Volume I

CAA

سول ایوی ایشن اتھارٹی

HQCAA/1901/128/AIB

CIVIL AVIATION AUTHORITY

AIRCRAFT ACCIDENT INVESTIGATION

A-300 AP-BAZ

WHICH OCCURRED ON
18TH MARCH 1991

AT

ISLAMABAD AIRPORT

CIVIL AVIATION AUTHORITY
KARACHI, PAKISTAN
AIRCRAFT ACCIDENT INVESTIGATION

LANDING ACCIDENT TO PAKISTAN INTERNATIONAL AIRLINES A-300 AIRCRAFT AP-BAZ OPERATING SCHEDULED DOMESTIC PASSENGER FLIGHT PK-300 KARACHI TO ISLAMABAD ON 18TH MARCH 1991 AT 0900 HRS. PST.

Authority:- Director General Civil Aviation Authority Memorandum No. HQ CAA/1901/128/AIB dated 18th March 1991. (Appendix 'A')

COMPOSITION OF INVESTIGATION TEAM

(a)	Air Cdre (R) Abdul Basit Chief Inspector & President A.I.B., CAA	Investigator Incharge
(b)	Mr. Ghulam Murtaza, Controller of Airworthiness Civil Aviation Authority	Investigator
(c)	Mr. Mohammad Ali Siddiqui, Ops. Investigator, AIB, CAA	Investigator
(d)	Capt. Amjad H. Faizi, Chief Pilot Corporate Safety PIAC	Co-opted Member

SYNOPSIS

Aircraft A-300 AP-BAZ was on a schedule domestic flight PK-300 from Karachi to Islamabad. The departure from Karachi was on time. The weather enroute was fair and the flight was uneventful. Islamabad weather was cloudy with traces of cumulonimbus clouds with light drizzle. After clearance from Cherat, the aircraft started to descend. Light turbulence was felt during descent.

The aircraft was radar vectored by Chaklala radar on to ILS of R/W 30. First Officer Sadaqat Kazmi operated the controls while Captain Junaidi handled the radio transmission. The First Officer was on under supervision as Co-Pilot on route training and was required to complete his 6th landing for final clearance and endorsement of type rating on his licence.

First Officer made an ILS approach and landing. The touch down was slightly beyond 4000 ft down the runway. After extended flare and smooth touch down, brakes were applied alongwith partial reverse thrust but the aircraft did not seem to decelerate so the Captain took over the controls. He pumped the brakes several times but felt no response.

Almost reaching the dumbell of R/W 12 and seeing that the aircraft was not decelerating, he selected the anti skid system off. He then turned the aircraft to the right with the help of nose wheel with an intent to skid and stop on the over run. This is not considered to be a recommended procedure.

The aircraft drifted to the right, skidded and jumped over two cemented platforms constructed about 1-1/2 feet high on the edge of runway to provide support to the aircraft arresting

barrier net. The right engine(No.2) came in contact with the F-16 arrester barrier, installed further down, on the shoulder of the over run. The underside of the engine was shorn off and caught fire. The cockpit crew fired the discharge agent which put out the fire and the warning light but smoke persisted due to lubricant etc contacting the hot engine surface. Once the aircraft stopped, the Captain ordered emergency evacuation of the passengers. None of the passengers was injured during this process, however some cabin crew received minor injuries.

One door L-4 on left side could not be opened due to malfunction, also the L-1 slide failed to operate automatically. The right side door R-4 was operated which should not have been because No.2 engine was on fire. The technique for use of slide varied amongst the cabin crew, they complained that the passengers insisted on carrying their heavy baggage which is contrary to the laid down ICAO instructions.

After the evacuation, the passengers were sent to the lounges on PIA transports, there was no loss of baggage. The crash fire facilities reached the scene of the accident immediately. They helped in controlling the fire on No.2 Engine. The aircraft was allowed to be removed from the runway by the investigation team. The runway was declared fit for normal operations after the PIA personnel towed away the damaged aircraft.

1. **AIRCRAFT INFORMATION**

1.1. Registration Marking	AP-BAZ
1.2. Aircraft type and maker's Sl. Nos.	A-300 S/No. 99
1.3. Engine types, airframe positions and maker's serial no.	CF6.50/C2 Engines # 1 S/N 455-358 # 2 S/NO. 455-970
1.4. Certificate of registration No. and validity.	No. 549
1.5. Certificate of Airworthiness No. and date of expiry, and Flight Manual No.	502 valid upto 26.3.91
1.6. Certificate of safety date and time (GMT) of issue and period of validity	C of M issued on 3.11.90 0200 hrs GMT; validity 1500 hrs.
1.7. Date of construction of airframe.	1980
1.8. Name and address of owner	PIAC, Karachi Airport.
1.9. Gross Weights. Maximum permitted by C. of A. for this flight, at the time of accident.	165,000 Kg

1.10. Loading. Centre of gravity limits in C. of A. and centre of gravity position at the time of accident and commencement of flight.	:	Within limit
1.11. Airframe history. (Give flying time since manufacture, last overhaul and last periodic check. List also essential modifications completed).	:	TSN 29062-12 TSO Same Time since last check 'C' 758.00
1.12. Engine histroy. (Give flying time since manufacture, last overhaul and last periodic check. List also essential modifications completed).	:	# 1 S/N 455-358 # 2 455-970 TSN 32170-15 TSN 25243-59

2. CREW INFORMATION

2.1. Pilot-in-Command

2.1.1. NAME	:	NASIR PERVEZ JUNAIDI
2.1.2. Position in the Cockpit	:	Captain
2.1.3. Date of birth	:	1.11.1943
2.1.4. Type of Lic. and No.	:	ALTP No. 347
2.1.5. Medical date with status	:	26.9.90 - Fit for renewal (subject to use of corrective glasses) ALTP. Advised to reduce weight.

2.1.6. RATING:-

2.1.6.1.	Type(s) held	:	B-707/720B, B-747 in (P-2) F-27, C-150, B-707/720B and A-300 in (P-1)
2.1.6.2.	Type current	:	Air Bus A-300.
2.1.6.3.	Assist/Flight I.R.	:	Simulator Instructor on A-300 Aircraft.
2.1.6.4.	Flight Engineer: I.R.		N/A
2.1.6.5.	Check Rating	:	Simulator Instructor on A-300 Aircraft. Designated CAA Inspector.

2.1.7. Flying Experience

2.1.7.1.	Grand Total	:	12089.26
2.1.7.2.	Total-in-Command A-300	:	3278.00
2.1.7.3.	Total-in-Command on the type accident/incident occurred	:	5109.00

2.1.8. Where trained : Flying Club/PIAC

2.2. CO-PILOT (UNDER CHECK)

2.2.1.	NAME	: SADAQAT ALI KAZMI
2.2.2.	Position in the Cockpit	: Co-Pilot
2.2.3.	Date of Birth	: 11.4.1941

2.2.4. Type of Licence and No. : CPL No. 1391

2.2.5. Medical date with status : 11.8.90 (Fit for renewal of CPL, Advised to reduced weight)

2.2.6. **RATING:-**

2.2.6.1.	Type(s) held	: C-15, DHC-6, F-27, Boeing 737.
2.2.6.2.	Type current	: Boeing 737 (under supervison on A-300)
2.2.6.3.	Assistant/Flight Instructor Rating	: N/A
2.2.6.4.	Flight Engineer Instructor Rating	: N/A
2.2.6.5.	Check rating	: N/A

2.2.7. **FLYING EXPERIENCE**

2.2.7.1.	Grand total	: 6943
2.2.7.2.	Total in command	: 4000 Hrs
2.2.7.3.	Total-in-Command Co-Pilot/A-300 incident/accident occurred.	: 20 Hrs on A-300 (UIS)

2.2.8. Where trained : PAF/PIAC

2.3. **CO-PILOT**

2.3.1. NAME : JAVED IQBAL

2.3.2. Position in the Cockpit : Jump seat

2.3.3. Date of Birth : 01.03.1952

2.3.4. Type of Licence and No. : CPL No. 1021

2.3.5. Medical date with status : 23.12.90 (Fit for renewal of CPL).

2.3.6. **RATING:**

2.3.6.1. Type(s) held : C-1501152, F-27, b-737 and A-300.

2.3.6.2. Type current :

2.3.6.3. Assist/Flight Instr. Rating : N/A

2.3.6.4. Flight Engineer Instructor Rating : N/A

2.3.6.5. Check Rating : N/A

2.3.7.**FLYING EXPERIENCE:**

2.3.7.1. Grand total : 4454

2.3.7.2. Total in command : 240 Hrs.

2.3.7.3. Total in command/ Co-Pilot on the type accident/incident occurred : 569 Hrs

2.3.8. Where trained : Flying Club

2.4.**FLIGHT ENGINEER**

2.4.1. NAME : WAJID ALI

2.4.2. Position in theCockpit : Flight Engineer

2.4.3. Date of Birth : 25.12.52

2.4.4. Type of Licence and No. : F/ELic.No. 188

2.4.5. Medical date with status : 29.3.90

2.4.6. **RATING:**

2.4.6.1.	Type(s) held	: B-707/720-B
2.4.6.2.	Type current	: A-300
2.4.6.3.	Assist/Flight Instructor Rating	: N/A
2.4.6.4.	Flight Engineer I.R	: N/A
2.4.6.5.	Check Rating	: N/A

2.4.7. **FLYING EXPERIENCE:**

2.4.7.1.	Grand total	: 6046.00
2.4.7.2.	Flight Engineer on the type accident/incident occurred.	: A-300-590.00

2.4.8 Where trained : PIA

3. **INJURY TO PERSON(S)**

3.1 No injury was caused to any person on board the aircraft or outside as a result of the accident.

4. **DAMAGE TO THE AIRCRAFT**

4.1 The aircraft was extensively damaged due to impact with the F-16 arrestor barrier at the end of the runway. No. 2 engine was damaged beyond repair, thrust reversor's fan and core cowls were completely written off. No. 2 Engine Pylon developed a bend creased on outboard side of primary structure box panel indicative of

deformation of primary structure. Right Hand Main Landing Gear's two tyres burst and two wheels crown tread scrapped, brakes assys, all hyd lines & electrical wiring and truck lower shield was damaged, its pitch damper cylinder body had bursted. Left Hand Main Landing Gear all four tyres were bursted.

4.2 During the final portion of the landing roll various parts from No. 2 engine and landing gears flew and caused dents and punctures to the fuselage and FOD to No. 1 Engine.

5. OTHER DAMAGES

5.1 F-16 arrester barrier belonging to PAF was destroyed beyond repair and had to be replaced.

5.2 Three runway lights were broken.

6. METEOROLOGICAL CONDITIONS

6.1 It was raining when the aircrat landed.

6.2 Met report at Appendix H-1 to H-2.

7. NAVIGATION AND LANDING AIDS (VISUAL/NON VISUAL)

7.1 Aircraft Navigation and Landing Aids were available and serviceable at the time of accident. These were not a factor in the accident. The landing aids were tested by CAA Calibration aircraft.

7.2 Callibration report of the Radio Aids it at (Appendix P-1 to P-3).

8. COMMUNICATION (INCLUDING RADIO COMMUNICATION)

8.1 All communications were available and serviceable at the time of incident.

8.2 These were not a contributory factor in the accident.

9. AERODROME AND GROUND FACILITIES

9.1 All Aerodrome and ground facilities were available. Crash fire tenders and rescue facilities immediately rushed to the scene of accident and helped extinguish the fire on No.2 engine.

9.2 The Captain ordered emergency evaucation from left side, however R-4 door was operated by cabin crew, in haste. The rescuers helped the passengers in evacuation through slide chutes. No passenger was injured during this operation.

10. FLIGHT RECORDERS

10.1 Digital Flight Data Recoders, PMR and the Cockpit Voice Recorder were removed from the aircraft. They were later on taken to France for analysis by President Accident Investigation Board.

10.2 Certain discrete binary parameters were not recorded. A letter to PIAC in this regard was sent for one time check of all aircraft equipped with DFDRs. PIAC carried

this check and submitted a report which is placed at Appendix 'W'.

10.3 **Five days prior to the accident,** on 13.3.91, malfunction in recording of a discrete parameter was detected by DFDR rest-out section but the same was not reported to the Quality Control Section till the occurrence of accident on 18.3.91. As result the aircraft kept on flying for 5 days without rectification of this defect. Keeping in view significance of DFDR, the system must be made serviceable promptly and PIA needs definite improvement in their system for reporting and rectification of such defects.

10.4 As mentioned in previous accident reports, the recording on Cockpit Voice Recorder was unsatisfactory. One of the reason which could be attributed is due to the fact that PIA Pilots have stoped using Boom Microphones. A study was made by the investigation team and it was found that over a period the head set with mircophones have lost importance with PIAC. Both CAA UK and FAA USA have a mandatory requirement for the use of **Boom Microphones** by the Pilots below 18,000 ft. The input from area microphones is attenuated due to engine and other noises while operating controls of flaps gears etc. It is not possible to have audible recording of conversation which transpires between the crews e.g. the check list read out, height call outs etc. This vital information was not avaliable to the investigation team.

11. WRECKAGE AND IMPACT INFORMATION

11.1 The aircraft was found on the over-run of runway 30 facing left at angle of 45 degree to the centre line. No.2 engine was found extensively damaged and there were indications of fire and agent discharged to extinguish the fire.

11.2 Six wheels of main landing gears were found burst due to harsh braking. Indications of aqua planning were also found on the tyres as well as on the runway.

12. FIRE

12.1 After impact with the F-16 arrester barrier, No.2 engine caught fire. Captain carried out the fire drill and extinguishing agent was discharged. Fire was also extinguished by the fire fighters from outside over the smoldering engine.

12.2 Due to fire, an emergency evacuation was ordered by the Captain. All passengers evacuated the aircraft through escape chutes. One door L-4 on the left side could not be opened due to malfunction. Also L-1 slide did not operate automatically. The right side door R-4 was operated which should not have been done as No.2 engine was on fire.

13. SURVIVAL ASPECTS

13.1 It was a survivable incident. No fatal injury was caused to any person on board or outside the aircraft.

14. TEST AND RESEARCH

Nil

15. OBSERVATION

N/A

16. INVESTIGATION

16.1 The Chief Inspector and President A.I.B. was informed by Chief Pilot Safety, PIA of this accident on telephone. Necessary actions were taken and APM Islamabad was asked to take blood and urine samples of the cockpit crew for analysis.

16.1.1 The accident did not involve injury to any passenger, as such the DG CAA immediately ordered an inquiry into the accident. An investigation team was constituted. (Memorandum at Appendix 'A'). Investigation team left the same day i.e. 18th March 1991, for Islamabad. Since Islamabad runway was closed for large aircraft, the team reached Lahore with an intention to take a Fokker Flight to Islamabad.

16.1.2 Due to bad weather and heavy rain, the investigation team reached Islamabad 2330 hours. They visited the scene of the accident and carried out preliminary inquires, alongwith the recovery team of PIA which was stationed at Karachi.

16.1.4 The aircraft was standing on the over-run of Runway 30 745 feet beyond the edge of runway at an angle of 45 to 50 degrees to the runway heading facing south east direction. No. 2 Engine which had contacted the F-16 arrester barrier operating machine, was found badly damaged with hydraulic and lubricants dripping from bottom of the engine. Fan cowling and reversers cowling of No. 2 Engine were found broken and number of fan blades had broken which hit the aircraft fuselage and wings. Wrinkles were noticed on No. 2 engine pylon and right hand inboard flap indicating damage to primary stucture.

16.1.4 Debris were injested by No. 1 engine causing damage to its fan blades and intake.

16.1.5 All four wheels on left hand landing gear had burst and forward two wheels of right hand landing gear were also found burst. The different agencies, namely CAA, PIAC and the PAF had photographed the crash site and the aircraft.

16.1.6 Aircraft Technical Log, Certificate of Maintenance, Certificate of Airworthiness and other important documents were taken in possession for scrutiny by the Airworthiness office in Islamabad.

16.1.7 Digital Flight Data Recorder, PMR and Cockpit Voice Recorder were also removed and taken into custody for analysis at the Airbus Industry and the aircraft was cleared by the investigation team for removal from the scene of accident.

16.1.8 The investigation team while in Islamabad inspected the runway site took photographs of the relevant marks on the runway, carried out preliminary survey of the aircraft, checked relevant systems, recorded preliminary statements of the 4 cockpit members and 16 cabin crew. Eye witnesses statements were also recorded and various personnel working at the airport were interviewed for information. The training and medical records of cockpit crew have been obtained for the investigation.

17. DISCUSSION OF EVIDENCE

17.1 The Digital Flight Data Recorder (DFDR) and Cockpit Voice Recorder (CVR) were sent to Airbus Industry France for analysis.

17.2 The report received from the Airbus Industry is reproduced below. Copy at (Appendix 'T')

17.3 FACTUAL INFORMATION ON THE ACCIDENT.

Location	:	ISLAMABAD
Date	:	14th April 1991.
Local Time	:	8:50
Flight Number	:	PK 300
Sector	:	Karachi/Islamabad
Type of A/C/MSN	:	A-300 B4-203 MSN 099
Total Flight hours	:	29,063
Total take-offs(Landings)	:	15,409
Registration	:	AP-BAZ
Airport informations	:	Field elevation: 1665 ft
	:	QNH: 1017 hpa
	:	SAT: 14 C
	:	Runway in use 30 Runway lenyth: 2743 m
	:	Wind 050 /05 kt
	:	Rain

17.4 DESCRIPTION OF THE ACCIDENT.

17.4.1 A detailed description of the accident and of the damages to the A/C is given in the document AI/ST12/943.1292/91 established by Mr. G. CASSAGNE the Airbus Industrie structure specialist who was sent on the site. A copy of this document is given in the annexure.

17.4.2 Some complementary information were obtained on 22/04/91 through Mr. C. DICHTEL, the Airbus Industrie field representative in KARACHI.

17.5 HISTORY OF THE INVESTIGATION.

17.5.1 The investigation is conducted by the Investigation board of the Civil Aviation Authority of Pakistan.

17.5.2 The CVR tape was copied in the laboratory of the french Bureau d'Enquetes-Accidents in Paris and the DFDR was processed in the centre d'Essais en Vol in Bretigny, France, on April 2 and 3.

17.5.3 A meeting took place on April 4, in the BEA premises. The participants to this meeting were:

Mr. Abdul Basit	Air Commodore (Retired) Chief Inspector and President Accident Investigation Board Civil Aviation Authority of PAKISTAN.
Mrs. Anne E. COURBIERE	Accident Investigator Bureau d'Enquetes-Accidents IGACEM Paris
Mr. Yves BENOIST	Director Flight Safety Airbus Industrie

17.5.4 During this meeting, Mr. BASIT asked for explanations and clarifications on the logics

and on the functionning of some of the A-300 systems. Answers were given to his satisfaction.

17.5.5 A review of the DFDR data was also made and the main frame of the most probable scenario was discussed and established.

17.5.6 The purpose of this note is to give the results of the DFDR data analysis and the most probable scenario as established by Airbus Industrie. The scenario is in line with what was established during the meeting in PARIS.

17.6 GROUND SPOILERS DEFLECTION INDICATIONS ON DFDR.

17.6.1 On the first listing, the roll spoilers deflection indications in flight are giving 1 on LH side and 2.4 on RH side. Both figures become 0 on ground, when a figure of 50 which corresponds to the ground spoiler function nominal deflection would be expected.

17.6.2 The binary data recorded on the tape are indicating that the surfaces deployed normally and that there is a shift of the position transmitters. After a correction applied on the conversion figures, a new listing was printed on 15/04/91 on which the ground spoilers deflections are normal.

17.7 DFDR ANALYSIS

17.7.1 **FINAL APPROACH.** The average IAS during the final approach down to 300 ft radio altitude is 143 kt and well maintained. This represents VREF + 6 kt (estimated A/C landing weight is 135.6 tons; this gives a VREF = 137 kt).

17.7.2 The A/C was flown approximately one dot below the glide slope down to an altitude of approximately 700 ft, (generated time 6036). The A/C was then flown back to the glide slope and then over (one dot at approx 150 ft).

17.7.3 At time 6065, the IAS started to increase to reach a maximum of 159 kt. This indicated speed increment is due to a combination of an increased flight path angle to recover the glide slope and, most probably, to a wind change. The power was reduced progressively down to flight idle which allowed the speed to slowly decay down to 133 kt at the touch down.

17.7.4 The A/C passed 50 ft radio altitude at time 6080 with a speed of approximately 152 kt (VREF + 15 kt). The glide slope deviation was very important (240 micro amps) which means that the A/C when passing 50 ft was already largely above the runway at VREF + 15 kt.

17.7.5 We can estimate that the A/C passed over the runway threshold at time 6077. She was acutally at slightly more than 100 ft radio altitude and at IAS = 153 kt (VREF + 16). This was followed by a long flare, which lasted approximately 15 sec. The distance flown from the runway threshould to the wheels touch down point can be estimated as 1350 m/3670 ft (figures valid for no wind component along runway axis).

17.7.6 These figures were obtained by the reconstruction of the A/C trajectory using the Glide slope deviation and the altitude, supposing that the GS beam is normal. We must have in mind that the results obtained with this method can never be very accurate.

17.8 **GROUND PHASE**

17.8.1 **USE OF THE THRUST REVERSERS.** The touch down occurred at time 6095 at IAS = 133 kt. The DFDR shows that the ground spoilers were fully deployed at time 6098. The nose wheels were on ground at time 6099 (pitch attitude = 0 degree)

17.8.2 The DFDR recording of the reversers "unlocked" and "deployed" indications being inoperative, we used the throttle positions being operative, to determine when the thrust reversers were activated.

17.8.3 This was just initiated at time 6097 (-2 on RH TLA) and an intermediate reversed thrust was progressively applied. The N1 reached 81% on engine 1 and due to the non symetrical throttle riggings, only 65% on the engine 2.

17.8.4 The throttles were slightly reduced at time 6112, decreasing the requested reversed thrust.

17.8.5 Only at time 6120, IAS = 58kt, probably when he realised that the runway end was approaching fast, the pilot decided to apply the full reverse (-69 seen on TLA 1 at time 6124, when the engine # 2 impacted the obstacle). This was at a distance shorter than 100 m from the runway end.

17.9 **AUTOBRAKE**

17.9.1 The touch down occurred at time 6095 the pitch attitude being then reduced to zero/-1. This is visible on the longitudinal accelerometer which value progressively reaches + 0.08 g.

17.9.2 To obtain the true A/C deceleration rate, a correction must be applied on the indicated Jx as obtained from the DFDR. We must also keep in mind that a positive indication means that the A/C decelerates. At time 6142 and

on, pitch attit. indicated: O Jx=+.02 At time 6215 and on, pitch attit. indicated: -J.4 Jx =+.04.

17.9.3 During the landing roll, the pitch attitude varies between -.9 and -1.4 . So, it is reasonable to substract 0.03 or 0.04g from the recorded decelerations to obtain the actual A/C deceleration.

17.9.4 At time 6100, approximately 5 sec after touch down, the deceleration reaches and is stabilised at a mean value of 0.17 - 0.03 = 0.14 g. This figure is very close to the autobrake MIN Mode nominal deceleration rate: 1.22 m/s2 obtained with a delay of 5 sec after the wheels touch down. So, most probably, the MIN mode of the autobrake was armed prior to land and operated normally.

17.9.5 At time 6106 there is a step in the deceleration rate. It reaches a mean value of -2.3 m/s 2 (after the application of the correction as seen above). Most certainly, this is the result of a pilot brake input on the pedals which consequently disconnected the autobrake. This is in line (according to Mr. Basit) with the F/E deposition who noticed the autobrake amber flashing light during the landing roll.

17.9.6 Between time 6110 to 6112, the deceleration rate decreases again and it will remain close to an average value of -1.4 m/s 2 (after the application of the correction as seen before).

17.9.7 The decrease of the deceleration rate occurs at the same time than a small pilot rudder input to the right.

17.10 DECELERATION RATE DURING THE END OF THE LANDING ROLL

17.10.1 The deceleration rate from time 6112 to the impact of the engine 2 on the stop machine at time 6124 remains approximately constant.

17.10.2 At time 6116, the N1 are 80% and 64% respectively for LH and RH engine. At the acutual speed of 78 kt, the deceleration rate is assessed at . 52 m/s 2 or. 053 g.

17.10.3 Same computation made at time 6122, with N1 90% on both engines and at a speed estimated at 60 kt gives a deceleration rate of .47 m/s 2 or .048 g.

17.10.4 From the above we may conclude that the deceleration obtained from the braking action remains rather constant & at a low value of approx. .8 m/s 2 or.08 g.

17.10.5 This phenomenum which seems to have appeared between times 6110 and 6112 can be explained by either:

17.10.5.1 A reduction of the pilot brake application to a very low value, and the pilot not having realised that the autobrake was disconnected.

17.10.5.2 The selection of the antiskid system to OFF. If, in this configuration and on a wet runway, the pilot brake input is important, this may lead to a blockage of all the wheels, leading to a very poor brake efficiency and subsequent tyres burst.

17.10.5.3 A intermitent phenomenum of aqua-planning caused by water accumulation on the runway due to the reported recent heavy rainfalls. This may also lead to very low braking action.

17.10.5.4 More probably, a combination of all the above three possibilities.

17.11 AIRBUS INDUSTRY DISCUSSION/CONCLUSION

17.11.1 The following conclusions are drawn with the few information available to us. We have in

hand only the listing obtained from the DFDR and the verbal informations given by Mr. BASIT during the meeting in Paris. In particular, we have not listened to the CVR.

17.11.1.1 The A/C flew over the runway threshold at more than 100 ft high and at VREF + 16 kt.

17.11.1.2 The flare was long and the touch down location is estimated at 1350 meters beyond the runway threshold. This is very close to the runway mid-length.

17.11.1.3 The selected mode on the auto-brake system was MIN mode. There is no evidence of any auto-brake system malfunction.

17.11.1.4 The reversed thrust application was initiated just after touch down but set to an intermediate value down to a point very close to the runway end, where the maximum reversed thrust was applied. The engine N1 remained always consistent with the throttle position. There is no evidence of any engine or reversers malfunction.

17.11.1.5 There was a pilot brake application about 10 sec. after touch down which induced the auto-brake system disconnection.

17.11.1.6 Along the final part of the landing roll, the braking action became and remained low. This may be explained by a combination of a damped runway and the deliberate selection of the antiskid system to OFF. There is no evidence of any brake system malfunction.

17.11.1.7 **It is the Airbus Industrie opinion that, in such final approach conditions, the pilot should have initiated to go around.**

17.12 **EXTENDED FLARE**

17.12.1 Extended Flare on Landing from the eye witness (Air Traffic Controller App V-23) and the DFDR Analysis (App T) the touch down was around 4000' to 5000'. PIA SOP for wet runway technique states that the Pilot must aim to touch down at 1000' feet. However if for some reason, the touch down is not possible at 1000' and the Captain should go around and another approach be made. Another important requirement for wet runway landing is a firm and positive touch down. The state-

ment of the passenger Captain Asad Zahoor (App V-25) indicates that the touch down was very smooth which is contrary to the laid down technique in the Flight Crew Operators Manual.

17.12.2 A well planned and properly executed approach flare and touch down gives maximum runway length for stopping the aircraft understanding the capabilities and limitations of the stopping systems and the tyre/ground interface provides basis for landing distance. Errors or deviations that accumulate in the approach or touch down may be difficult to correct in the subsequent roll out.

17.13. **ROLL OUT:** The stopping forces available are aerodynamic drag (spoilers and flaps) reverse thrust and wheel brakes. The total force that can be generated is the sum of these three components and depends upon the aircrafts speed, the prevailing runway conditions, pilot technique. Aerodynamic drag and reverse thrust forces are most effective at high speeds. The brake force varies inversely with speed and depends upon the runway conditions, the load on the tyres (weight minus lift) and pilot technique.

17.13.1 On wet runways the total stopping force available is less than on dry runways due to the reduced braking effectiveness. The reversers and the spoilers become more important since they now present a large proportion of the

total force capability. Wet runway braking capability is smallest at high speeds and decreases as the speed decreases, with spoilers furnishing 80 percent of the high speed stopping force, where as the brakes furnish 70 percent of the low speed stopping force. Overall, the total wet runway stopping capability is 60% to 80% of the dry runway capability.

17.13.2 Approaching with excess speeds, touching down far beyond the target zone, wether caused by excessive threshold height or an extended flare, and failing to use either of the spoilers brakes and reversers effectively are particularly costly on wet and slippery runways. This over run incident was probably the cause of extended flare, late touch down high speed and injudicous use of brakes and not utilized reversers to the maximum allowable limits.

17.13.3 From the DFDR analysis report, it is evident that the pilot although selected reverse thrust immediately after the touch down but set the throttles to an intermediate position This did not give the desired rate of deceleration. Keeping in view that the brakes were selected in Auto medium mode and with modification based on Airbus Industry SB No. A-300-32-244 on the deley relay the brakes are activated 10 seconds after the spoilers have

been deployed, the initial deceleration is obtained from the reverse thrust. Partial deployment of the reverse thrust during the landing roll aggravated the emergency to the extent where it got beyond the control of the crew to stop the aircraft even when the brakes were applied with the help of rudder pedals. This brake application came on 10 seconds after touch down which is near about the time the Auto Brakes would have become effective. By applying pressure on brake pedals, the pilot can over-ride the Auto selection, however this application also came on very late. This explanation can be plausible that since first officer was making the landing and as he was not qualified/rated on this type of aircraft, it never registered in his mind the seriousness of landing long and that the Auto Brakes would come on with a delay of 10 seconds. Had he understood this, the application of brakes with rudder pedals would have been initiated soon after the touch down and not with a delay of 10 seconds. Close to the end of the runway the Captain took over controls and placing the Anti Skid switch 'off', disengaged the Auto Brake mode. Also simultaneously full reverse thrust were applied but both actions on the part of the crew were critically delayed. There is no evidence of any engine or reversess malfunction.

17.13.4 Along the final part of the landing roll, the braking action became and remained low. This may be explained by a combination of a damped runway and the deliberate selection of the anti skid system off. There is no evidence of any brake or anti skid malfuction.

17.14 **TOUCH DOWN:** The touch down was very smooth (Witnesses statement App V-25). This is contrary to the company's procedures on any type of conditions of the runway. A positive touch down removes thin film of water and ensures positive contact between the tyres and the runway surface.

17.14.1 The landing flare should be performed so that the touch down is not un-necessarily delayed and does not jeopardize directional control capability by failing to provide wheel spin-up to establish runway tracking forces.

17.14.2 Lowering the nose as soon as the main wheels touch down helps the aircraft on the ground by placing load on the tyre. This helps to spin up the wheels and establish runway tracking capability. This is extremely important in aircraft equipped with anti-skid. Unless the spin up of wheels takes place, and a reference speed signal is produced, the anti-skid will not function and prevent wheel locking consequently protecting the tyres from blowing out.

17.14.3 The six tyres blow out was the result of the same phenomenon. The anti-skid did not come into play because of the smooth touch down consequently spin up the wheels did not take place and finally harsh braking caused the locking of the wheels which resulted in tyres blowing out.

17.15 **AUTO BRAKES AND ANTISKID:** The brakes are the primary means for stopping the aircraft and are applied separately on each side of the aircraft by pressing the respective brake pedal. The pedal force applied results in appication of hydraulic pressure to brakes.

17.15.1 AN AUTOBRAKE system is provided and by selecting the appropriate deceleration rate, it allows to increase the life of the brakes. It also reduces the braking application delay in the event of an acceleration stop and improves passenger comfort.

17.15.2 Before landing the pilot selects a deceleration rate on the AUTOBRAKE panel, according to available runway, and braking is energized by the electrical command for ground spoilers extension. (before take off the pilot selects the MAX rate).

17.15.3 The system is disarmed if Pilot (CM-1) or co-pilot (CM 2) exerts a force of about 15 daN (34 lbs) on one rudder pedal or about 10 daN (22 lbs) on both pedals.

17.15.4 Automatic braking is deactivated but remains armed when the ground spoilers are retracted (GO AROUND). When the autobrake is not used, braking control is ensured normally through the Pilot or Co-Pilot rudder pedals.

17.15.5 Anti Skid system minimizes tyre skidding and prevent wheel lock ups during braking. This system prevents tyre blow out, and optimize braking effectiveness under all runway conditions.

17.15.6 In the anti-skid system, the actual speed of the wheel is measured by a transducer in the axle and is compared to a, "reference" wheel speed. If the actual wheel speed drops below the reference then a "Skid System releases the brake pressure to allow the tyre/ground friction to increase the wheel speed. When the anti-skid system defects that the skid has been corrected, it allows re-application of the brake pressure.

17.15.7 An essential element in the skid control circuit is the reference wheel speed signal. Without this signal, skidding or locked wheels cannot be detected. The comparison signal is generated by the wheel itself spinning up after touch down. On dry runways this occurs almost instantaneously. However wheel spin up is slower on wet and slippery run-

ways. If brake pressure is applied prior to wheel spin up, locked wheels can result.

17.15.8 Airplane tests on very slippery wet and flooded runways indicate that prompt wheel spin up does occur once sufficient load has been placed on the tyres. These tests show that, even on flooded runways, sufficient wheel spin up to establish an anti-skid comparison signal for skid detection can be expected to occur by the time the spoilers are raised and the nose is lowered. Most anti-skid systems also employ TOUCH DOWN PROTECTION AND WHEEL PROTECTION.

17.15.9 The Pilot landed long and the touch down was extremely smooth. By landing long a feeling of urgency sets into the Pilot to stop the airplane as quickly as possible as he knows that there is very little runway left. He then immediately, before spin up of the wheel, steps hard on the brake pedals, never giving a chance for the anti-skid to come into play thereby locking the wheels and subsequently blowing out of the tyres.

17.15.10 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.

17.15.11 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 are being used at Karachi, Lahore and Islamabad to check the runway braking condition for wet and dry runway surface conditions. This equipment was found to be unserviceable on 17th March 1991, while checking the braking action the meter became unserviceable due to worn out tyre: This however was rectified on 18th March 1991, by replacing the tyre and fresh readings obtained which are placed at (Appendix N-1 to N-2).

17.15.12 **The Mu Meter assesses the following:-**

- Friction of Dry runway surface.
- Friction of wet runway surface.
- Slipping tendency of runway during rain.
- To determine the effect on friction taken there.
- To obtain friction effect and braking action on ice-snow covered runway.

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

- Special tests before giving surface treatment to runway.

17.15.13 The following relationship between co-efficient of friction and braking efficiency are used for passing to air-craft.

MEASURED CO-EFFICIENT ESTIMATED BRAKING

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

17.16 TRAINING OF COCKPIT CREW

17.16.1 For some period there was no induction of pilots, to meet the shortage in PIA. The traditional source i.e. military services continues to dry up. There will be continuing shortage of experienced pilots as aviation industry expands. Abinitio pilots have low time and are inexperienced are now being trained for airline seats. This is a special challenge to training department of PIA. The large scale induction of cadet pilots has depleted the pilots training centres. There

should be a planned growth according to the capacity which PIA can handle.

17.16.2 In order for training program to produce the best possible personnel, the right people must be selected. The selection criteria for pilots, maintenance etc have focused primarily on technical aptitude. We must understand that training on techincal skills dimensions will not guarantee that crew can function with high degree of reliability and efficiency. Personality characteristics have significant influence of team performance in the modern multiple seat automated aircraft. The human error incidents and accidents cannot be solved purely by technological solutions. We must concentrate on selection, training and adopting new technologies to improve crew coordination, judgement and decision making.

17.17 **DISCONTINUATION OF FLIGHT TRAINING:**

17.17.1 Flight evaluation for the purpose of certification should be considered as fine tuning after satisfactory training of pilots on simulator. The number of incidents/accidents indicate the need to review the revivial of flying training for the purpose of safety if the present trend continues.

17.17.2 The instructor failed to exercise his option to execute a go around when the aircraft remained in extended flare and touched down far beyond the touch down zone. Enough emphasis it seems is not being laid on making a positive touch down at all times and more so when the runway condition is wet and slippery.

> "Rule 55(i) of CAR 1978 states that --A person shall not act in any capacity as a member of the flight crew of a registered aircraft or as flight operation officer unless he holds a licence granted or rendered valid under this part being a licence that--
>
> (a) is appropriate under the provisions of this part, and
>
> (b) is endorsed with the rating (if any) that is appropriate under the provisions of this part, for a person acting in the particular capacity."

Note:- This rule will have to be amended if simulator training is to be used for aircraft ratings.

17.17.3 Moreover if during flight training a pilot does not achieve the desired standard, he can

be taken off from flying that aircraft. However the pilot doing training on normal passenger flight could commit an error and fatally injure the crew as well as over large number of passengers. This particular flight was a training flight for the first officer who was required to complete his 6 landing for final clearance endorsement of type rating on his licence, poor training standards are reflected from the facts that the instructor gave the landing to the co-pilot who was not fully qualified and in fact a training in adverse weather conditions.

17.17.4 F/O Sadaqat Kazmi was not rated for A-300 type of aircraft. To obtain a rating on a particular type of aircraft, it is required that a pilot must complete 6 take offs and landings on that type. Due to discontinuation of flight training, this requirement was being done on scheduled passenger flights. This constitutes a violation of rule 55(i) of CAR 1978.

17.18 **CREW COMPLIMENT FOR SIMULATOR TRAINING:-**

17.18.1 PIA at times is conducting its simulator training without proper crew compliment i.e. Captain, Co-Pilot and Flight Engineer. At times two co-pilots are occupying both Captains and co-pilots seats in the simulator. This again poses the problem of

training pilots in being far from true conditions. The assesment of such a training cannot be made if a proper crew compliment is not available. As a matter of fact when two co-pilots and detailed for transition training on simulator, the net result of such a training can be from minimal to negative. Not having proper crew compliment is also against the latest in training technique i.e. Cockpit Resources Management (CRM) and Line Orientation Flight Training (LOFT).

17.19 COCKPIT RESOURCE MANAGEMENT & LOFT

17.19.1 Deficiencies are revealed by accident and incident investigations. New methods of training Flight Crew Members like Cockpit Resource Management (CRM) are drawing attention of the Airlines and International Aviation community. Cockpit resources include auto pilots auto throttle, redundancy in aircraft system and last but not the least mainpower available in the aircraft like cockpit flight engineer & cabin crew etc. This innovative Concept in pilot training needs to seriously looked in by PIA Operations. The concepts introduced are communication, assertiveness, advocacy, inquiry, command and leadership.

17.19.2 The purpose of this program is to focus on two primary goals i.e. team building and

achieving operational goals. Flight Safety International has been conducting cockpit reasource management training for several years.

17.19.3 A study by Boeing airline safety indicates that almost half 48.3 percent accidents occur in the final approach and landing stage. Crew members do not overnight abondon good professional behaviour to become undisciplined, incompetent, complacent or negligent. This often reflects long exposure to an operational environment which tolerates such behaviour. This in turn usually reflects on management which is indifferent to the need for a more enlightened approach to human behaviour and performance.

17.19.4 As the aviation develops their are higher expectations of Flight Crew performance, it is necessary to develop corresponding measures of assessment. To date we continue to use individual performance criteria which meansures one's flying skills in terms of prescribed standards of performance relating to control dexterity. Such parameters include altitude, plus minus one hundred feet; airspeed plus minus ten knots; etc. It is ironic that at a time we are looking even more closely at crew performance, it is still possible for one crew member to fail a check ride while the others pass. Yet, it is not

possible for only one member of the crew to crash and the entire crew survives. In fact the role of pilot has changed from that of control manipulator, to that of an information processor and system manager.

17.19.5 Benefits from this management system are so evident that some of the well established airlines have started holding CRM classes every year, replacing simulator sessions. This means one CRM class and then six months later simulator session and after another six month another CRM class. Normally CRM sessions last three working days. The benefits of the three mechanics of training are so evident that an overwhelming majority of airlines have adopted a new method of checking the crew proficiency. It is called 'Line Oriented Flight Training' or LOFT.

17.19.6 Loft is basically a flight scenario pre-fed into a simulator; Assigned crew flies this scenario without any interception from the training or check captain. Parameters of this type of check are based on the these mechanics and are time capsuled. LOFT, in itself is a complete topic, requiring in depth discussion.

17.19.7 The matter was discuseed with Chief Pilot Corporate Safety. He suggested that we introduce this method of training in our

Airline. However, before we introduce CRM & LOFT, a joint study is required to be made by PIA and CAA and a feasibilty report raised on the subject.

17.19.8 During discussion with Chief Pilot Training it was found that no formal course for pilot instructors in the PIA Training Centre is conducted. There should be a provision where a course in teaching techniques, airmanship and student psychology be taught to the potential pilot instructors.

17.20 UNDER SUPERVISION FLYING

17.20.1 After a pilot has completed his initial simulator training, six take offs and landing's on line, he is required to fly 25 hours of under supervision flying. The organisation at times in order to complete this requirement quickly, details him on two flights to Karachi Jeddah and back of 9 hrs each and one flight to Karachi Dahran and back of 5 hrs 30 mnts. This short cut arrangement makes training lose its effect. The pilot should be trained sector wise so that he receives maximum training value from the under supervision flight restrictions.

17.21 DELAYED BRAKING MODIFICATION

17.21.1 PIAC incorpordated a modification on the Automatic brakes system. The delay relay was orginally timed to initiate Auto Brakes after two seconds. This was adjusted to 5 seconds initially and later are increased to 10 seconds. This means that the Auto Brakes would come into play 10 seconds after the spoilers have been deployed on landing. This time converted into distance would be approximately 2700. In this particular accident, the aircraft touched down approximately 4500, from the threshold. The brakes became effective at approximately 7000. On a runway of 9000, this is an extremely late application of the brakes and can be considered a contributory factors to the cause of the accident.

17.21.2 These modifications were initially issued by Aerospatial under cover of service Bulletin 35-551-32-0003 dated 12th May 1980 and later on Airbus Industrie issued SB No. A-300-32-244 dated 24th October 1980.

17.21.3 These modification were carried out by PIAC without prior approval from CAA. Which constitutes violation of rules 35 of Civil Aviation Rules 1978.

Rule 35 states as follows:-

"35.(1) A person may apply to the Director General or an authorized person for approval of the design of a modification or repair of:-

(a) an aircraft or aircraft included in a type of aircraft; or

(b) an aircraft component or aircraft components included in a type of aircraft component.

(2) Where an applicant under sub-rule (1)---

(a) furnishes to the Director General or the authorized person such evidence relating to the design to which the application relates (including evidence of the effect of the design on the safety of an aircraft) as the Director General or the authorized person may require; and

(b) satisfied the Director General or the authorized person that

the design conforms with any relevant design standard in force under rule 21 in respect of the type of aircraft or aircraft component to which the application relates.

the Director General or the authorized person shall give approval to the design.

(3) Where the Director General or an authorized person, is considering an application for approval of a design of a modification or repair under sub-rule (1) is not satisfied that the design will not effect the safety of an aircraft, the Director General or the authorized person may, if the applicant so requests, authorize:-

(a) the making of the modification or repair to a particular aircraft; or

(b) the making of the modification or repair to a particular aircraft component and the fitting of that aircraft component to a particular

aircraft,' with a view to an application being made under rule 136 for permission to test the aircraft in flight to discover whether or not the making of the modification or repair has adversely affected the safety of the aircraft."

17.21.4 During investigation when PIAC was asked to explain this discrepancy, they took the plea. That as the Manufacturer had approved this modification, no further approval is required from CAA. However, PIAC has formulated a comittee of seven specialists consisting of only technical personnel who evaluated and cleared this modification. Even though this modification would effect the performance of the aircraft on landing, no pilot or any person from operations was included in this committee. During questioning technical advisor to the MD PIAC and G.M. quality control felt that no approval from CAA was required for modification and no pilot is required to be included in the evaluation committee. The chances are that if PIAC had sought clearance from CAA, the matter would have been put upto Operation and their comments on flight safety aspect obtained.

17.21.5 A letter to Airbus Industrie was sent requiring information about other Airlines with similar modification. Telex received indicates that Indian Airline, Continental Airbus, Japan Air System, Malaysia Air Services and Phillipine Airline are using only 5 seconds delay.

17.21.6 No doubt the modification is approved by regulatory authority of the country of manufacture and Pakistan has adopted the code of Airworthiness of the country of manufacture as provisioned in ICAO annex 8, still representation of a pilot or Operations Engineer, Flight Operation representative in the modification evaluation committee is necessary to assess the operational re-percussions of such modifications with reference to our environmental conditions.

17.21.7 This is understandable as time calculated for manual application is 4 seconds therefore it is an actual delay of one second only. This whole secenrio of modification needs to be investigated in detail seperately. Flight Operation should study as to if it is necessary to continue using 10 sec. delay in the A-300 auto brake system.

17.22 R-4 Door

17.22.1 R-4 door could not be opened for emergency evacuation of passengers. Investigation revealed that the escape slide installed on R-4 door was not detached from its container due to failure of operating mechanism. During review of records pertaining to overhaul of this escape slide (Pt. No. A30476-101-1-22 S. No. 4069) it was revealed that proper overhaul procedure has not been provided to overhaul personnel, instead of that the technicians are required to refer overhaul manual. Further interrogation revealed that the work is done on the basis of memory and overhaul manual is referred when some difficulty is encountered during the process. This practice results in omission of steps required vide latest revisions in overhaul manual. To preclude re-currence of such omission PIA should prescribe overhaul steps on procedure cards/ sheets alongwith reference of relevant section of overhaul manual for guidance.

17.23 METEOROLOGY

17.23.1 Islamabad Airport is located near the Margala Hills and the local weather is subjected to valley phenomenon. Due to orographic effect, and plenty of moisture available because of Tarbela Dam, a local build up takes place.

Because of the valley, phenomenons of wind backing veering and wind shear are experienced by the pilots. Frequent thunderstorms and dust storms specially in summers are very severe. In winter season long stretch precipitatin activity and poor visibitily around the airfield. The meteorlogical facilities and modern weather sensors are required to monitor continuously these phenomenon at Islamabad Airfield. The present equipment is outdated and mostly remains out of order due to non availibility of spares and technical facilities.

17.24 **WIND SHEAR**

17.24.1 There are many sources that can alert the pilots to potential wind shear conditions weather reports and forecasts provide an initial warning of the possibility of wind shear including reports of frontal and thunderstorm activity and mountain waves. Radar is the most important aid in helping to avoid thunderstorms and heavy percipitation.

17.24.2 Low level windsheer alerting system is now available in the market. Met Department/CAA should consider acquiring LLWAS for Islamabad Airport due to its location and Met conditions with this system tower can report the different winds once the thres- hold is

exceeded (usually a different of 15 knots between airport preimeter sensors and counter field reading). For the DFDR reaching there is an indication of wind shear in the recordings, but there could not be supported by ground wet recordings facility as no paper for the anemometer is available. The location of wind sensors and the weather radar at Islamabad needs to be investigated.

17.24.3 The recommendations of Director Met. PAF should be studied by a committee which Ministry of Defence should detail, in addition it should also look into the working of the Met. Department. (App V-29).

17.25 **AIRCREW MEDICAL RECORD WAS CHECKED**

17.25.1 The record has revealed that there are many PIAC pilots who are flying with excessive over-weight which is contrary to the ICAO regulations.

17.25.2 There are instances where pilots have been warned to reduce weight gradually since last 02 years but instead of reducing some pilots have rather gained weight from their previous medical examinations. This could become a serious inflight incapacitation problem as over-weight is known risk-factor for diabetes and Coronary Artery Diseases.

17.25.3 PIAC was requested to issue general instructions to all the pilots who are over-weight by more than 10 Lbs to ask them to reduce the weight gradually failing which medical examiners will be constrainted to disqualify such pilots temporarily till their weight is brought under control. A weight table recommended by ICAO was enclosed for their guidance.

18. FINDINGS

18.1 The following findings have emerged after examination of the scene of accident, the wreckage, recordings of statments of the witnesses listening to ATC. tape, study of aircraft and crew records and analysis of DFDR and CVR:-

18.1.1 Departure from Standard Operating Procedures which are defined as a result of a synergistic approach to problem solving for pilots were violated. Unapproved procedures were used to deal with abnormal conditions which are not prescribed in approved flight manuals or check list.

18.1.2 The runway is being maintained as per ICAO requirements i.e. rubber deposit removal with machines is done at regular intervals and braking action measurements performed with Mu meter.

18.1.3 There are rubber deposits in the beginning of R/W 30 because this is an instrument runway and remains mostly in use, but the rubber deposits are removed regularly, and R/W function coefficient kept within limits.

18.1.4 Two of the three members of the Cockpit Crew were properly licenced and held ratings for Airbus A-300 type of aircraft.

18.1.5 The First Officer Sadaqat Ali Kazmi, who made the landing was inexperienced co-pilot on the type. He was making his 6th landing (last landing) before he would have finally been cleared to operate with other line pilots.

18.1.6 The Captain of the aircraft exercised poor judgement by allowing the co-pilot to land under the existing adverse conditions (Heavy weather, rain and wet runway) at the time of landing.

18.1.7 Both, Captain Junaidi and First Officer Kazmi, were declared overweight by the CAA Medical Board. Study by aviation medical branch records shows that large number of pilots are over weight.

18.1.8 The blood/urine sample analysis of the Cockpit crew was carried out immediately after the accident and found within normal limits.

18.1.9 Two Air Traffic Control Officers, both of PAF, have stated that they saw the aircraft touched 4000' down the runway; this is supported by Digital Flight Data Recorder.

18.1.10 None of the crew members called the 80 KT and 60 KT calls, nor remembers the speed at touch down. Inadequate communications on part of

all the crew members to resolve the confusion also contributed to this accident.

18.1.11 The Captain of the aircraft took over the control, without giving any verbal command, while the aircraft was on the centre line of runway and intentionally skidded it to the right and switched off the brake anti skid system.

18.1.12 The aircraft was subjected to side loads which could have resulted in collapsing of the main gears with disastrous results. Six tyres burst due to switching off of the anti skid system and harsh application of the brakes causing the wheels to lock and burst the tyres subsequently. The tyre marks on the runway indicated that some aquaplanning also occurred.

18.1.13 There is no formal course being conducted for pilot instructors in the Pakistan International Airlines Training Centre.

18.1.14 The aircraft A-300 AP-BAZ was certificated, equipped and maintained in accordance with CAA requirements. The aircraft was correctly refueled and properly loaded with passengers and cargo for the flight. The C.G. position and landing weight were within limits.

18.1.15 Six tyres burst due to switching off of the anti skid system and harsh application of the brakes causing the wheels to lock and burst the tyres subsequently.

18.1.16 There was no reported injury to any passenger or third party. However one of the cabin crew, an Air Hostess, sprained her arm while snatching baggage from a passenger who insisted on taking his hand baggage with him on the slide chute.

18.1.17 Crash fire and Rescue personnel responded promptly and reached the scene of accident without delay.

18.1.18 There is resistance by PALPA to the idea of introducing CAA Flight Inspectors to monitor the performance of the PIA Pilots.

18.1.19 Individual unsafe practices by pilots come under review during accident investigation. To detect organizational or institutional error, potential annual safety audits are not being conducted by PIA. The safety audit must reach into all departments that interact with flight operations including upper level management.

18.1.20 Recurrent training period of cabin crew has been reduced to only one day from normal three days. This has been done without

approval from CAA in violation of ICAO recommended procedures.

18.1.21 Cockpit crew is not being scheduled for emergency evacuation drill and wet dinghy drill for the past few years - violation of recommended procedures.

18.1.22 CAA does not have the rules for penalizing the operators who violate the regulating provision of the Civil Aviation Rules. The amended CAA rules have been submitted to Ministry of Defence and awaiting approval for long time.

18.1.23 PIA pilot induction policy is based on adhocism. This leads to improper training practices. As an example the recent induction of Pilots in the PIA is several times beyond its training capacity.

18.1.24 PIA needs to review its training policy and procedures along with modern concepts of Cockpit Resource Management and Line Oriented Flying Training.

18.1.25 PIA to review the existing procedure for the selection and appointment of supervisory pilots, ensuring that the basis of selection is primarily professional ability. Preference should be given to pilots who hold/held Flight Insturctor Rating.

18.1.26 Large sized hand baggage of passengers was allowed on board the aircraft which is against the recommended pratcice. This baggage could not be stowed properly and at the time of accident, heavy objects were reported to have fallen from hat racks etc. resulting in cluttering the isles which acted as obstruction to passengers evacuation.

18.1.27 DFDR defects are not being attended to as per the maintenance practices.

18.1.28 Actions required in connection with overhaul of components are not clearly prescribed and referringto overhaul manual is also not strictly followed.

18.1.29 PIA maintenance carried out modification on Auto Brakes system by adjusting the delay relay from two seconds to 10 seconds. The evaluation committee formed comprised of all technical personnels. There was no representative from the Flight Operations.

18.1.30 Captain of Flight BA 119 British Airways B-747 who landed earlier has stated that the runway was wet with Medium to Good braking action.

18.1.31 The runway was wet due to persisting rain/ drizzle. The ATC informed the crew that Braking Action was reported to be Medium to Poor by PK-380, B-737 which landed at 0745 Hrs.

18.1.32 The runway remained closed for large jet aircraft from 0840 hrs on 18th to 0300 hrs on 19th March 1991 due to damaged aircraft remaining on the over run.

18.1.33 Since CAA is planning the extention and recarpeting of the Islamabad Runway therefore the need for runway grooving has become irrelevant.

18.1.34 The defect history of the aircraft for the last seven days was reviewed and found that the aircraft did not have any defect which could effect its braking capability. APU of the aircraft was unserviceable but that did not contribute towards this accident.

18.1.35 The normal (green) hydraulic system operation, regarding brakes, was checked and found serviceable, its reservoir was full.

18.1.36 The alternate (Yellow) hydraulic system was not used. This system is powered by No. 2 engine and after damage to No. 2 engine yellow system fluid was found to have leaked out.

18.1.37 BITE check of Auto brake system was performed after the accident and was found satisfactory. Thrust reversor system of No. 2 engine has been badly damaged, however thrust reversor operation on No. 1 engine was checked after isolating No. 2 engine system and was found operating normally.

18.1.38 Anti-skid system was checked and found not indicating any malfunction. Exact status of those components and selection of respective systems by flight crew has been recorded in Digital Flight Data Recorder (DFDR).

18.1.39 Further investigation after analysis of the DFDR could not be continued as the PIA had started recovering the aircraft for Haj Flights without written permission of CAA.

18.1.40 CAA does not have Flight Inspectors for enforcing regulations and standardization. However the process of selection is in progress and two pilots of CAA are being trained under the guidance of ICAO team.

18.1.41 Airworthiness Branch of CAA needs to be strengthened. The case for additional Maintenance Inspectors is being taken up with the CAA Board.

18.1.42 PIA Pilots have stopped using boom mikes because of reasons not known to CAA. It is a mandatory requirement for all air carrier operators.

18.1.43 During last ten months there have been almost five cases of PIA aircraft going beyond the full length of runway on different airfields due to late touch down and higher speeds.

18.1.44 The Director Flight Operations PIA has held only the post of route check pilot on DC-10 aircraft. He has held no other executive post prior to his present appointment.

18.1.45 PIA has issued the flight operations manual after getting the approval of CAA in 1982. This manual needs to be revised, Chief Inspector CAA high lighted the short comings, etc of the manual to the Director of Flight Operation PIA.

18.1.46 The Meteorological Department has not responded promptly to the investigation team. The working of the department particularly aeronautical meteorology needs to be reviewed for accelerating the programs of automation, and location serviceability of its weather observation equipment. The MOD should constitute a committee consisting of members

from Met. Deptt. and users of these facilities to go into further details.

18.1.47 No technical fault with the aircraft at the time of accident has been found so far.

18.1.48 CAA Medical Board conducted a study of Aircrew Medical records and found out that 35 pilots are over weight. They have been advised to reduce their weight.

19. CAUSES

Human error - Pilot Factor - Avoidable.

19.1 **PRIMARY**

19.1.1 In that the Pilot-in-Command allowed the first officer under route check to land the airraft in wet runway conditions which is contrary to standard operating procedures, and failed to take prompt action to prevent the accident.

19.2 **SECONDARY**

19.2.1 The First Officer touched down far beyond the recommended touch down point for wet runway landing procedure.

20. RECOMMENDATION

20.1 Disciplinary action under the Civil Aviation Rules, 1978 be instituted against Capt. Nasir Pervez Junaidi ALTP No. 347 for operating the aircraft negligently by failing to follow the Standard Operating Procedure thereby violating rule 251(9) and rule 155(1) of Civil Aviation Rules 1978.

20.2 PIA should take appropriate action against F/O Sadaqat Ali Kazmi for poor display of judgement and airmanship. CAA to be informed of the action taken.

20.3 Director Flight Operation of PIA has less than one year to reach the age of superannuation. PIA must select and groom suitable pilot for this key post.

20.4 PIA Must review/amend its Flight Operation Manual and have it approved from CAA at the earliest.

20.5 CAA should review the existing flight standards organisation and appoint suitable Flight Inspectors as soon as possisble.

20.6 PIA must brief once again their Captains and supervisory pilots of their responsibilities to assume control from Co-Pilots/undertraining pilots well in time to avoid jeopardizing the safety of the flight. Management should advice aircrew for adherence to Standard Operating Procedures, with particular emphasis on landing technique.

20.7 PIA to review and standardize their syllabus for cabin crew training as per ICAO Annex VI and have it approved by DG CAA.

20.8 Cockpit crew must be detailed annually for emergency drill including wet dinghy drill at least once in five years.

20.9 PIA should lay down a health fitness programme to ensure all aircrew maintain proper physical fitness with particular emphasis on weight control.

20.10 PIA should establish a Basic Course for Pilot Instructors in PIA Training Centre and instructors should be trained before being nominated for instructional duties.

20.11 PIA must review training policy, procedures and consider introduction of CRM and LOFT concepts in line with other airlines policies.

20.12 PIA must enforce aggressive Flight Safety Programme and conduct annual safety audit. The ultimate responsibility for safety lies with the operator.

20.13 PIA should ensure adequate procedures for checking and maintaining Digital Flight Data Recorder and Cockpit Voice Recorder equipment. The data available from these equipment should be utilized regularly for monitoring performance of the crew and serviceability of equipment.

20.14 System for reporting of DFDR defects be revised to preclude the possibility of delay in recovering of the equipment.

20.15 CAA requires that head sets with Boom microphones be used below 18,000 by all commercial aircraft operators. PIA is to submit a compliance report within reasonable time.

20.16 PIA's Modification Evaluation Committee should also include a representative from Flight Operations to assess the operational aspects of the modifications.

20.17 In connection with overhaul of escape slides and other components the complete overhaul procedure or the relevant steps alongwith references of overhaul manual be provided in overhaul cards/sheets and the shop supervisors should ensure that overhaul manual is referred during the overhaul of components.

20.18 PIA Maintenance should ensure strict compliance of CAR 1978. Aircraft involved in accidents should not be worked upon unless permission in writing is obtained from Investigator-in-Charge.

20.19 PIA must review the policy of allowing passengers to carry oversize baggage in cabin.

20.20 The Ministry of Defence should detail a committee consisting of members from Meteorological Department, PAF and CAA to review working of Met. Deptt.

17 20.21 "The Ministry of Defence should expedite approval of the revised Civil Aviation Rules which have been submitted.