HQCAA/1901/353/SIB

PAKISTAN CIVIL AVIATION AUTHORITY
(SAFETY & INVESTIGATION BOARD)

ACCIDENT TO M/S PIAC, AIRCRAFT FLIGHT # PK-653, ATR42-500 REG. # AP-BHJ ON 31st AUGUST 2012 AT ALLAMA IQBAL INTERNATIONAL AIRPORT, LAHORE

INVESTIGATION REPORT

ACCIDENT OF M/S PIAC, AIRCRAFT ATR42-500, FLIGHT # PK-653, REG. # AP-BHJ ON 31ST AUGUST 2012 AT AIIAP, LAHORE

Synopsis

On 31 August 2012, PIAC, Aircraft ATR42-500, Registration Number AP-BHJ was scheduled to operate Flight # PK-653 from Islamabad to Lahore (ISB – LHE). First Officer was the Pilot Flying (PF) and Captain was acting as Pilot Not Flying (PNF) during the entire sector till landing at Lahore Airport. The aircraft was given information of rain on the airfield once established on final approach. The flight remained uneventful till approaching ILS minima (220 ft AGL) on final approach. The field insight call was given at 1.5 NM by Captain of aircraft. The autopilot was disengaged twice before reaching / crossing ILS minima. After crossing ILS minima on final approach, aircraft rate of descend increased and went below the glide path. As per First Officer and Captain corrective actions were taken, however, DFDR and CVR data did not confirm any action to reduce / arrest the increasing rate of descend. The maximum rate of descend as per DFDR data after disengagement of autopilot and crossing ILS minima, recorded is 700 ft/minute. The aircraft continued to descend below the glide path and touched down on prepared undershoot well before the threshold / landing area and close to the right edge of prepared undershoot (in line with the runway 36R right edge lights). The right main landing gear of aircraft impacted the Befab - safe land barrier 12-3 foundation (approximately 18 inches high) towards the right edge of prepared undershoot after travelling 200 ft which broke / dislodged the right main landing gear from its main attachment / mount. The aircraft subsequently drifted right and the nose along with left main landing gear also went off the prepared runway shoulder after breaking two runway edge lights. The cockpit crew made an endeavour to bring the aircraft back on runway but by that time right lower fuselage and engine No 2 propeller along with right wing tip had made contact with the grassy ground thereby increasing drag and pulling aircraft towards right which resulted in aircraft going off the runway right shoulder. The aircraft came to a halt after travelling 2025 ft from its touchdown point on prepared undershoot. No passenger received any minor / major injury. However, the aircraft suffered visible structural damage on fuselage, right main landing gear area, No 2 engine propeller and under the belly.

Investigation Authority

DG CAA issued notification vide Letter No HQCAA/1901/353/SIB dated 05 September 2012 authorising Safety & Investigation Board, PCAA to investigate the accident is attached as Appendix "A". No state was requested to appoint accredited representative.

1. FACTUAL INFORMATION

1.1 **History of the Flight.** Flight No. PK-653 was planned for sector Islamabad – Lahore – Multan – Lahore – Islamabad. The incident took place on landing at the

end of first sector from Islamabad to Lahore. Flight followed standard domestic air route till Hafiz and then circumnavigated the weather cells present towards west and southwest of Lahore before establishing on finals RWY-36R while asking radar vectoring for ILS approach.

1.2 **Injuries to Persons.** No passenger received any minor / major injury.

1.3 **Damage to Aircraft.** Aircraft suffered visible structural damage on fuselage, right main landing gear area, No 2 engine propeller and under the belly. Detailed damage assessment report is being arranged / planned by PIAC in collaboration with M/s. ATR.

1.4 **Flight Crew Information.** There was a set of two pilots on board the aircraft including one Captain and one First Officer manning the cockpit. The detail of crew members is as under:

(a) Captain Fahim Khan, P # 51459

- Date of Birth : 30 September, 1952
- Medical Validity Date : 30 March, 2013
- Flying Experience Total : 12292:35 Hrs
- Flying Experience ATR : 2940:25 Hrs
- CRM Refresher : 30 March, 2013
- ATPL No : 1302

(b) First Officer Raheel Rafi, P # 61096

- Date of Birth : 07 January, 1982
- Medical Validity Date : 31 May, 2013
- Flying Experience Total : 288:00 Hrs
- Flying Experience ATR : 88:00 Hrs (including 50 hrs under supervision)
- CRM Refresher : January, 2012
- CPL No : 2737

1.5 **Aircraft Information.** The ATR42-500 (AP-BHJ) aircraft was inducted on the fleet aircraft inventory of M/s PIAC on 29 December, 2006. The detailed aircraft and engine related data is appended below:

1.6 **Aircraft.**

- Aircraft Make : ATR
- Type of Aircraft : ATR 42-500
- Manufacturing Date : December, 2006
- Serial No : 00657
- Aircraft Registration : AP-BHJ
- Aircraft Hours : 15503:48

1.7 **Engine No 1.**

- Engine type / model : PW127M
- Engine Serial No : PCE-ED0006
- Date of Manufacturing : 31 December, 2007
- Date of Overhaul : 14 October, 2011
- Date of Installation : 26 December, 2011
- Engine TBO : O/C (Engine life restricted at 13636 Cycles due Seal Air Inter Stage OR 11062 TSN due HPT Blades whichever comes earlier)
- Engine hours after overhaul: 1683:10

1.8 **Engine No 2.**

- Engine type / model : PW127M
- Engine Serial No : PCE-ED0591
- Date of Manufacturing : 28 July, 2012
- Date of Overhaul : New
- Date of Installation : 26 August, 2012
- Engine TBO : O/C (Engine life restricted at 13636 Cycles due Seal Air Inter Stage OR 11062 TSN due HPT Blades whichever comes earlier)
- Engine hours after overhaul: 23:36

1.9 **Propeller Engine No 1.**

- Propeller type / model : 568-F1
- Propeller Serial No : FR20061153
- Propeller Hours : 12416:58
- Installed on AP-BHJ : 26 December, 2011

1.10 **Propeller Engine No 2.**

- Propeller type / model : 568-F1
- Propeller Serial No : FR20070250
- Propeller Hours : 11953:17
- Installed on AP-BHJ : 26 December, 2011

1.11 **Meteorological information.** The weather cells present towards west and south west of Lahore were negotiated / circumnavigated by Captain. Initially drizzle while circumnavigating the weather and then rain over the airfield was reported to PK-653 by Approach Control. As per Met Dept AIIAP, Lahore, the weather was cloudy with rain but without thunder (not a thunderstorm). The maximum wind recorded was North East 12 kts at 1005 UTC and recorded 12 mm rain at Lahore airfield for the day. The weather conditions at the time of landing are considered probably very close to those depicted in the METAR released at 1000 UTC, however a SPECI message was also released at 1015 UTC:

- METAR OPLA 311000Z 33008KT 4000-RA SCT040 BKN100 32/24 Q1002 TEMPO 31030KT 2000 TSRA FEW030CB R/H 66%=

- SPECI OPLA 311015Z 16009KT 3000-RA BKN040 OVC100 29/24 Q1003=

1.12 **Navigation Aids Availability.** ATR42-500 aircraft is equipped with ADF, VOR / DME and ILS equipment for the conduct of flying operations and it was serviceable. All the ground equipment related to ADF, VOR / DME and ILS was found serviceable at the time of occurrence.

1.13 **Communication Aids Availability.** ATR42-500 aircraft is equipped with HF and two VHF radio sets for its two way radio contact with all concerned / relevant agencies during the conduct of flight.

1.14 **Flight Register.** The cockpit and cabin crew data was logged and duly recorded in Flight Log register of ATR42-500 (AP-BHJ) for the sector Islamabad to Lahore as per the PIAC procedure in vogue.

1.15 **Impact Information.** Aircraft touched down on main landing gears in the beginning of prepared undershoot (3 ft 6 inches ahead of green area) towards the right of runway centre line in line with the runway eastern edge lights. After travelling 200 ft on prepared undershoot close to the right edge, the right main landing gear impacted the Befab - safe land barrier 12-3 foundation (approximately 18 inches high) towards the right edge of the prepared undershoot which broke / dislodged the

right main landing gear from its main attachment / mount. No other impact / ground contact of aircraft was observed prior to prepared undershoot of runway 36R.

1.16 **Other Damages.** Aircraft while departing from prepared runway surface at Lahore broke four runway edge lights.

1.17 **Aircrew Medical Examination.** Following the incident on 31 August 2012 at AIIAP, Lahore, Blood and Urine samples of Captain and First Officer did not reveal any abnormality.

1.18 **Fire.** No pre / post occurrence air / ground fire indications by Captain, First Officer of aircraft and evidences of same by Investigation Team Members were observed.

1.19 **ATC Tape Extract.** ATC Tape Extracts were retrieved for detailed analysis.

1.20 **CVR / DFDR.** Cockpit Voice Recorder and Digital Flight Data Recorder were retrieved for analyses by investigation team. The CVR and DFDR data was made available by using PIA facilities and detailed discussions on available data were conducted during analysis phase. It was found that certain parameters of DFDR data after crossing ILS minima could not be correlated, therefore assistance of BEA France was sought to resolve the query. The CVR extracts are attached as Appendix "B" and the detailed analysis of ATR France is attached as Appendix "C".

1.21 **Crew Resource Management (CRM).** At the time of occurrence FO Raheel Rafi was the PF and Captain Fahim Khan was acting as PNF. After crossing ILS minima for runway 36R, as per DFDR data analysis when the aircraft experienced increased rate of descend, corrective actions for executing a go around or arresting increased rate of descend were not initiated by PF or PNF due to which aircraft continued to lose altitude and touched down on the prepared undershoot very close to the beginning and right edge.

1.22 **Cockpit Switchology.** Following cockpit switchology was noted by Investigation Team after the occurrence:

(a) Both fire handles were found in normal position (not pulled).

(b) Idle Gate Lever found in "Pulled" position (Red mark visible).

(c) Both Condition Levers in Fuel Shut off position.

(d) Both Power Levers in Ground Idle position

(e) Landing Gear Lever in Down position.

(f) Gust Lock in engaged position.

(g) **Parking Brake lever not set.**

(h) Flaps 35^0 down (landing configuration).

(i) Both altimeters reading airfield elevation.

(j) No apparent damage in aircraft Cockpit area observed.

(k) Indications of various indicators inside the cockpit could not be recorded as battery connections were disconnected due safety reasons and aircraft was without any electrical power.

1.23 **Retrieval of Aircraft.** A significant delay was observed in initiation of recovery activity by operator on occurrence site due to non availability of various recovery tools / equipment. For removal of aircraft from the occurrence site, the aircraft was raised by inflatable balloons. A track of pallet sheets for towing of aircraft was laid over the wet grassy surface of fair weather strip. After 28 hrs PIAC team towed away the aircraft to bay No 14 on the apron for damage assessment and subsequent repair work.

1.24 **Damage Assessment / Repair scheme.** PIAC Engineering set up coordinated with M/s ATR, France for damage assessment and development of aircraft repair scheme and report forwarded by ATR, France is attached as Appendix "D".

1.25 **Useful Investigation Techniques.** Besides employing various investigation techniques and procedures, data extracted from CVR, DFDR and Multi Function Computers (MFCs) was heavily relied for development of flight profile and events leading to the accident and their analysis.

2. ANALYSIS

2.1 **Flight Data Analysis.** DFDR read out and the analysis of the recorded parameters is based upon the trajectory, pictures and all information contained in the ATR Factual Analysis (ref DT/CA-6556/12 dated 20 November, 2012), Lahore ground runways information and Google Video of runway. The purpose of this analysis is to build-up the sequence of events for bringing out operations findings. It is important to note that 4 seconds data was missing during the landing phase ie the time after impacting with the concrete barrier foundation.

2.2 **Sequence of Events**

2.2.1 The flight took off from Islamabad at about 09:12:00 (all timing may be referred as UTC), climbed with autopilot to FL 150 where it cruised approximately between 09:27 and 09:42 and it the flight remained uneventful till en-route to point HAFIZ.

2.2.2 The Captain informed at 09:42:50 to Lahore Approach Radar that they would be negotiating the weather en-route and would proceed towards south west of Lahore and they were cleared as per their request.

2.2.3 The Captain requested at 09:57:58 for radar vectoring to intercept the final approach.

Approach

2.2.4 The LOC and G/S were armed simultaneously at 09:59:15. The LOC was captured at 09:59:44. The landing gears were extended at 10:00:25 and G/S was captured at 10:00:45 when aircraft was flying at 137 KIAS and 3300 ft. The go around altitude was set at 2800 ft after LOC and G/S engagement at 10:00:50.

2.2.5 During the first portion of the final descent, the IAS was maintained between 110 to 115 kts.

2.2.6 The vertical load factor shows light turbulence characteristics.

2.2.7 As per the cockpit crew input, from 600 to 700 ft AGL positive visual contact was established with the airfield approach lights.

2.2.8 As per the cockpit crew input, they did not encounter / observe lightening / thunder on final approach.

2.2.9 At 10:03:54 the aircraft was at 500 ft AGL while flying at 121 KIAS, 112 kts of ground speed and the pitch angle was about -3^0, increasing.

2.2.10 At 10:04:02 the autopilot was first time disengaged at altitude of 420 ft AGL, however, it was re-engaged after 2 seconds.

2.2.11 At 10:04:30 the autopilot was disengaged at 200 ft AGL at 107 KIAS, ground speed of 97 kts and pitch angle was about 0^0.

2.2.12 At 10:04:37 the PF applied a nose down input (about 2^0 of elevator) and the pitch decreased to -2^0.

2.2.13 At 10:04:39 the PF applied nose up input (about 3^0 of elevator) and the pitch increased by 3^0 in 4 seconds.

Landing

2.2.14 At 10:04:42 the round out / flare out was initiated at 30 ft AGL. The pitch increased from $+0.8^0$ to $+2.4^0$ in 2 seconds. The Power Levers were almost not moved and both engines torque were still around 35%. The IAS was stable at about 103 kts.

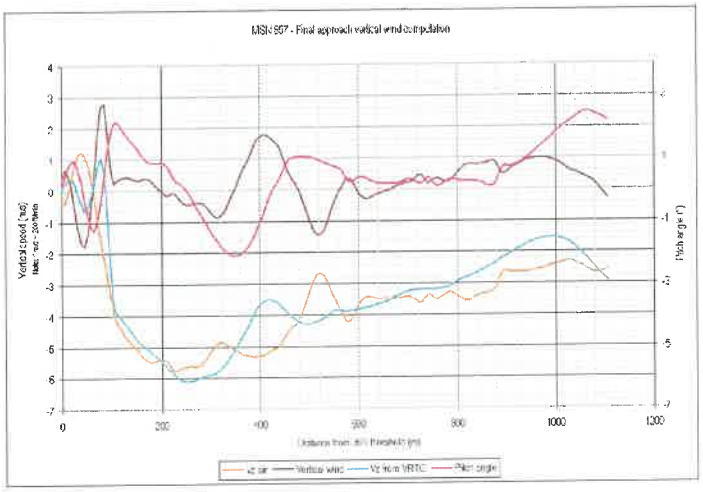
2.2.15 At 10:04:44.5 the aircraft touched down 3 ft and six inches ahead of the beginning of prepared undershoot and 18 ft from the eastern edge of prepared area (in line with eastern edge runway lights), with a pitch attitude about $+2^0$ wings level. The heading of aircraft was 001^0 and the load factor rose to 2.56 g. The cockpit crew

applied a nose down input, the pitch decreased to -1.5^0 and the nose wheel came in contact with prepared undershoot surface.

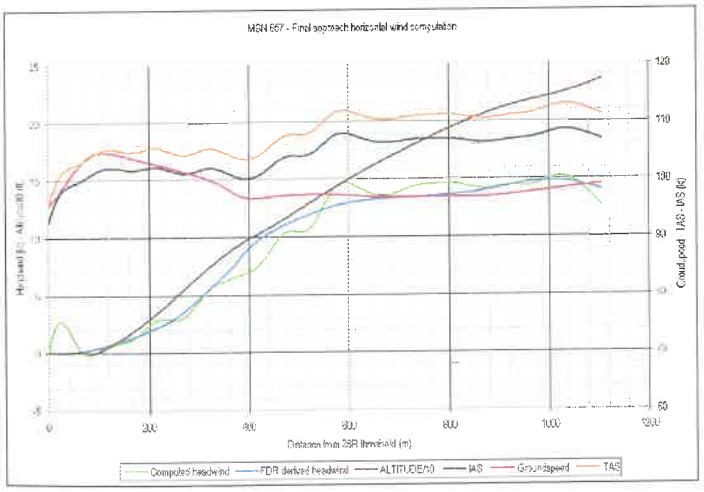
Wind Computations and its Effect on aircraft Flight Path

2.2.16 The wind computations were analyzed to ascertain the effect of prevailing winds on the final approach / landing of ATR aircraft.

2.2.17 **Vertical Wind Component.** The vertical wind component computed from DFDR data revealed that there was a limited vertical wind component throughout the final approach (less than 1 m/sec). However, between 500 to 400 m from threshold, a downward vertical wind of about 1.4 m/sec (275 ft/min) changes to an upward component of about 1.8 m/sec (354 ft/min). This represents a relative updraft of approximately 3 m/sec (600 ft/min) which was possibly the cause of the pitch down input by the PF that resulted in the 3^0 pitch down movement.



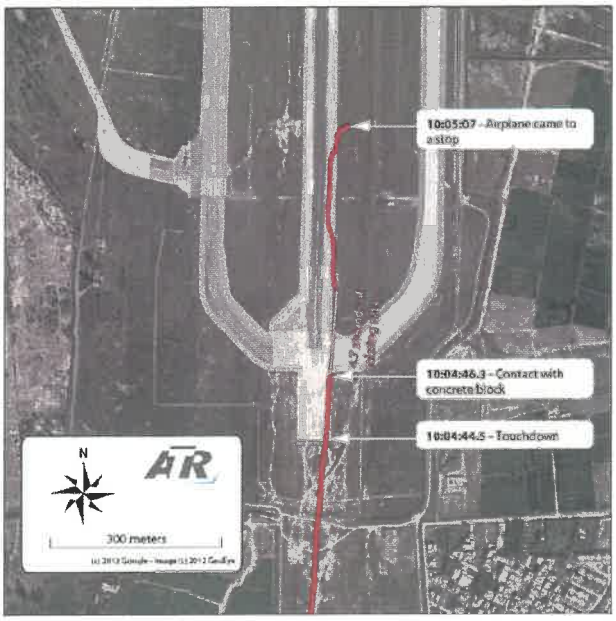
2.2.18 **Horizontal Wind Component.** The horizontal wind data was compared with the recorded wind data and they both follow the same trend in the last portion of flight before touchdown. The head wind component decreased from 13 to 4 kts between 600 m and 200 m from threshold which corresponds to an altitude of aircraft between 150 and 25 ft AGL.



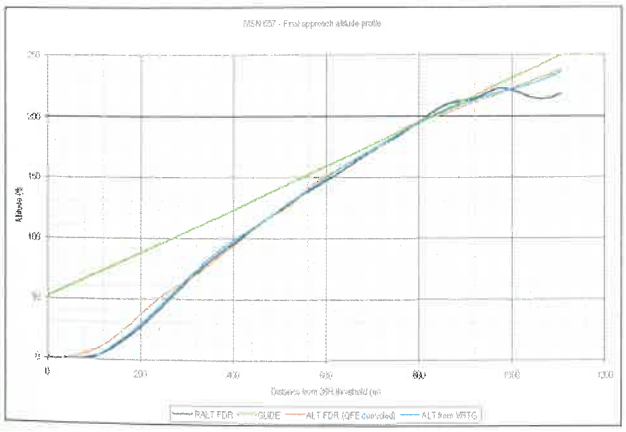
Note: *Throughout the final approach, the recorded wind varied from 040^0 – 080^0 / 5 – 10 kts between 1000 and 700 ft QNH to 020^0 – 040^0 / 13 – 20 kts down to 100 ft AGL. The last recorded data at touchdown is 297^0/ 3 kts.*

Flight Path Analysis

2.2.19 **Horizontal Flight Path.** The PF flew the aircraft in autopilot mode till crossing ILS minima and therefore the aircraft maintained runway centre line till crossing ILS minima. After crossing the ILS minima and disengagement of autopilot the aircraft drifted towards east (right) and the heading increased from 001^0 to 005^0 and then back to 001^0 before touchdown. The extracted horizontal flight path from ATR Report is appended below.



2.2.20 **Vertical Flight Path.** The vertical flight path profile is drawn in altitude above ground versus distance from runway 36R threshold. The chart below shows the pitch evolution as well as the various vertical speed parameters that are quite well correlated. It has to be noted that the 3^0 pitch down between approximately 500 and 350 m from threshold is reflected in the vertical speed evolution in the same time. It decreases from about -800 to -1200 ft/min, which represents a 50% increase in the rate of descent while flying only 100 ft AGL.



2.3 Technical Analysis

2.3.1 All defects found on the inspected parts of ATR42-500 (AP-BHJ) confirmed that they had been damaged after touchdown / landing.

2.3.2 No evidence of failure or malfunction of any aircraft system / sub-system prior to the touchdown / landing has been found.

2.3.3 It is conclusively ascertained during the process of investigation that the ATR42-500 (AP-BHJ) aircraft was fully serviceable during the mishap training flight till touchdown / landing.

3. Finding

3.1 Both the cockpit crew were fit to undertake the scheduled flight.

3.2 The flight remained uneventful till crossing "Hafiz" and then altitude and headings were adjusted for weather avoidance.

3.3 The flight never penetrated through the weather.

3.4 Contrary to SOPs, the First Officer was PF during final approach and landing despite Captain of aircraft having the information of wet runway surface and after encountering the rain on final approach.

3.5 The vertical wind component computed from DFDR data revealed that there was a limited vertical wind component throughout the final approach (less than 1 m/sec).

3.6 Between 500 to 350 m from threshold, a downward vertical wind of about 1.4 m/sec (275 ft/min) changes to an upward component of about 1.8 m/sec (354 ft/min) which represents a relative updraft of approximately 3 m/sec (600 ft/min).

3.7 After encountering a relative updraft, the PF lowered the nose of aircraft to continue the final approach / landing which resulted in the 3° pitch down movement.

3.8 A 3° pitch down input by PF in between approximately 500 and 350 m from threshold resulted in increased rate of descent from about -800 to -1200 ft/min (a 50% increase in the rate of descent while flying only 100 ft AGL) which was probably experienced as sudden sink by cockpit crew.

3.9 By virtue of very low altitude (100 ft AGL) the Captain could not react to the sudden variation and aircraft touched down in the beginning of prepared undershoot in line with the runway eastern edge lights.

3.10 After landing on prepared undershoot, the aircraft experienced structural damage due to the impact with concrete foundation of Befab 12-3 safe land barrier.

3.11 The cockpit crew tried to control direction and maintain the aircraft on prepared surface but due to the structural and right main landing gear damage, the aircraft drifted towards right and came to a halt on the eastern green belt after travelling 2025 ft from its touchdown on prepared undershoot.

3.12 All the passengers were disembarked through normal exit with no injuries to anyone.

3.13 The safety services reacted very swiftly and reached the scene of occurrence.

4. Observations

4.1 PIAC recovery team took 28 hrs to remove the aircraft from the occurrence site for resumption of operations from runway 36R/18L at AIIAP, Lahore.

4.2 Initially PIAC recovery team was observed to be deficient of required recovery equipment items / tools.

4.3 The SOPs in respect of PF and PNF during flying were not being followed by the cockpit crew of PK-653.

4.4 Captain of aircraft did not take over the control of aircraft from First Officer on final approach for landing despite encountering rain and knowing the wet runway surface conditions.

4.5 Autopilot disengagement was observed on final approach at 432 ft and 385 ft AGL, however, subsequently it was engaged at 403 ft and 348 ft respectively, whereas the ILS minima was observed to be 220 ft AGL.

4.6 The go around procedure was not discussed during the arrival brief.

4.7 The option of Go around never came in the mind of PF after encountering the unsafe set of conditions.

4.8 After crossing ILS minima, the aircraft experienced increased rate of descend till touch down on prepared undershoot, but required recovery actions were not observed in terms of go around decision ie advancing power levers to arrest the increasing rate of descent.

4.9 Despite encountering rain on final approach, the wipers of aircraft were kept in OFF position.

4.10 Captain neither advised the First Officer nor took over the control of aircraft for corrective actions for execution of go around despite increased rate of descend after crossing ILS minima (before touchdown).

4.11 Before leaving the aircraft after occurrence, the cockpit crew relied on memory to carry out the required cockpit checks.

4.12 Before leaving the aircraft after occurrence, the cockpit crew forgot to pull Fire Handles (both).

4.13 Captain being PNF on arrival did not read the approach checklist instead First Officer read the approach checklist while acting as PF.

4.14 The ATIS information being transmitted by AIIAP at 0923 UTC and 0954 UTC gave weather warning for thunderstorm and rain valid up to 0400 UTC.

4.15 Despite experiencing an increased rate of descend (destabilized approach) after crossing ILS minima, Captain / First Officer did not initiate a go around.

4.16 The Airport Information Publication (AIP) issued by PCAA contains the information regarding presence of barrier foundations at AIIAP, Lahore. However, the extensive structural damage caused to the aircraft is due to the impact of ATR42-500 aircraft with Befab 12-3 safe land barrier foundation at AIIAP, Lahore.

5. Conclusion

5.1 The initial approach was conducted under approach radar vectoring after negotiating the weather and the aircraft reached 3000 ft when the approach mode was engaged (the LOC and G/S modes were armed). The aircraft was configured for landing and LOC along with G/S modes were captured.

5.2 The final approach was stabilized till crossing ILS minima.

5.3 After crossing the ILS minima, at about 200 ft above ground, the PF (First Officer) disconnected the autopilot.

5.4 At 100 ft AGL, PF lowered the nose of aircraft to cater for slight updraft which resulted in increased rate of descend and the aircraft went below the glide path with a steeper slope.

5.5 The aircraft in spite of the flare and the torque 35% (both engines) that was not reduced, touched down at 3 ft and 6 inches ahead of beginning of prepared undershoot with an approximate rate of descend of 750 ft/min with slight nose up attitude and wings level in line with the runway eastern edge lights.

5.6 The aircraft because of touching down close to the edge of prepared undershoot, impacted with the concrete foundation of Befab safe land barrier and resulted in serious structural damages.

5.7 The aircraft under fuselage portion (belly) came in contact with the ground along with right wing tip and No 2 engine propeller which resulted in veering of aircraft towards the green belt / area towards the east of runway 36R.

5.8 Finalization

5.8.1 **Cause of Occurrence.** Captain's gross violation of FCOM procedures and SOPs along with lack of CRM caused the occurrence.

5.8.2 **Contributory Factor.** Failure of first officer to point out the gross violation of FCOM procedures and SOPs by the Captain of aircraft during landing and mishandling of aircraft after crossing ILS minima caused the occurrence.

6. Safety Recommendations

6.1 Directorate of Regulatory, PCAA is to study the inclusion of landing practice in various weather conditions / parameters eg rain, fog etc during the conduct of simulator training of aircrew.

6.2 Directorate of Regulatory, PCAA along with PIAC to analyze the performance of aircrew involved in the accident and ensure necessary recurrent training is conducted before clearing them for flight.

6.3 Directorate of Regulatory, PCAA along with PIAC to devise mechanism / procedure for ensuring the implementation of SOPs during flight by cockpit crew.

6.4 Directorate of Regulatory, PCAA is to study and devise mechanism to handle removal of wide body aircraft from occurrence site for resumption of operations in minimum possible time by involving PIAC along with other operators in establishing recovery teams (independently / jointly) at Islamabad, Lahore and Karachi with state of the art recovery equipment.

6.5 Directorate of Regulatory, PCAA is to re-emphasize on cockpit crew of all operators for observance of FCOM and SOPs religiously during flight.

6.6 Directorate of Regulatory, PCAA is to re-emphasize on cockpit crew the importance of go around decision after encountering abnormal flight conditions prior to touch down on final approach.

6.7 Directorate of Regulatory, PCAA is to re-emphasize on cockpit crew of all operators for observance / implementation of standard arrival brief religiously.

6.8 Directorate of Regulatory, PCAA is to re-emphasize on cockpit crew of all operators to follow the checklist and not rely on memory for carrying out checklist actions prior to leaving the cockpit in order to avoid missing out / non conformance of important actions.

6.9 Pakistan Meteorological Department and Directorate of Air Traffic Services are to devise a mechanism for ensuring correct and updated aerodrome information availability on ATIS round the clock.

6.10 The replacement of existing Befab 12-3 safe land barrier at all the joint user runway locations may be discussed and resolved at appropriate level between PCAA and PAF.

6.11 Reports on safety recommendations (6.1 to 6.10) of this report are to be submitted to SIB as soon as its completion, but not later than 45 days from the issue of this report.