

CIVIL AVIATION AUTHORITY
KARACHI, PAKISTAN

AIRCRAFT ACCIDENT INVESTIGATION REPORT

LANDING ACCIDENT AT KARACHI INTERNATIONAL AIRPORT ON 6TH AUGUST 1988 AT 1249 HOURS P.S.T. INVOLVING PAKISTAN INTERNATIONAL AIRLINES BOEING 747 AIRCRAFT REGISTRATION MARKS AP-BCN WHILST OPERATING SCHEDULED DOMESTIC PASSENGER FLIGHT PK-301 FROM ISLAMABAD TO KARACHI

Authority:- Director General, Civil Aviation Authority
Memorandum No.HQ.CAA/2651/33/Legal dated
Karachi 09 August, 1988. (Appendix - "A").

COMPOSITION OF INVESTIGATION TEAM

- | | |
|---|-----------------------|
| 1. Air Commodore Abdul Basit
Chief Inspector and President
Accident Investigation Board | Investigator Incharge |
| 2. Capt.Farmanuddin,
Director, Karachi Airport | Investigator |
| 3. Capt.Shaukat Khan
Chief Flight Inspector | Investigator |
| 4. Mr.Malik G.Jaffer
Controller of Airworthiness | Investigator |
| 5. Capt.Saleem
Chief Pilot Technical PIA | Co-opted member |
| 6. Dr.S.G.Qadir
Chief Med.Officer CAA | Co-opted member |

SYNOPSIS

Pakistan International Airlines Boeing 747 aircraft Reg.MK. AP-BCN operating scheduled domestic passenger flight PK-301 from Islamabad to Karachi. Departure from Islamabad was at 0610 hours UTC with Pilot-in-Command Capt.Salahuddin Chughtai. The aircraft made two approaches before it finally landed on the third approach. The first attempt to land was discontinued due to high speed on the glide path. The Second approach was

abandoned/....

abandoned as the aircraft was not properly established on the glide slope and localiser. On the third approach the Pilot touched down late and felt failure of braking action due to hydroplaning on the wet runway. By application of full reverse thrust, and maximum manual braking the Pilot managed to stop the aircraft on over-run area of the runway, covering approximately 500 feet beyond the end of regular runway i.e 500 feet before the soft/Kutchra ground ahead. The smoke/fire was observed by the Control Tower to be coming out from the engines when the aircraft was beyond half way down the runway during the landing roll. The Pilot switched off the engines on the over run. Immediately after the aircraft came to a stop the pilot actuated the passenger evacuation system to evacuate 440 souls on board. During evacuation 3 passengers sustained major injuries; and 17 passengers minor injuries they were given first aid and sent home as reported by PIA Chief Medical Officer.

The runway remained blocked from 0749 to 1100 hrs U.T.C.

1. AIRCRAFT INFORMATION:

- | | | |
|--|---|---|
| 1.1. Registration Marking | : | AP-BCN |
| 1.2. Aircraft type and makers S.No. | : | (a) Boeing 747-217B
(b) Serial No. 20801 |
| 1.3. Engine Type/Airframe position and maker S.No. | : | (a) Four engines installed in pods under the wings (Type JT9D-7A)
(b) S.No. 1. 685690
2. 685975
3. 685959
4. 695734 |

1.4. Certificate/.....

- 1.4. Certificate of Registration : (a) No.588
No. and validity (b) Validity (continued)
- 1.5. Certificate of Airworthiness : (a) No.541
No. and date of expiry (b) Date of expiry
15-10-88 to 14-10-89
- 1.6. Certificate of Maintenance : Valid
- 1.7. Date of construction of airframe : 15-10-1973
- 1.8. Name and address of the owner : M/s.PIAC, PIA Building of
Karachi Airport, Karachi
Pakistan
- 1.9. Gross weight and max weight : TOGW = 248120 Kg
MAX = 351534 Kg
- 1.10. Loading and C of G limits : MAC 29.5% within limits
- 1.11. Airframe History : (a) Aircraft hrs : 51770 hrs
(b) No. of landing:12282 landings
(c) Last check :225 hrs
Inspection + Pre-flight inspection
- 1.11.1. Essential Modifications : All incorporated
- 1.12. Engine History : (a) T.S.N. 1. 27405
2. 39239
3. 37706
4. 23723
(b) Cycles 1. 8471
2. 9688
3. 8497
4. 7438
- 1.12.1. Essential Modification: All incorporated
- 1.13. Technical Defects History : No technical defect
persisted which could be
attributed to this
incident.

CREW/.....

2. CREW INFORMATION

2.1. Pilot-in-Command

2.1.1. Name : Capt. Salahuddin Chughtai
2.1.2. Position in the cockpit : Captain
2.1.3. Date of Birth : 30-6-1935
2.1.4. Type of Licence and No. : ALTP No.101
2.1.5. Medical date with status : 28-8-88. Subject to use of corrective glasses. (Capt. Salahuddin Chughtai who was Pilot-in-Command is suffering from D.Mellities controlled by diet only since last 6 yrs with no complication/ effects-of disease)

2.1.6. Rating

2.1.6.1. Type(s) held : DC-3, F-27, Trident, B-707/720B, DC-10 and B-747
2.1.6.2. Type current : B-747
2.1.6.3. Flight Instructor rating : F.I. Rating
2.1.6.4. Flight Engr Instructor rating : -
2.1.6.5. Check rating : -

2.1.7. Flying Experience

2.1.7.1. Grand Total : 16660.00 hrs
2.1.7.2. Total in command : 12329.00 hrs
2.1.7.3. Total in command/Co-pilot/flight Engr on the type accident/incident occurred : 3312

2.1.8. Where trained : M/s. PIAC

2.1.9. Date of Joining the Org: 1958

Copilot/.....

2.2. CO-PILOT

2.2.1.Name : Naveed Ahmed Aziz
2.2.2.Position in the cockpit : First Officer
2.2.3.Date of Birth : 31-7-1957
2.2.4.Type of Lic and No. : ALTP NO.597
2.2.5.Medical date with status: 13-6-88. Fit for 3 months,
Next Medical after 3 months.
Alongwith report of lipid
profile.
(Medical records of Capt.
Naveed Ahmed Aziz reveals
obesity. He was about
35 lbs.-overweight when
he was last examined in
July, 1988. He has been
warned several times to
reduce weight but with-
out any marked improvement)

2.2.6.Rating:

2.2.6.1. Type(s) held : F-27, B-707/720B, A-300
and B-747 (on flying permit)
2.2.6.2. Type current : B-747
2.2.6.3. Assist/Flight : -
Instructor
2.2.6.4. Flight Engineer: -
Instructor
rating
2.2.6.5. Check rating : -

2.2.7.Flying Experience:

2.2.7.1. Grand Total : 6385.02 hrs
2.2.7.2. Total in command 2329.00 hrs
2.2.7.3. Total in command/
Copilot/flight 4.12 under supervision
engineer on the
type accident/
incident occurred

2.2.8.Where trained : Lahore Flying Club

2.2.9.Date of joining the Org : 1977

2.3. CO-PILOT

2.3.1. Name : Javed Ahmed Khan
2.3.2. Position in the cockpit : Observer Seat
2.3.3. Date of Birth : 12.6.1947
2.3.4. Type of Lic and No. : ALTP No.517
2.3.5. Medical date with status: Fit for renewal of airline transport Pilot Licence By Board. Next Medical at CAMB alongwith eat Scan and report of Urologist from the Hospital where nephrectomy was performed.

2.3.6. Rating:

2.3.6.1. Type(s) held : F-27, B-707/720-B, DC-10, B-747
2.3.6.2. Type current : B-747
2.3.6.3. Ass't/Flight : -
Instructor
2.3.6.4. Flight Engineer: -
Instructor
2.3.6.5. Check rating : -

2.3.7. Flying Experience:

2.3.7.1. Grand total : 8240:15
2.3.7.2. Total in command 1875
2.3.7.3. Total in command/
Co-Pilot/Flight 1389
Engineer on the
type accident/
incident occurred.

2.3.8. Where trained : M/s.PIAC

2.3.9. Date of Joining the Org : 1975

FLIGHT/.....

2.4. FLIGHT ENGINEER

2.4.1. Name : Riaz Ahmed Khamisani
2.4.2. Position in the cockpit: Flight Engineer
2.4.3. Date of Birth : 30-9-1948
2.4.4. Type of Lic and No. : F/E No.145
2.4.5. Medical date with status : 1-12-87. Fit for F/E Lic.
(F/E Riaz Ahmed Khamisani had sustained RTA twice within a span of 10 months i.e. between 22-3-86 to 14-1-87. His licence was last re-validated by CAA Flight Surgeon with no limitations).

2.4.6. Rating:

2.4.6.1. Type(s) held : B-707/720B, A-300 and B-747

2.4.6.2. Type current : B-747

2.4.6.3. Assist/Flight : -
Instructor
rating

2.4.6.4. Flight Engr : -
Instructor
rating

2.4.6.5. Check rating : -

2.4.7. Flying Experience:

2.4.7.1. Grand total : 6158.55 hrs

2.4.7.2. Total-in-command : -

2.4.7.3. Total in : 132.28
command/flight
engineer on
the type
accident/incident
occurred

2.4.8. Where trained : M/s.PIAC

2.4.9. Date of joining the Org: 1971

3. PASSENGER AND LOAD INFORMATION

3.1. Total number of souls on board were 440. Their breakdown is as follows:

- 3.1.1. Crew - 16
- 3.1.2. Passengers - 424 Passengers including 23 infants.

3.2. Aircraft load information is as follows:

- 3.2.1. Weight of passengers - 28500 Kg
- 3.2.2. Weight of passengers - 3400 Kg
baggage and Cargo
- 3.2.3. Revenue (Cargo) - 685 Kg

4. HISTORY OF FLIGHT

4.1. PIA Boeing 747 aircraft Registration Mark AP-BCN was scheduled for flight as PK-300 from Karachi to Islamabad on 6th August, 1988. There was no discrepancy reported by the engineer and the flight on this sector was uneventful. However during landing at Islamabad No.2 engine thrust reverser was found to be malfunctioning. The fault was rectified and the aircraft prepared for flight as PK-301 from Islamabad to Karachi with 424 passengers and 16 flight crew members. The weather enroute was fine upto Nawabshah from where the weather became turbulent, cloudy with few cells of Cumulonimbus clouds (CB). The aircraft was radar vectored for ILS approach on Runway 25R. The first officer Capt. Naveed Ahmed Aziz was on the controls during the first approach. A go around was executed from the finals as the aircraft was high on speeds during the descent. The Captain took over the controls and was again radar vectored for another

ILS/.....

ILS approach for Runway 25R. Due to close proximity of CB cell, the radar controller positioned the aircraft close to the runway from where the aircraft could make a final approach to land. The Captain felt that he was brought in too tightly to the outer marker where it was difficult for him to establish on the glide slope and localiser but had visual contact with the runway. He informed ATC that he would make a bad weather circuit. During the bad weather circuit, at down wind he was informed by the Controller that another aircraft on F-27 PK-541 was experiencing problems due to turbulence and if it could land No.1. The Captain agreed to this request and discontinued the bad weather circuit. He was again radar vectored to the final approach of runway 25R. When the pilot broke clouds, and had visual contact with the runway, he disconnected the auto pilot at approximately 300' and landed. The touch down was late. The speed brakes were deployed and the reversers selected. The Captain noticing no appreciable deceleration over-rode auto brakes and used maximum manual brakes to stop the aircraft. The aircraft came to a sudden halt 500' on the stopway. (Refer APP.'B').

4.2. During the landing roll beyond half way down the runway, near Delta taxiway the ATCO informed the Pilot that spark/ flames were coming out from behind the engines.

4.3. As soon as the aircraft stopped the Captain switched off the engines on the over-run and actuated command evacuation system. During the evacuation 3 passengers sustained major injuries and 17 minor injuries who were given first aid and sent home.

5. INJURY/.....

5. INJURY TO PERSONS

- 5.1. Three persons sustained serious injuries whilst evacuating from the aircraft. They were hospitalized. Seventeen other passengers received minor injuries during evacuation. They were provided first aid and sent home (list of injured attached at (Appendix-C)

6. DAMAGE TO AIRCRAFT

- 6.1. All 4 engines of the aircraft were badly affected due to high E.G.T which has necessitated the overhaul of four HPT modules. The approximate cost of damage involved in the accident is U.S.\$ 17,01,889/=. The details of this expenditure including man-hours and cost of material etc. is given at Appendix 'D'.

7. OTHER DAMAGES

- 7.1. This accident caused loss of revenue to CAA for blockage of runway for 3 hours and 11 minutes and consequential disruption of flight schedule both of PIA and foreign airlines. Not-with-standing the repair cost of Aircraft, PIA had to sustain revenue loss due to grounding of this aircraft for 6 days (from 6-8-88 to 12-8-88) and its test-flight cost prior to induction of this aircraft in operations.

8. METEOROLOGICAL CONDITIONS

- 8.1. Local Met warning for Karachi and neighbourhood for the period 06,0500 GMT to 06,0900 GMT. was issued.
- 8.2. Thunderstorm/rain likely to occur over Karachi airfield and neighbourhood during the above period. Surface wind from NE may gust to 30 kts, visibility may reduce to 2 KMs or less during showers. MOD/SEV turbulence and icing associated with 2-3 Octas CB base lowering to 2000 ft A.G.L. as per Appendix 'E₁ to E₃'.

9. NAVIGATIONAL & LANDING AIDS

9.1. All Navigation and Landing Aids were serviceable and operating normal.

9.2. Navigational and landing aids were not a factor in this accident.

10. COMMUNICATION

10.1. All radio facilities were serviceable.

10.2. These were not a factor in this accident.

11. AERODROME AND GROUND FACILITIES

11.1. Adequate for operation of B-747 aircraft.

11.2. These were not a factor in this accident.

12. DIGITAL FLIGHT DATA RECORDER (DFDR) ANALYSIS

12.1. DFDR SR No.3006 Pt. No.981-6009-011, installed on the Aircraft (on 18-7-88) has a capability of recording 98 parameters over a preceding period of 25 hrs. Data more than 25 hrs old is erased immediately before new data is recorded. The input signals are preconditioned and digitized as required. Monitor circuits within the FDAU (Flight Data Acquisition Unit) and DFDR provide fault signals to actuate fault indicators on the FDAU in the event of unit failure. The DFDR is turned on automatically when the anti-collision light switch is put on, the DFDR is also turned on by the ground power sensing relay when ground power is removed from the airplane. Operating power for the system is 115 volts ac supplied from essential flight instrument bus through the FLT REC

circuit breaker on P7. On this aircraft the DFDR was recording all the relevant parameters satisfactorily and the same were retrieved subsequently in the PIA shop & at Washington (NTSB) U.S.A.

12.2. It has been observed that just before landing the aircraft was varying its position from -0.2 to -0.8 dots below the glideslope upto 07:49:13 and from +0.4 to +3.6 between threshold and time of landing 07:49:46 GMT. It may be noted that glideslope beam emanates at 960 ft. from the threshold of runway 25R at an angle of 3° . This clearly indicates that at the time of approach the aircraft altitude over the threshold was well above the glide slope beam. At an altitude of 306 ft the Pilot disengaged auto Pilot CMD 'A' channel. The aircraft landed at GMT 07:49:46 with its radio altitude Zero'feet, CAS 153K and LD -0.5 g. Four seconds later its thrust reversers (all 4 engines) were unlocked and then again 4 second later, its thrust reversers were applied at speed of aircraft 136 Kts. Thirteen seconds later all the 4 engines went into full reverse power with aircraft speed 82 Kts.

12.3. The Normal max. EGT limit on JT9D engine is 915°C and thus from the point GMT 07:50:07 to GMT 07:50:30 (23 second) all the 4 engines operated in full reverse condition. The max EGT recorded is as follows:-

(a)	Engine No.1	=	1018 $^{\circ}\text{C}$
(b)	" No.2	=	1003 $^{\circ}\text{C}$
(c)	" No.3.	=	1004 $^{\circ}\text{C}$
(d)	" No.4	=	997 $^{\circ}\text{C}$

12.4. The aircraft came to dead stop (at 07:50:35) in the middle of the over run area i.e. 501 ft. At the point of halt the max deceleration was recorded at -0.43 (max braking action).

It is/.....

It is relevant to mention that this aircraft is equipped with JT9D engines which can develop reverse power greater than 90%, unlike CF6-50 engines which have mechanical stops and can not go beyond 90% reverse. Five seconds after coming to a halt, the Captain operated fire extinguishing handle and thereby the power supply to DFDR was discontinued and therefore, there is no recording on the DFDR beyond 07:50:40 GMT. The mathematical calculations made for computation of distance travelled by the aircraft on the runway from point of touch-down at 07:49:46 GMT to the point of halt at 07:50:35 GMT on each second basis revealed that aircraft covered a distance of 6812 ft in about 49 seconds duration, which would indicate that the aircraft touched runway at 4188 ft from the threshold. (App. 'F'). The NTSB confirmed the serviceability and recording of the information on the DFDR.

- 12.5. GRAPHICAL PRESENTATION has been prepared by N.T.S.B, Washington, from the parameters available from the DFDR for analysing the landing incident. There are points which need to be noted which could have affected the length of landing roll. Just before touch down the aircraft speed has touched a peak of 160 Kts. Thereafter it has gradually washed out till 153 Kts at touch down. during the landing roll the control column position indicates a nose up control input increasing up to 10° for approximately 34 seconds after touch down. during this 34 seconds period longitudinal acceleration parameters indicate values between -0.1 to -.23. At this point the control column goes to approximately 0, longitudinal acceleration rapidly increased to a maximum value of -.43. At the same time, the control column position goes to 0, there is significant rudder input of about 20 degrees deflection. This results in a positive excursion of the lateral acceleration values to peak

value of/....

value of .1256 as the heading changes approximately 7 degrees. These variations in the aforementioned parameters would be indicative of a situation where the Captain may not have been able to utilize maximum braking energy, and also wanting to turn off at the end of runway to avoid going on the over run area. (App. 'G' attached to this report).

12.6. COCKPIT VOICE RECORDER (CVR) This aircraft was equipped with (CVR) model AV-557A, part No.980-6005-010, S.No.392. It records and preserves a continuing record of the latest 30 minutes of flight crew communications and conversation. The voice recorder system has four separate inputs for simultaneous recording of any communications in the flight compartment on 4 track magnetic tape. Channel 1 receives audio from the Flight Engineer, Channel 2 receives audio from the first officer and channel 3 receives audio from the Captain. Channel 4 audio is taken from a microphone pickup in the voice recorder control panel. An erase head in the recorder unit automatically erases previously recorded information prior to recording. An internal monitoring circuit ensures proper operation of the recording mechanism and circuit. The entire tape may be erased after the airplane has landed and the parking-brakes has been applied. Operating power for the voice recorder system is 115 volts, 400 Hz ac obtained from the essential radio bus through the VOICE RECORDER circuit breaker.

12.7. This voice recorder contains the recording for about 25 minutes with the CAA Ground Radar ATCO (Mr. Adnan-ul-Arbi). The conversation between Pilot and ATCO (Radar) on 125.5 MHz is quite clear upto the time the Radar advised PK-301 to contact control tower on 118.3 MHz

after/.....

after landing. But, subsequent 'eventful' conversation between the Pilot and Control Tower ATCO (Miss.Naeema Naqvi) is not audible or not recorded. The tape extract of the relevant transmission on 125.5 MHz on this accident (PK-301) dated 6-8-88, taken from ground station corroborates with the voice recorder audio output.

12.8. The detailed conversation between the Cockpit Crew was not audible. The board was interested in hearing the conversation after the aircraft had landed. During discussion with the W.T.S.B, Specialist it was confirmed that the tape had not been erased as suspected earlier. The conversation could have been recorded if the intercom had been used, which is not the present practice in PIA. However the maintenance of the CVR equipment including the pick-up is not satisfactory.

13. FIRE

13.1. After landing, first time the fire was observed and reported by the ATC Controller to the Pilot when the aircraft had crossed 'Delta' taxi-track. ATC advised the Pilot that he should switch off the engines. After the aircraft came to halt, the Pilot switched off the engines and thereafter no fire was observed. The Crash fire Rescue Vehicles of CAA also reached on over-run area for assistance, but the services were not used for any operation as they found that the fire had gone off.

13.2. The cause of fire appears to be due to the operation of all the four engines in maximum reverse condition

at speeds/.....

at speeds even less than 60 Kts. At lower speeds, with loss of cooling affect, all the four engines were subjected to extremely high temperatures and over-revolutions. The emission of long flames in such state of engines is normal. This was taken as spark/fire by the ATC Controller. Subsequent examination of the engine turbine verified the existence of flame/high temperature. From a remote distance and bad weather it could not be possible for ATC Controller to distinguish between sparks and fire, nevertheless the flames were evidently there.

- 13.3. Four fire bottles on engines and one on APU were operated by Captain as found discharged and the same were later replaced

14. SURVIVAL ASPECT

- 14.1. The accident was survivable and no abnormal vertical or lateral G (acceleration) was involved. However aircraft, after landing, was subjected to high longitudinal deceleration due to operation of engines in maximum reverse thrust. The apprehension of fire, after the aircraft came to halt, prompted the Pilot to order evacuation which was not disciplined and resulted in minor injuries to 17 passengers and 3 passengers, who exited from R3 door, sustained major injuries.
- 14.2. For emergency evacuation, there were 11 doors on Boeing 747 AP-BCN including one in upper deck.
- 14.3. The L4 and R4 doors (and slides) were intentionally not operated by the cabin crew reportedly due proximity of

these/....

these slides near the exhaust of engines. All other slides, except R3, operated normal.

- 14.4. Due to lack of positive control i.e. no announcement made, the passenger got panicky and scared, but the evacuation was accomplished in reasonable time.

15. TEST & RESEARCH

NIL

16. OBSERVATIONS

- 16.1. From the previous flights the recorded snags of the aircraft were reviewed. The reports pertaining to the various systems of the aircraft, and other associated systems were found regularly rectified. However on the preceeding flight PK-300 Karachi to Islamabad No.2 thrust reverser had been reported unserviceable. The same was duly rectified at Islamabad and all four engines thrust reversers operated satisfactorily while landing at Karachi. Also the aircraft weather radar was reported unserviceable which was rectified at Karachi on 4th August. As such the weather radar was serviceable.
- 16.2. While replaying the Video Recording of the radar picture it was found that no recording had been made on magnetic tape MIV-800 system and the time recorder unit on the audio tape was intermittent these were brought to the notice of the Senior Electronics Engineer of CAA. (APP. 'H₁ - H₄'). Some nonstandard transmission were made by the controller and vernacular were recorded on tape. (App. 'I₁ to I₃').
- 16.3. While investigating the serviceability of Mu Meter at Karachi it was noticed that three such machines had

been/....

been procured from Messrs. IAL Karachi on 7th February 1985 vide contract No. HQ.CAA/2175/1/205/SUP/PROC. These machines were issued to Karachi, Lahore and Islamabad. General Manager Electronics Depot has confirmed that the machine is defective in the auto function and a similar defect exists in Mu Meter at Lahore. (Appendix 'J').

17. INVESTIGATION

- 17.1. **RADAR VECTORING** Pakistan International Airlines B-747 aircraft registration marks AP-BCN operating scheduled domestic passenger flight PK-301 from Islamabad to Karachi, departed Islamabad Airport at 0600 UTC on 6 Aug 88. There were 424 passengers, 4 flight crew and 13 cabin crew.
- 17.2. While PK-301 was descending from flight level 180 to 100 at approximately 50 DME, the radar controller advised PK-301 of Karachi weather stating that the weather is overcast with cumulous clouds and with drizzling on and off. (App. 'K').
- 17.3. At 0732 UTC PK-301 was given descent clearance from flight level 50 to 3000 ft. It was then maintaining its speed of 250 Kts as stated by the Captain. As the flight was cleared down to 2000 ft at 07.33 UTC for final approach it continued maintaining the same speed. At 07.34 UTC PK-301 was cleared for making an ILS approach on runway 25R at Karachi Airport. Just then speed signal in the Radar Scope started registering 385 Kts and it alarmed the radar controller.
- 17.4. **FIRST APPROACH.** The speed signal was missing since PK-301 came on the scope. The Radar Controller noticing a high speed during the approach of PK-301 at 6-7 NM from the runway became alarmed and questioned

the pilot/.....

the pilot if he could satisfactorily complete the approach. The pilot acknowledged the high speed by saying that he had maintain a higher speed as he was experiencing heavy turbulence. The Radar Controller was concerned that if PK-301 overshoot the localiser or did not descend on the ILS from 2000 ft, it might have a Near Miss with Aeroflot IL-76 which had taken off from runway 25R. He therefore directed the tower that Aeroflot must hold 120° heading.

17.5. The ATCO was not aware that PK-301 was being radar vectored on the finals of runway 25R. This came as a surprise to her as she noticed Boeing 747 going around at a low height close to the eastern side of the tower. The Radar Controller did not pass the traffic information to the control tower.

17.6. **SECOND APPROACH.** Meanwhile PK-301 abandoned its ILS approach on runway 25R and was vectored towards the North for intercepting the localiser. As the area beyond 10-30 NM of Karachi was having few CB Cells, the Radar Controller tried to vector PK-301 close to the field to avoid these cells which resulted in the aircraft being positioned too close from which the approach could not be made safely. Therefore this approach was also abandoned. During this process PK-301 informed the controller of prevailing thunderstorm on the approach with moderate to severe turbulence and heavy rain.

17.7. PK-301 therefore had to overshoot again and since PK-301 had the runway in sight, he requested for a left hand down-wind for a visual approach on runway 25R. The Controller agreed for the visual approach. Meanwhile Fokker PK-541 who was experiencing heavy

turbulence/...

turbulence made a request for priority approach. While PK-301 was establishing approach on ILS runway 25R, PK-301 agreed to the request of PK-541, and confirmed that he would be No.2 on approach.

17.8. THIRD APPROACH. On the final approach PK-301 experienced heavy turbulence and rain. As the Air speed indicator was fluctuating a speed of approximately 153 Kts was maintained. The calculated approach speed was 134 Kts. according to the aircraft weight configuration.

17.9. According to DFDR glide slope data readings, PK-301 had slightly started going up above the slope and remained slightly up till touch down, it was also visually observed by the Air Traffic Controller in the tower.

17.10. According to statements of the two ATCO's from tower, and fire guards from the fire station, and the PIA Technician, the aircraft touched down close to taxiway foxtrot which is slightly more than 3000 ft from the beginning of runway. The Chief Inspector and Pilot Chief Investigator visited the site and could trace back the tyre tracks to approximately same position as indicated by the witnesses.

17.11. On the final approach while the aircraft was experiencing turbulence, wind shear, rain, the captain had to maintain higher approach speed, therefore he selected 'Auto brakes', to Mid position for landing as per procedure for wet runway landing.

17.12. PK-301 had established on localiser and glide slope and had visual contact with runway around 300 ft, he disconnected the auto pilot.

17.13. Meanwhile/.....

17.13. Meanwhile F-27 Fokker aircraft PK-541 had landed at 0746 UTC and was asked about the braking action to which PK-541 replied, "Braking action is good but there is heavy rain on short final". Meanwhile PK-301 was positioning on final approach for landing.

17.14. The parameters for landing conditions were:-

- (a) Aircraft landing weight ——— 229000 Kgs
- (b) Outside Air Temperature(OAT) 20°C
- (c) Runway in use 25R (10,500 ft)
- (d) Wet runway landing roll (7475 ft)

17.15. The aircraft made a smooth touch down as stated by Captain Frazer (an experienced training Captain of PIA who was on board the aircraft) and some other passengers. Also the DFDR does not show a significant reduction of speed.

17.16. At the time of touch down it was drizzling and the surface wind had veered to 060°/10 Kts. The heavy rain was still on the final approach.

17.17. **LANDING** After the aircraft had touched down the Captain felt that the aircraft was not decelerating in the normal manner despite application of full reversers on all the engines. He, therefore, decided to apply manual braking by which he could exert more pressure than the auto brakes in Med. position. as the end runway was approaching and speed had not been brought under control. The Captain continued in the auto reverse even when the speed had come below 70Kts. The aircraft most probably was partly hydroplaning. While the aircraft had crossed beyond middle of runway the ATCO witnessed sparks and flames coming out of the engines. This was reported to the Captain. During this time the aircraft had come to a halt on the over run area, the ATCO re-affirmed that flames were coming from behind the

aircraft and the Captain should switch off the engines. The Captain shut down the engines and actuated all the fire extinguishers including that of APU as per emergency procedure. After this action approximately 30 seconds later the ATCO confirmed negative fire followed by a call from Indian Airline aircraft that the fire was due to reversors. During this time Captain probably decided to evacuate the passengers.

- 17.18. **EVACUATION FROM THE AIRCRAFT** During the emergency action, the evacuation was supervised by 13 PIA Cabin Crew. Out of the total 11 exits available on this aircraft only six were used.
- 17.19. The upper deck slide is normally not used unless the approach from upper deck to lower deck is not available. Exits L4 and R4 were not opened because of fire behind the engines as reported by some of the passengers from the cabin area.
- 17.20. The two exits which open onto the wings have slides which consist of two portions. First portion of the slide is for evacuating passengers (PAX) from the cabin to the wings and second portion of the slide is used to disembark the passengers from the wing surface to the ground. In case of the left door the slides did inflate but due to strong winds it twisted the second portion over. The slide on the right door operated but the second portion did not inflate due to technical malfunction.
- 17.21. A total of 20 passengers received injuries as reported by the PIA Chief Medical Officer and Airport Health Officer. Three passengers sustained major injuries and were admitted in hospitals for treatment while the rest were given first aid and sent home.

17.22. As the aircraft came to a halt the fire tenders promptly reached the scene of occurrence later on followed by PIA and other transports. By this time it had started raining heavily with strong gusty winds reaching a speed of 21 Kts as recorded by the Met Department.

17.23. Emergency action was taken by the ATCO as laid down for aircraft incident, but when the injuries to passengers were reported the incident was reported as an accident. Therefore no blood or urine sample was taken of the cockpit crew nor the emergency plan activated. However the Airport Manager who was later detailed for investigation reached the scene of incident and recorded briefly the statements of the cockpit crew.

17.24. The cabin crew remained on the aircraft till the PIA Security Staff took over the belongings left behind by the passengers in the cabin. The Airport Security Force guards later on arrived at the scene of incident and took over the aircraft.

17.25. The Investigator and the Controller of Airworthiness surveyed the aircraft for any external visible damage. Immediately after the accident the aircraft was examined for any physical damage, the following observations were made:-

17.25.1. Apparently no significant damage to aircraft structure or engines was visible.

17.25.2. No apparent damage noted inside the cockpit and/or passenger cabin, including the Cargo Compartments.

17.25.3. All fusible plugs were intact, the brake wear indicators were found within limits and all the flaps were fully extended.

17.25.4. All four engines were found in full reverse thrust configuration. The EGT gauges were found stuck beyond maximum limits i.e. between 997 to 1018°C thus indicating overheating of the engines.

17.25.5. Except R4, L4 and a portion of R3 all the remaining slides were found deployed.

17.25.6. Parking brake lever found in parked position.

17.25.7. All 18 tyres (16 main + 2 nose) did not reveal any signs of over heating, softening or melting on the tread or side wall except tyre No.1 which had a portion of 8 inches peeled off due to severe rub.

18. DISCUSSION OF EVIDENCE

18.1. **RADAR VECTORING** - When PK-301 was cleared down through various heights for approach and the Controller noticed that speed signal of aircraft was missing from his scope he should have questioned the Pilot concerning his speed or asked for recycling the transponder. The Pilot would have then recycled the transponder or used the standby set if required. However if this process did not restore the speed signal in his scope he nevertheless would have been aware of the speed of PK-301 and instructed the Pilot to slow down his aircraft when approaching close to the final approach leg.

18.2. Probing/.....

- 18.2. Probing for the speed is an important function of the controller for monitoring the aircraft progress as it approaches near for intercepting ILS localiser and glide slope during its final approach. If a speed signal had failed for whatever reason to appear in the scope, it did not relieve the controller of his responsibility of monitoring the progress of the aircraft. If the controller had done so earlier, the Pilot could have been asked to slow down his aircraft or re-adjust its flight path to avoid a possible conflict with the departing traffic, Aeroflot departing from runway 25R for east bound departure maintaining a radial of 140° . In so doing in the past, they always reported over the VOR before setting course. However, the controller acted promptly on noticing high speed of PK-301 in advising the tower controller that Aeroflot must maintain a heading of 120° . This timely action of the controller avoided a possible near miss between PK-301 and the Aeroflot.
- 18.3. The Captain of PK-301 equally had the responsibility of informing the controller that he was maintaining higher speed as he was encountering heavy turbulence. This would have alerted the controller for taking necessary steps for re-adjusting his missed approach profile with a greater margin of safety as he remained in touch with the tower controller who was controlling traffic around the airport..
- 18.4. Since both Captain and the Controller had understood each other that PK-301 was then No.1 in the approach sequence, it is therefore all the more confusing to note why the Captain did not inform the Controller of maintaining high speed when he was cleared as No.1 for approach and landing. ILS let down could have only been possible if he had progressively slowed

down/....

down his aircraft for approach before intercepting the localiser and glide slope during his descent from 3000 to 2000 ft. His speed was however 250 Kts as stated by him instead of being 385 Kts as appeared in the scope of the Radar Controller which obviously had some defect.

18.5. As the overshoot was inevitable the Controller vectored the aircraft towards the north before paralleling it with localiser course of 25R and taking it closer to the outer marker for another approach. The intention of the Controller was to avoid the bad weather which was now closing in towards the outer marker. He therefore positioned the aircraft within seven miles from the airport and two miles from the outer marker for avoiding weather. The Controller should have anticipated and he could have given him a left hand turn instead of right hand turn into the weather. The vectoring of the Controller is questionable thereby placing PK-301 at high off set angle and 3 miles from the beginning of the runway.

18.6. **SECOND APPROACH** From this position aircraft could not possibly carry out a safe approach. The Controller realising this aspect asked PK-301 to go round again. PK-301 therefore overshot to the left and wanted to conduct a visual bad weather approach from left hand down wind for runway 25.

18.7. The Radar Controller got involved deeply in traffic around and bad weather around Karachi that he failed to pass the traffic information to the tower controller which was his duty and could have resulted in a serious mishap. The second approach could not materialize into a landing as the radar controller did not anticipate the location of bad weather in the northern sector and gave a turn to aircraft to the right resulting in too close a position to the runway from which position landing could not have been possible.

LANDING/....

18.8. LANDING Some of the factors which can cause the aircraft to overshoot on landing:-

18.8.1. Tail wind component.

18.9. During 0700 UTC to 0800 UTC the winds reported by the Met Department. As recorded on 6th Aug 1988 on wind Anemograph were as follows:-

TIME (UTC)	WIND DIRECTION	SPEED
0700	280	12
0715	290	07
0730	320	Calm
0745	080	10
0752	110	21
0800	110	11

18.10. As seen from the above records the winds reported by the ATCO were correctly reported i.e. 060/10 Kts. Further investigations were carried out by the Chief Investigator as doubt was created by the Captain of the aircraft that the winds were in excess of 10 Kts.

18.11. The site where the anemometer is located near the edge of the wide body hangar tarmac. This position was selected most probably for the Old runway. The present position from which the recording of the wind is made and information provided to the ATC is not considered correctly located to give the wind velocity to aircraft landing on runway 25R. There is a possibility that the gust factor/wind shear velocity reported in a similar weather could be different from the weather conditions prevailing on the runway. This creates a doubt in favour of the Captain but the fact remains that the ATC gave correct reading.

18.12.The/.....

- 18.12. The Fokker aircraft PK-541 and Boeing 747 reported heavy rain on finals which was moving towards the runway which later moved over the runway. It was drizzling on and off and the runway was wet but the Fokker PK-541 aircraft reported braking action good when asked by the Air Traffic Controller. The down wash from this heavy rain cell could have extended the touch down point.
- 18.13. An automatic weather station equipment (AWS) has been installed at the beginning of the runway 25R. It is reported by the Meteorologist Incharge that it is still in experimental stage. The reason why the equipment is not being used needs to be investigated by the Director General Pakistan Meteorological Department.
- 18.14. **APPROACH SPEED AND GLIDE PATH** The approach speed specified for the weight of the aircraft is given in the Pilot's hand book and it provides for margin of safety above the minimum of safe speed. i.e. Minimum control speed and aircraft stall speed. As per given weight of Pk-301 for that particular flight 229000 Kg. the corresponding approach speed for this configuration was between 132-134Kts.
- 18.15. The speed maintained by the Captain was about 153 Kts which comes to less than 20 Kts allowable for full gust conditions and $\frac{1}{2}$ of the head wind, addition to the approach speed. The aircraft operation manual allows this to cater for turbulence/wind shear/gust effect, but there was tail wind of 10 Kts and no gust reported. It is obvious for that approach speed there is a certain length of runway required to stop the aircraft. But if the speed is high beyond the maximum recommended speed the landing roll would definitely increase correspondingly.
- 18.16. The aircraft was slightly above the glide path which would have definitely delayed the touch down point. In addition to this had the aircraft been held off the

ground/.....

ground to wash off the excess speed the touch down point would definitely be delayed. This has been positively indicated from the DFDR reading that the touch down was smooth as the speed had been washed off on touch down nor there has been an appreciable longitudinal deceleration recorded. An experienced pilot, Captain Frazer of PIA and other passengers have confirmed that the touch down was smooth.

- 18.17. **HYDROPLANING** Since it was drizzling on the runway an inspection carried out earlier at 0724 UTC by Van No.1 which reported runway being clear and slightly wet. Between inspection and the time of landing water may have accumulated in patches on uneven surfaces. Due to these wet, patches hydroplaning can be induced particularly to aircraft landing at high speeds.
- 18.18. **HYDROPLANING ITS CAUSES AND REMEDIES** Tyre aquaplaning or hydroplaning is technically described as "a condition in which hydrodynamic lift force developed between the tyre footprint and the fluid-covered runway surface equals or exceeds the vertical reaction of the aircraft mass acting on the tyre, resulting in loss of directional stability or braking effectiveness". This means that the contact between the tyre and the runway is lost as the tyre rides on the film of water. The co-efficient of friction which is as high as 0.8 on a dry runway will decrease to 0.3 at slow speeds and 0.0 at high speeds during aquaplaning/hydroplaning. Such conditions will increase the stopping distance during landing. Once aquaplaning starts the Pilot has only the aerodynamic braking and reverse thrust available for stopping the aircraft since wheel brakes become ineffective.

18.19. The/.....

- 18.19. The type of runway surface will determine the amount of fluid (water, slush, etc.) necessary for hydroplaning, the rougher the surface, the more fluid necessary to sustain hydroplaning.
- 18.20 There are three known types of hydroplaning. Dynamic hydroplaning occurs when there is standing water on the runway one-tenth of an inch or more in depth. The water acts to lift the tyre off the runway. Tests have shown that the minimum speed for complete dynamic hydroplaning is approximately nine times the square root of the tyre inflation pressure. This speed is for the onset of dynamic hydroplaning and it should be remembered that once hydroplaning has started it can continue to a much lower speed. Changing the weight on the tyre has little effect on this speed as the size of the footprint changes with weight.
- 18.21. The second type of aquaplaning is viscous hydroplaning which occurs when the runway is damp, and results from the viscous properties of the fluid. A thin film of fluid a thousandth of an inch or so thick cannot be penetrated by the tyre and it rolls on top of the film. This type of hydroplaning occurs at lower speeds than dynamic hydroplaning, however, viscous hydroplaning requires a smooth surface. Rubber deposits on a runway surface if not removed periodically can result in making the surface smooth, and would therefore contribute to this type of aquaplaning.
- 18.22. **REVERTED RUBBER** Hydroplaning is the third type. This type requires a prolonged skid, reverted rubber, and a wet runway surface. Reverted rubber is a condition in which the rubber takes on an uncured appearance. It is sticky and tacky due to the heat generated by friction between the tyre footprint and the wet runway.

This reverted rubber acts to seal the water between the tyre and the runway. The water trapped in the tyre footprint area is heated and converted into steam which supports the tyre above the runway surface. The condition of the tyre surface effected by the heat generated by such aquaplaning is easily distinguishable. No such marks of heating appear on tires subjected to dynamic and viscous type aquaplaning. Also since a prolonged skid is necessary for reverted rubber aquaplaning, this type of aquaplaning does not usually occur to aircraft fitted with serviceable anti skid braking systems if the system is in operation, but can occur if touch down is made at a spot where no wheel spin up occurs, thereby initiating reverted rubber skid.

18.23. RUNWAY SURFACE One of the causes of hydroplaning can be due to surface of the runway. The surface from use over a long period may cause reduction in co-efficient of friction. It can be further reduced if the rubber deposits of tyre accumulate over a period of time and particularly so if the runway is wet. This effect can be further aggravated if the touch down is made smoothly by the aircraft instead of a firm touch down.

18.24. REMOVAL OF RUBBER DEPOSIT After the accident runway surface inspection was conducted. Rubber deposits in the touch down zones on both ends of the runway were noticed. Runway 07 left comparatively had less rubber deposits as the prevalent winds at Karachi do not allow the use of this end of runway regularly. Since the last accident took place at Karachi Airport, CAA has purchased a machine for removing rubber deposits.

Every/.....

- 18.25. Every year rubber deposits from runway are removed before the rainy season. The work lasts a few month and is completed before the start of rainy season. In the past runway remained closed for aircraft operation every day for 2 hours during such operation. Initially, chemicals were used for cleaning the surface which was not only time consuming but caused damage to the runway structure. To overcome this, a machine was imported for cleaning the runway, which supplies high pressure water for cleaning purpose.
- 18.26. Last year cleaning of runway surface was initiated on 2nd May, 1987 and work was completed on 25th June, 1987. (App.I
- 18.27. The position of rubber deposit accumulation is continuously monitored. In January, 1988, the rubber deposits had again accumulated to the level that the equipment to clean it was deployed. The work was completed by end of April. 1988. The total area cleaned was 5,700 running feet (3,200 feet on runway 25R and 2,500 feet on runway 07L end). In order to avoid closure of runway for two hours every day, the work was done during slack period of day/night. This proved successful.
- 18.28. The runway has been fit for operation at all times.
- 18.29. **RUNWAY BRAKING CONDITION** The co-efficient of friction of tyres on a runway is a function of many factors. Runway surface condition and texture, rubber composition, tread pattern and depth, inflation pressure, surface friction, shearing, relative slip speed, etc. are all factors which affect the co-efficient of friction. The application of wheel brakes supplies a torque which tends to retard the wheel rotation. When braking torque is equal to rolling torque the wheel experiences no

acceleration/....

acceleration in rotation and the equilibrium of a constant rotational speed is maintained thus the application of brakes develops a retarding torque and causes an increase in friction force between the tyres and the runway surface..

18.30. A common problem in braking technique is application of too much brake pressure which creates a braking torque greater than maximum possible rolling torque. In this case the wheel loses rotational speed and locks, thus subjecting the tyre surface to a full slip condition with a marked decrease in the co-efficient of friction.

18.31. In order to measure the braking co-efficient of the runway surface friction measuring equipment known as MU Meter is needed. Three MU Meters were imported by CAA. These meters located at Karachi, Lahore and Islamabad are used to check the runway braking condition for wet and dry runway surface conditions. This equipment was found to be unserviceable. The matter was discussed with Director Airport Karachi and Director Technical of CAA. On 24th July, 1988 while checking the braking action the meter became unserviceable and was sent to General Engineering/Electronic Depot for rectification. The equipment was made available on 12th Sept 1988 but was found that the computer/printer was still defective. Keeping in view the necessity of this test, manual readings were recorded in the presence of the Chief Inspector. This meter is used to assess the following:-

18.31.1. Friction of Dry runway surface.

18.31.2. Friction of wet runway surface.

18.31.3. Slipping tendency of runway during rain.

18.31.4. To determine the effect on friction taken there are patches of water on runway.

To/...

18.31.5. To obtain friction effect and braking action on ice-snow covered runway.

18.31.6. The braking condition caused due to rubber deposits on runway.

18.31.7. Special tests before giving surface treatment to runway.

18.32. The following relationship between co-efficient of friction and braking efficiency are used for passing to aircraft.

<u>Measured Co-efficient</u>	<u>Estimated Braking</u>
0.40 and above	Good
0.39 to 0.36	Medium to good
0.35 to 0.30	Medium
0.29 to 0.26	Medium to poor
0.25 to below	Poor

18.33. Friction test was carried out in July, 1988 during rain which indicated braking action good. A test was carried out in the presence of Chief Inspector with the following results.

<u>DRY READING</u>			
<u>A</u> 10,000'	25R - 07L	<u>Friction Graph</u>	<u>B</u>
054740	A-A = 441	0.8	000000
055181			000541
<u>WET READING</u>			
<u>A</u> 1000'	07L - 25R	<u>Friction Graph</u>	<u>B</u>
055181		0.6	000000
055217	A-A = 36		000000
<u>A</u> 1000'		<u>Friction Graph</u>	<u>B</u>
055544		0.4	000000
055566	A-A = 22		000052

18.34. However after the test the Karachi Airport Management had started cleaning the rubber deposits. Chief Inspector also attended one of the cleaning operation and found the work was not satisfactory. This was brought to the notice of SATO. The machine was rectified and the Chief Inspector again witnessed the cleaning operation. The cleaning action was positively visible but there was lack of optimum performance from the machine.

18.35. **LANDING ROLL** During the landing roll the pilot felt that the aircraft was not decelerating he therefore opted to apply manual braking and continued to use full reversers even below the speed of 70 Kts. The Operation manual of B-747 allow the use of thrust reversers in case of emergency which was the condition in this case.

18.36. As the thrust reversers were being used the Tower Controller witnessed sparks and flames coming out of the engines and brought this to the notice of the Captain. The EGT was seen rising by the Flight Engineer to beyond limits the passengers and cabin crew reported hearing banging noise which confirms that the engines had stalled. Therefore there were definitely sparks/flames visible to the ATCO and she correctly brought it to the attention of the Captain.

18.37. After the aircraft engines were switched off following readings of the engine instruments were recorded.

<u>PARAMETER</u>	<u>ENGINE NO.1</u>	<u>ENGINE NO.2</u>	<u>ENGINE NO.3</u>	<u>ENGINE NO.4</u>
EGT	1018	1003	1014	997
N1	83	83	86	80
N2	94	94	95	94

INVESTIGATION/.....

18.38. **INVESTIGATION OF ENGINES** The engines were removed from the aircraft and subjected to investigation which indicated that all the four engines had been subjected to very high temperatures particularly No.3 engine turbine blades were found with metal spray on them. The EGT indicator of the No.2 engine was found under reading by 6° . The N-2 indicators of No.1 and No.3 engines were found to have excessive friction and could not be further investigated.

18.39. Engine No.3 sustained maximum damage. It operated at 1014 C EGT for 10 second. Its Boroscopic inspection was not satisfactory. Its first stage H.P turbine blades had leading edge coating burnt leaving glossy surface. Second stage turbine blade were partly burnt and necked on the trailing edge near the tip. In LPT trailing edge of nozzle guide vanes were partly burnt. For details of damage please refer paragraph No.6. The No.3 engine (S.No.685959) had 37706 hrs since new, 8497 cycles and 1020 hrs time since last inspection. Whence the aforestated condition of No.3 engine was apprised to manufacturer, they intimated that internal temperature, which resulted in above damage, must have gone upto 2300 F. This and other engines therefore, had experienced very high temperature coupled with flames due to loss of cooling at low speed. It may be noted that use of reverse thrust is normally prohibited when aircraft speed falls below 70 Kts or else the damage (as happened) occurs. The emission of long flame from the outlets of reverse thrust on this engine in hazy weather appeared to be fire to the control tower, and the same was intimated to Captain by the ATC. The damaged engines/turbines etc are being forwarded to British Engine Overhaul Ltd., (BEOL) UK for over-temperature and metallurgical analysis. (Photograph at App.'M₁ to M₁₂').

18.40. EVACUATION FROM AIRCRAFT As the aircraft came to an abrupt halt the Captain switched off the engines. No announcement had been made so far as to what was happening. When the aircraft came to a halt abruptly the senior purser took the initiative and announced on the intercom that cabin crew and passengers remain seated. As no further instructions came from the cockpit he unbuckled himself and climbed up to the upper deck and went into the cockpit to ask for further instructions. He was advised to wait and subsequently the Captain switched on the evacuation command system.

18.41. The Captain should have realised that the tower controller had reported flames and sparks coming out of all four engines. This could have been due to compressor stall. Which can further be confirmed by no fire warning lights, high EGT loud bang noises which were heard by different occupants of the aircraft. Also the ATCO confirmed that the flames were no longer visible from the engine. Immediately after the Captain informed tower that the engines have been switched off another aircraft probably IAC-132 (Indian Airline) transmitted, "Sir they were exhaust flames which were in reverse". Therefore the evacuation of the passengers was rather in haste and could have been delayed till the engines stopped and the spray thrown forward appearing to be smoke cleared. Perhaps it gave an impression to the Captain of engine fire and possibly wheel fire as he had been applying heavy braking during hydroplaning. If the wheels are hydroplaning then they should not heat up. Even if they did get heated up the Boeing 747 has the over temperature indicators in the cockpit which should have been utilized.

The Captain/.....

18.42. The Captain did not wish to take a chance with the fire spreading he therefore decided on a quick action of evacuating his passengers. Under these conditions it would have been therefore an in-appropriate time for the flight crew to have indulged in starting the APU for motoring the engines to avoid over temperature damage to the engines.

18.43. In the last 20 minutes or so when the aircraft had made three approaches tension had built up in the passenger cabin amongst the occupants. As the aircraft had made two approaches earlier the crash and fire rescue personnel had been alerted. They had also been told by the ATCO about the fire on the aircraft to which the fire crew had responded admirably. The fire tenders were in position almost as soon as the aircraft had come to a halt. There were a total of 13 PIA cabin crew and as per the statement of Senior Purser they were detailed as follows:-

(a) Upper deck	- Mr.Javed Butt
(b) L-1	- Mr.Abdul Quadir (S.P)
(c) R-1	- Miss.Naeema Bano & Mr.Azeem
(d) L-2	- Mr.Mohammad Aslam
(e) R-2	- Mr.Mehboob
(f) L-3	- Mr.Omair Aidrus
(g) R-3	- Miss.Marina YU
(h) L-4	- Miss.Rana Shahzadi Miss.Shahida Parveen
(j) R-4	- Miss.Quandeel Affandi
(k) L-5	- Miss.Azra Aijaz
(l) R-5	- Miss.Salma Firdous

- 18.44. The evacuation commenced immediately. The upper deck slide was not activated as this is used in extreme cases when the passengers cannot descend to the main cabin. In this case the passengers were guided down to the lower deck and during this period a child tripped who was helped by an Air Hostess.
- 18.45. During the evacuation when about 25% of passengers had disembarked the Captain did notice that there was no fire and stopped evacuation. However the response was not coming from passenger he therefore gave another call to Rush Evacuation.
- 18.46. Of the 11 exits available only six were used. Of the remaining 10 exits the exits L-4 and R-4 were not operated because the cabin crew and passengers had seen smoke/flames behind the engines and using their initiative the Air Hostesses diverted the passengers to other exits. The passengers had become a bit panicky and were wanting to open these doors in fact one of the Air Hostess was hit in the ribs by a passenger with his bag. (App. 'N').
- 18.47. There are two exits on wings L3 & R3. The L3 exit was manned by flight steward who inspected the inflated slide and found that the wing slide portion had twisted over and could not be utilised. He therefore went out to straighten out the slide, Having failed to do so, he blocked the exit by putting a restraint strap across the exit which is provided in the aircraft for this purpose. The passengers were redirected by the steward to the forward area. In case of R3, the exit was being manned by an Air Hostess. As soon as the evacuation signal was activated and as soon as the door was opened by her the passengers approximately 10 of them pushed her aside and before she could assure the over wing slide is

inflated/....

inflated-went outside. On her visual inspection she found that the overwing slide had not been inflated which is suppose to function automatically when the door is opened. She then went for the manual handle for the actuation of slide which also did not work. During this time about 4-5 passengers jumped over the wing side out of which 3 sustained major injuries they could not be spotted from the aircraft. The Air Hostess called back the rest of the passengers who had stepped over the slippery wing of the aircraft. She also later put a strap across the door to stop any passenger from going out, and diverted the pax to other exits.

18.48. The rest of the six exits were properly utilised. The cabin crew whose door was not being operated moved over to the other exits. The aisles were completely blocked by the passengers who were trying to collect their brief cases etc., from the overhead racks, so the crews had to jump over the seats to change their positions. The Air Hostess in the first class cabin started using the megaphone as intercom system became non-operative due to switching off of the aircraft.

18.49. The only slide which partly did not inflate was the ramp-portion of the off wing slide, hence complete passage from R-3 door of aircraft to the ground was not available. This caused serious injury to some of the passengers who were evacuated through this door (R3). The detailed examination of the off-wing slide revealed that its panel did not fully open and slide remained stowed inside. Red colour indicator pin confirmed that latches were disengaged but one of its thruster (i.e. on No.2 position), part No.2174200-14 and S.No.1570 had its operating rod seized/jammed due to internal failure. The serviceable

thruster/....

thruster operating rod and firing pin is also indicated for comparison purposes on the attached photograph. The failure of this thruster further damaged the deployment cable and caused kink at the ball end of the cable assembly. As a result of these failures, slide did not inflate. However, operation of other thruster was normal, as verified by unlocking of latches of housing panel. The life of thruster is 5 years, of which it had consumed 4 years and was found installed on this aircraft, since its purchase from C.P Air (Canada) by PIAC in the year 1986. The life of cable assembly is on-condition, nevertheless its damage was consequential. The periodic inspection of slides, as per Maint., schedule calls for their rigging-check only at every check 'C' interval i.e. at 4400 hrs. This was done 2 months preceding accident. This check on slide was introduced recently by Boeing Co., as a result of some previous incident on the escape slide L3 blowing off in mid air, on PIA Boeing 747 aircraft AP-BCL on 26th December, 1987 (PK-785). During investigation on AP-BCN it was apprehended that inadvertant operation of Ditching Handle on the R3 door by Cabin Crew may have inhibited the deployment of Off-wing slide portion, but the same has been discounted as its operation would have declutched the entire off-wing slide section and the aforesaid damages could not have occurred. It is, therefore, concluded that the door was operated appropriately by the crew but the system was technically defective as such the deployment of slide could not take place.

- 18.50. In order to get more detailed information from the passengers regarding the evacuation an advertisement was issued in all the leading papers of the country both in English and Urdu requesting the passengers to get in

touch with CAA Inspectorate either on telephone or by writing. A person claiming to be a Jordanian Pilot rang up; he was asked to submit his comments in writing but nothing has been received up to date.

18.51. Of the 424 passengers only a few responded to the advertisement Namely.

- (a) Mrs. S.Ali-zai
- (b) Brig (R) M.A.Farooqui
- (c) Mr. Tariq Saeed
- (d) Mr. Sultan Muhammad Khan
- (e) Allama Aqueel Turabi

(Statements of Witnesses attached Appendix 'O').

18.52. In addition to the request CAA Medical Officer was sent to the hospitals where the injured passengers were admitted and Airport Health Officer and the PIA Doctors. The general complaints could be listed as follows:-

- 18.52.1. No announcement was made when the aircraft went around twice.
- 18.52.2. No PIA cabin crew was visible.
- 18.52.3. No guidance was provided to them
- 18.52.4. No PIA crew was seen at the base of the slide chute.
- 18.52.5. No body was there to receive the passengers in the terminal building nor any immediate help was available.

18.53. **NO ANNOUNCEMENT** The complaint of no announcement seems to be genuine because the flight was terminated at the end of third approach. During approximately 25 minutes the aircraft took to make these approaches, the passengers

witnessed/....

witnessed the aircraft descending and climbing again disappearing in clouds became tense and frightened. Some one from the cockpit should have put the passengers at ease by anticipating their anxiety. This added to the fear of the passengers when evacuation was ordered.

18.54. NO CABIN CREW VISIBLE The crews were asked at length about their locations and actions and it is concluded that all the exits were being manned although full crew compliment was not available. Additional help was provided by three British Airways Air Hostesses who were travelling as passengers on this flight. Since the cabin crew were located at the exits and were helping the passengers they would not be visible to the passengers as their views would be blocked by the passengers standing in the aisle with some of them hands raised to open the overhead to draw their personnel belongings. However if there had been additional cabin crew they could have made themselves visible by standing on the seats on the middle row and shouted the necessary instructions. In fact this is the reason whey the British Airways Air Hostesses managed to be seen by the passenger and provided the necessary assistance. The megaphone located in the cabin could have been used for making announcements. One was used by the Air Hostess in the First Class cabin but the instructions were not audible along the full length of the cabin.

18.55. NO GUIDANCE PROVIDED Some of the passengers felt that they should have been told to leave their baggage and to take off their shoes. There seems to be some controversy on this issue. Detailed examination and cross examination of the cabin crew and PIA Security Staff revealed that number of shoes, personal belonging and brief cases had

been/....

been left behind and later returned to their owners; in some cases when the passengers were requested to leave their baggage they did not respond to the instructions. It is felt that the evacuation chart kept in the seat pockets needs further improvement which may resolve this problem for future.

18.56. NO ONE AVAILABLE TO RECEIVE THE PASSENGERS IN THE TERMINAL

This is a valid observation made by the passengers. As per the instructions to cabin crew, they are not required to do this job. PIA should ensure that in future in the event of an incident or accident on the airport that adequate numbers of ground handling staff are available to look after the passengers.

18.57. PIA TRAINING CENTRE Since the passengers observations were mainly dealing, with the training of cabin crew the board members, discussed the cabin crew training at length with the Chief Instructor. The centre usually imparts emergency evacuation training to all crew members through films, books and class room instructions. Though the training material is adequate it is not however, based on IATA/ICAO regulations. The professional courses are being conducted periodically and the cabin crew are fully conversant with the procedures. The Board saw the training facilities and found them of reasonable standard except for the following points which need to be looked into:-

- (a) The mock-up in the training centre does not have exit doors for wide bodied aircraft which are required for training of cabin crews. At the present they do so by going on to the actual aircraft which is tedious and time consuming.

(b) the/.....

(b) The slide used for practising evacuation is not of Boeing 747 which is much higher than the existing slide in the training centre. It was brought to the notice of Board that this point is being implemented and the work was in progress.

18.58. PIA CREW TO RECEIVE PASSENGERS AT THE END OF SLIDE

It was reported by the passengers that no PIA crews were available to receive passengers at the end of the slide. It is international practice for the cabin staff manning the doors to brief the first two or three able bodied males to hold the slides at the bottom and assist other passengers. In this particular case almost all slides were manned either by passengers or by the crash fire rescue personnel who arrived at the scene of accident almost immediately.

18.59. MEDICAL RECORD Capt. Salahuddin Chughtai who was Pilot-in-Command is suffering from D.Mellitus controlled by diet only since last 06 years with no complication/effects-off disease as stated by officer though D.Mellitus is known to affect nervous-system in many ways specially affecting the reflexes. Various investigations like blood-sugar level could have revealed human-error factor contributing in causation of above accident/incident if the same was conducted within one to two hours of occurrence. His glycosylated Haemoglobin test done on 29th August, 1988 is abnormal, above the average, which indicates that his diabetic state requires further assessment and evaluation.

18.60.Capt.//.....

- 18.60. Capt. Javaid Ahmed had renal carcinoma which was operated in West Germany in April, 1984 and thereafter no evidence of any spread of cancer in the adjacent organs has been noted as revealed from his medical records. His last investigation reports (except Neurological Examination REPORT) done in July, 1988 do not reveal any metastasis in the adjacent organs. His licence was thus revalidated with no limitations/restrictions by CAA Flight Surgeon in July, 1988. He has never been shown to Neurologist for his evaluation specially in presence of the above disease. He may not be sent to the specialist for neurological evaluation.
- 18.61. Medical record of Capt. Naveed Aziz. reveals obesity only. He was about 35 lbs over weight when he was last examined in July, 1988. He has been warned several times to reduce weight but without any marked improvement. Obesity is a predisposing factor of diabetes and cardiac ailments. He should have been checked for all above tests immediately after the accident. His licence was re-validated in July, 1988 by CAA Flight Surgeon with limitations.
- 18.62. F/E Riaz Ahmed Khamisani had sustained REC full twice within a span of 10 months i.e. between 22-3-86 to 14-1-87. His licence was last re-validated by CAA Flight Surgeon with no limitations.
- 18.63. Miss. Naima Naqvi, who was working at Control Tower at the time of the incident has been checked for visual acuity as per ICAO Medical Standards and her Medical records are uneventful. The medical records of Mr. Adnan-ul-Arabi and of Miss. Serwat Roohi ATCOs also do not reveal any abnormality since their induction in CAA.

18.64. POST/.....

18.64. POST ACCIDENT/INCIDENT MEDICAL CHECK-UPS OF AIRCREW

As per CAA Rules cockpit crew have to be medically examined within 1-2 hours of any accident/incident for essential laboratory tests like blood-sugar, Alcohol, Drug Screening, Carbon-monoxide, and Serum lactic acid tests to ascertain human error factors in the presence of special medical records of cockpit crew in above incident, such laboratory tests could have contributed some clue for such unusual happenings. The above important tests were not conducted by competent staff at Karachi Airport contrary to this office instructions issued to all Airport Managements and which are considered as part of their SOPs.

19. FINDINGS

19.1. From the foregoing investigation and discussion based on the available evidence. The Investigators find:-

19.1.1. The aircraft was correctly refueled and properly loaded with passengers and cargo for the subject flight. The C.G position and landing weight were within limits. ✓

19.1.2. The weather was cloudy with intermittent drizzle. *W. Wind shear* There was wind shear and heavy rain on finals with few CB cells in the vicinity of the airfield. ✓

19.1.3. The aircraft touched down well beyond the recommended distance as given in the operating manual of Boeing 747 for wet runway landing technique. A positive touch down was not made as recommended. ✓

19.1.4. The/.....

- 19.1.4. The aircraft failed to decelerate and stop on the main runway due to approach at high speed, smooth touch down and aquaplaning.
- 19.1.5. There was probably a higher tail wind than that noted by the duty ATCO and passed to the aircraft.
- 19.1.6. The control column was held in an 8°-10° nose up position for 34 seconds after the touch down, indicating that the weight on the nose wheel was low. Thus resulting in failure to make use of maximum braking energy.
- 19.1.7. Maximum thrust reversers, on all four engines upto zero speed, were used causing damage to the engines, and resulted in the sparks/flames observed by the Controller.
- 19.1.8. The ATCO informed Captain correctly of observing sparks/flames from the engines during the landing roll.
- 19.1.9. During the three approaches till the aircraft came to a halt no announcements were made to keep the passengers informed/calm.
- 19.1.10. The Senior Purser took the initiative of announcing that cabin crew and passengers remained seated, when he did not receive any indication from the cockpit.
- 19.1.11. Some of the passengers and cabin crew also reported seeing flames/smoke from behind the engines.

- 19.1.12. The aircraft stopped on the over run area 501 ft beyond the end of main runway.
- 19.1.13. Crash Fire and rescue personnel reacted promptly and reached the scene of accident immediately after the aircraft came to halt. They also helped in evacuation of passengers.
- 19.1.14. The Evacuation system was actuated by the Captain shortly after the aircraft stopped. Cabin crew reacted promptly and operated the necessary exits for evacuation.
- 19.1.15. Evacuation exits L4 and R4 were not opened due to possibility of fire; Exit door slides L3 and R3 malfunctioned. While L3 slide twisted over, the off wing slide of R3 did not deploy.
- 19.1.16. Only six exits were used for evacuation.
- 19.1.17. A few passengers exited from R3 on to the wing surface and from there jumped to the ground, 3 passengers received major injuries during the evacuation. These passengers were not cleared by the Air Hostess. They moved her aside and thinking it to be the correct procedure they jumped from the wing thereby sustaining injuries.
- 19.1.18. Air Hostess Marina Yu was stationed on R3 to ensure safe evacuation of the passengers. She is small and was easily over powered by the panicky passengers.

19.1.19.Minor/.....

- 19.1.19. Minor injuries were sustained by 17 passengers who were given first aid and sent home. Three passengers sustained major injuries.
- 19.1.20. All passengers evacuated using emergency slides, except for a pregnant lady and family member in attendance. They were evacuated by Ambu-lifter which arrived after about 20 mts.
- 19.1.21. Cockpit crew and the cabin crew stayed inside the aircraft.
- 19.1.22. CAA Personnel arrived at the over run area within 5-10 minutes and started their investigation.
- 19.1.23. Detailed damage is indicated at Appendix 'D'.
- 19.1.24. The aircraft was airworthy and properly certificated for flight. The flight crew were properly licenced and held valid licences and ratings to operate B-747 aircraft.
- 19.1.25. The First Officer under training was occupying the right seat while the rated Co-pilot was sitting on the jump seat.
- 19.1.26. PIA Training Centre does not have the slide/chute of Boeing 747 in the training centre.
- 19.1.27. The mock-up in the training centre does not have wide body cabin door for practicing/evacuation of passengers.
- 19.1.28. The syllabus for cabin crew at the training centre is not standardized with ICAO Annex-VI.

19.1.29. Recording/.....

- 19.1.29. Recording on the tape of CVR is not audible/not recorded. This problem can be overcome by the use of boom microphones.
- 19.1.30. The play back of Video recording of the radar picture was not available, and the timer unit of audio recorder was not functioning.
- 19.1.31. The Mu. Meter equipment and rubber deposit removing machine were not fully serviceable.
- 19.1.32. The location of the anemometer is too far from the runway.
- 19.1.33. The automatic weather system (AWS) located near 25R is not in operation.
- 19.1.34. The blood and urine samples of aircrew were not taken for medical tests.
- 19.1.35. Captain Salahuddin Chughtai is suffering from D.Mellitus controlled by diet since last six years.
- 19.1.36. Captain Javaid Ahmed has been operated upon for renal carcinoma (Kidney Cancer) he needs to be investigated by a Neurologist. He holds a licence without any restriction.
- 19.1.37. Capt.Naveed Aziz's medical record reveals a case of obesity, he has been warned several times to reduce weight.
- 19.1.38. Cockpit crew are not being given recurrent training on emergency drills.

20. CAUSE OF THE ACCIDENT

- 20.1. From the foregoing findings, after consideration of all the available evidence, the investigators are of the opinion that the probable causes for failure of the aircraft to stop on the runway, were the wet condition of the runway and the failure of the Pilot-in-Command to ensure that procedures laid down in the B-747 Operations Manual for landing in wet runway conditions, were employed.
- 20.2. Contributing factors were a tail wind and the smooth touch down.
- 20.3. Injuries to passengers occurred during the emergency evacuation when three passengers sustained serious injuries after they forced their way onto the wing through door R3 and jumped from the wing. The slide from the wing to the ground had failed to deploy because of a technical failure. Other slides were available for evacuation, but some passengers because of panic forced their way past the attendant at the door and proceeded to jump down from the wing. The attendant failed to control the passengers.

21. RECOMMENDATIONS

- 21.1. In view of the finding in this investigation and the observations by the investigators, the following recommendations are made:-

21.1.1. Action/....

- 21.1.1. Action under Civil Aviation Rules, 1978 be considered against Captain Salahuddin Chughtai ALTP No.101 for failing to ensure that the correct procedure for landing on wet runway as laid down in the Boeing 747 manual were followed. Rule 140 (4) is applicable.
- 21.1.2. Capt.Salahuddin Chughtai ALTP No.101 should be placed under observation of a medical board for a minimum period of one year to ensure that the ailment, Diabetes Mellitus, from which he is suffering is under control.
- 21.1.3. Captain Javaid Ahmed's licence ALTP No.517 should be endorsed with medical restrictions till the investigations by the Neurologist is completed.
- 21.1.4. PIA Training and recurrent training programme be reviewed to ensure that adequate flying and technical knowledge with specific stress on emergency procedures is imparted to the flight and cabin crew.
- 21.1.5. PIA Management to take proper steps to ensure adherence to standard operating procedures and flying technique of aircrew is maintained at all times.
- 21.1.6. Only rated/Co-pilots to occupy right hand seat during abnormal flight conditions.
- 21.1.7. PIA to Review the cabin crew training programme to ensure prompt and safe action for evacuating and handling the passengers in an emergency.

21.1.8.PIA/...

- 21.1.8. PIA should consider installation of Boeing 747 chute/slide and evacuation door for different types of aircraft on their mock-up in PIA Training Centre.
- 21.1.9. PIA should standarize their syllabus for cabin crew training as per ICAO Annex-VI and have it approved by DG CAA.
- 21.1.10. PIA to ensure adequate procedures for checking and maintaining CVR equipment.
- 21.1.11. CAA requires that head sets with boom microphones be used when head sets are used in accordance with PIA S.O.Ps.
- 21.1.12. CAA to maintain a strict surveillance on the PIA Training and recurrent training programmes to ensure they are adequate.
- 21.1.13. CAA should review the procedures for ensuring serviceability of the Video-recording of the radar scope.
- 21.1.14. CAA should review in consultation with Met. Department, the location of the Anemometer at the Airport and the Automatic weather station should be made operational as soon as possible.

21.1.15. CAA/....

- 21.1.15. CAA should serviceability of the Mu Meters and rubber deposit cleaning machine.
- 21.1.16. CAA should review the procedure for collecting of samples of blood and urine of cockpit crew for Medical analysis.

REMARKS BY DG CAA

- 1. I agree with the findings and recommendations.
- 2. M/s PIAC and concerned Directorates at HQ CAA are to take necessary action on the recommendations.

13 Dec '88