differential braking if required, to regain runway center line (Remark - Optimum nose wheel steering angle for slippery runway is 3 to 5 degrees) (Note: Differential braking was not used, and the nose wheel steering angle used was the maximum possible as indicated by the nose wheel marks).
4. When rolling parallel with the runway center line and near center line, apply reverse thrust and brake pedal pressure to develop maximum braking.

From the available evidence, there is no indication that during the roll out after the deviation from runway center line was recognized, that the recommended procedures were employed. These in this instance would have entailed, release of brakes, check of engine power at idle, use of rudder, nose wheel steering and differential braking to regain runway heading, before reapplying brakes. This investigator is of the opinion that had these procedures been employed, the power condition of No.4 engine would have been recognized and corrected, and the aircraft returned to the runway center line.

19. FINDINGS

- 19.1. The crew members were properly certificated and qualified for the flight.
- 19.2. The aircraft (Boeing 747-100 Registration N718 PA) was certificated, equipped, and maintained in accordance with PAA requirements.
- 19.3. At the time of the accident it was drizzling and the runway was wet, but there was no standing water. Runway braking action was medium.
- 19.4. Wind at the time of landing was 140/05 knots.
- 19.5. Rubber contamination on the runway had been removed from runway 25R/07L by 27th February, 1983.

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18.10. The crew failed to monitor the power condition and therefore failed to recognize the asymmetric power condition and correct it.

18.11. The crew failed to employ standard recommended procedures to recover from a loss of directional control.

18.12. The Captain failed to take over control, but got in the controls to assist the copilot when he reported that he had no brakes or nose wheel steering.

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- 19.11. Optimum nose wheel steering for wet slippery runway conditions was not employed. Maximum nose wheel steering was used.
- 19.12. No flat spots, or reverted rubber were found on the tyres. Nor were any signs of reverted rubber found on the wheel tracks on the runway.
- 19.14. The tyres were in good condition and inflation pressures were within limits.
- 19.25. No aquaplaning (hydroplaning) occurred.
- 19.26. Differential braking was not employed during recovery attempts.
- 19.27. Runway 25R/07L at Karachi International Airport is not grooved. Lack of runway grooving is not considered to be a cause factor in this accident.
- 19.28. No equipment is available at Karachi Airport for measuring runway friction capabilities. A mu-meter is on order by the Pakistan C.A.A.
- 19.29. All 227 passengers and 16 crew members survived the accident and evacuated the aircraft without injury.
- 19.30. Evacuation was accomplished via slides L4 R2, R3, R4 and R5. The R4 slide ripped off at the girt bar during the evacuation. Evacuation probably took a few minutes longer than the two minutes estimated by the Senior Purser.
- 19.31. Crash Fire and Rescue Services were prompt, and arrived at the crash site almost immediately. There was no fire.
- 19.32. The aircraft Boeing 747-100 Registration N738 PA sustained substantial damage as a result of the accident.
- 19.33. One VASI light unit of the three bar VASI for runway 07L was destroyed as a result of the accident.
- 19.34. No other person/persons was/were injured as a result of the accident.

20. PROBABLE CAUSE

- 20.1. The Civil Aviation Authority, Pakistan determines that the probable cause of the landing accident on runway 25R at Karachi International Airport at 0438 hours (Pakistan Standard Time) on 4th August 1983, to Pan American World Airways Flight PA 073,

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APPENDIX





APPENDIX "H₄"

