



PAKISTAN CIVIL AVIATION AUTHORITY
(SAFETY & INVESTIGATION BOARD)



**ACCIDENT TO M/S PIAC, AIRCRAFT
FLIGHT # PK-688, ATR42-500
REG. # AP-BHO ON 30TH MAY 2009 AT
ALLAMA IQBAL INTERNATIONAL AIRPORT, LAHORE**

FINAL REPORT

ACCIDENT TO M/S PIAC, AIRCRAFT ATR42-500, FLIGHT # PK-688, REG. # AP-BHO ON 30TH MAY 2009 AT ALLAP, LAHORE

SYNOPSIS

The investigation was ordered by the Director General Civil Aviation Authority Memorandum No. HQCAA/1901/331/SIB dated 1st June 2009. On 30th May 2009, PIAC, PK-688 Aircraft ATR42-500, Registration Number AP-BHO was scheduled to operate Flight # PK-688 from Multan to Lahore (MUX – LHE). The aircraft was piloted by 2 + 1 aircrew. During incident flight, after landing at Lahore Airport, aircraft drifted toward left and went through the green area (between both runways) passing over the centre drainage (Pic-1) and stopped at secondary runway near taxiway 'E'. Four passengers received minor injuries and aircraft suffered with severe structural damage including the nose landing gear and the left main landing gear shock absorber collapsed. The aircraft stopped on the red left edge of 36L runway. Passengers and crew members evacuated normally.

DG CAA authorised Safety & Investigation Board, PCAA to investigate the accident. Besides Investigation Board comprising 4 members appointed by the Director General Civil Aviation Authority, Pakistan, the reps from M/s. PIAC, M/s ATR, France and BEA (French Investigation Agency) were also the part of investigation team. No other state requested to appoint accredited member.

Comments from Accredited representative from BEA, France, the State of Manufacture and State of design were requested in May 2011, but not received.

1. FACTUAL INFORMATION

- 1.1 **History of the Flight:** Flight No. PK-688 was planned for sector Islamabad – Lahore – Multan – Lahore – Islamabad. The incident sector was from Multan to Lahore. ATD Multan was 1155 UTC and ATA Lahore was 1416 UTC. Flight followed standard domestic air route to Lahore RWY-18L. While approaching, Captain requested Runway 36, straight vector for ILS approach.
- 1.2 **Crew Information:** There was a set of three pilots (multiple crew cockpit) including one Captain and two First Officers manning the cockpit at the time of incident landing. The detail of operating crew members is as under:
 - (a) Captain Turab, P # 49255, as Captain of Aircraft, ATR experience 600 hrs, Grand Total 10,000 hrs.
 - (b) First Officer Asim, P # 47192, as Co-pilot, ATR experience 1099 hrs, Grand Total 1099 hrs.
 - (c) First Officer Tanveer, P # 60704, Occupying Jump Seat, ATR experience 1900 hrs, Grand Total 2900 hrs.
- 1.3 **Injuries to Persons:** 04 pax received minor injuries
- 1.4 **Damage to Aircraft:** Aircraft received structural damage on nose & main landing gears and under the belly. Detailed damage assessment and recovery scheme was prepared by M/s ATR and PIAC.
- 1.5 **Other Damages:** Aircraft while departing from runway surface at Lahore broke a few edge lights and damaged ditch / drain between main and parallel surfaces.

- 1.6 **Impact Information:** Aircraft had touch down on wheels, and thereafter veered to left. No other impact was observed prior to landing. However, aircraft impacted ground while crossing a ditch between both the runways at AllAP, Lahore.
- 1.7 **Fire:** No fire and smoke indications were observed. However, aircraft fire bell started sounding till aircraft was switched off.
- 1.8 **ATC Tape Extract:** ATC Tape Extract for the duration was retrieved for required analysis.
- 1.9 **CVR / FDR:** Cockpit Voice Recorder and Flight Data Recorder were retrieved for analysis. CVR was made available by using PIA facilities, whereas FDR readout was managed from BEA, France.
- 1.10 **Met Report:** It was a clear day with vis 4 kms, haze. There was no significant weather phenomenon, except surface wind from 120 degrees, 10 knots reported by AllAP, Lahore. During approach, 02 minutes before touch down the wind reported by ATC was 130°, 15 kts (tail wind component).
- 1.11 **Aircrew Medical Examination:** Following the incident on 30th May 2009 at AllAP, Lahore, Blood and Urine samples of Captain, First Officer and Co-pilot did not reveal any abnormality.
- 1.12 **Crew Resource Management (CRM):** At the time of occurrence FO Asim was the Pilot Flying (PF) and Captain Turab, also the Captain of the aircraft, was the Pilot Monitoring (PM), whereas, FO Tanweer was in the cockpit on Jump seat. After the onset of occurrence, when aircraft was continuing to veer / drift left, PM took over the control till aircraft came to stop.
- 1.13 **Cockpit Setup:** Following Cockpit switchology was noted immediately after the occurrence:
- (a) Both Engines Power levers found stuck at 58 degree.
 - (b) Both engines Condition Levers found stuck at 100% / Override position.
 - (c) Both fire handles found pulled.
 - (d) Idle gate lever found in "IN" position. (Red mark not visible).
 - (e) Nose wheel steering system switch found at "OFF" position. Tiller handle found in Zero position.
 - (f) Parking Brake lever in released position.
 - (g) Rudder pedal found stuck. Control Column moved independently on Pitch channel showing uncoupling of Elevator.
 - (h) No obvious damage in aircraft Cabin area observed.
 - (i) Indications of various indicators inside cockpit could not be recorded as Battery Connections were disconnected due safety reasons and aircraft was without any electrical power.
- 1.14 **Retrieval of Aircraft:** After the accident, the aircraft was raised by inflatable balloons, a temporary arrangement to replace the damaged left hand main landing gear shock absorber and towed away up to the Government of Punjab Aircraft Hangar for damage assessment and subsequent repair work.
- 1.15 **Useful investigation techniques:** Besides employing various investigation techniques and procedures, data extracted from 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

- 2.1.1 FDR read out (MSN 663) and an analysis of the recorded parameters is based upon the trajectory, pictures and all information contained in the ATR memo (ref

LC/LHE/0001/2009), Lahore ground runways information and Google Video of runway. The purpose of this analysis is to build-up the sequence of event for bringing out operations findings.

2.2 Sequence of Event

- 2.2.1 **From 13h 46min 16s to 13h 46min 20s - Final approach on runway 36R:** The aircraft performed an approach with a drift angle of 7° (magnetic heading of 8°; Runway 1°) corresponding to a wind of 130°/19 Kt. This wind intensity is confirmed through the Ground speed (GS) and the calibrated airspeed (CAS) recorded during this period which was respectively 128 Kt and 114 Kt. The wind effect is counteracted through the left pedal (about 4° of rudder), the wheel to the right (right aileron at about -3°) giving a right bank angle of about 4°. Altitude variation: 210ft to 162ft (48 ft).
- 2.2.2 **At 13h 46min 27s:** At an altitude of 60ft half of de crab is performed. (Heading 4°; Roll 2°). The aircraft is at 68m before the runway threshold and 12m on the left of the runway centreline. The recorded speeds were: GS 130kt and CAS 118kt. The recorded PLA of 43° corresponds to a torque of 23% with a NP 82%.
- 2.2.3 **At 13h 46min 28.30s - Runway 36R threshold:** At this time the aircraft passed the runway threshold at an altitude of 44.9ft and was 9.96m on the left of runway centreline. The recorded speeds were: GS 131.9kt and CAS 121kt.
- 2.2.4 **From 13h 46min 28.30s to 13h 46min 37.65s - Flare:** The pitch angle reached a positive value at 20ft above ground. Few seconds before the touch down, the crew performed the de crab and the heading decreased to 2° with a positive bank angle (1.5°, Right wing down) to take into account the wind effect (130°, 15Kt). Pedal on the left and wheel on the right (positive rudder and negative right aileron).
- 2.2.5 **A 13h 46min 37.65s - Main landing gear touch the ground:** One second before the touch down the PLA are reduced to 37° (Flight Idle). The aircraft touched down with a pitch angle of 1.7° and a roll angle of 0.35°. The recorded speeds were: GS 123kt and CAS 108kt. The touch down occurred at about 635m after the runway threshold and 6 m on the left side of the runway. The loads factor recorded during the touch down were: Vertical 1.31g, Longitudinal 0.1g and Lateral -0.06g
- 2.2.6 **At 13h 46min 40.6s: Nose landing gear touch the ground:** To maintain the aircraft on ground the crew applied a pitch down input (Elevator -6° to 8°) and the NLG touched the ground when the pitch attitude reached -1.5°. Then the "All Gears Squat Switch" was recorded in ground position. The NLG touched the ground with a heading of 3° at about 815m after the runway threshold and 9.7m on the left side of the runway centreline. Between MLG touch and NLG touches the crew maintained negative right aileron to counteract the cross wind. During this period the recorded GPS wind direction and wind speed were 116° to 145° with 14kt to 10kt.
- 2.2.7 **From 13h 46min 41.4s to 13h 46min 47s:** Despite negative right aileron value the roll angle is always negative and when the crew released the control wheel (Right aileron -1°) the roll increased and the right MLG left the ground. This is confirmed by the "All Gears Squat Switch" recorded in flight position. In the same time the crew used positive rudder to counteract a heading increase (1.4° to 10.6°) which added negative roll angle. The aircraft moved to the left side (Heading 353°) stopped by a right pedal input (rudder -7° during) and a positive roll by the control wheel (Right aileron -5°). The above corrective actions stabilized the heading about 2° with distance 1193m beyond the runway threshold and 15m on the left of the runway centreline. IAS 87Kt and GS 106.4Kt.
- 2.2.8 **From 13h 46min 47s to 13h 46min 53.25s:** The crew maintained the right pedal (average rudder -8°) and the heading moved to 8°. But in the same time the crew released again the roll control (Right aileron +1.5°) and the right MLG left the ground during 2 seconds. This is confirmed by the "All Gears Squat Switch" recorded in flight position. The elevator was maintaining in pitch down position (about 12°). These actions

(Roll and Pitch) counteract the benefic effect of rudder and the heading moved quickly to 351° despite a late negative aileron and full right pedal (rudder -28°). The NLG wheels marked the ground due to negative bank angle and pitch down input on the elevator.

- 2.2.9 **At 13h 46min 53.25s** The aircraft left the runway with the recorded speeds of GS 95kt, IAS 77kt at 1509m after the runway threshold (CG position) corresponding to 1500m for the NLG. This is confirmed by the available photos of the NLG marks on the runway compared with the Google map pictures of the airport (1499m).
- 2.2.10 **At 13h 46min 57s:** The PLA were reduced to 20° (ground idle) and the longitudinal load factor changed from 0.125 to 0.25g.
- 2.2.11 **At 13h 47min 02/05s : Hard Ground :** Using the positioning by Google and the trajectory the aircraft reached the hard ground surface with the NLG at 13h 47min 02s and left with the MLG at 13h 47mn 05s (03 sec). At 13 h 47 min 02s the speed was GS 67.5kt, IAS 49kt. At 13 h 47 min 05 s the speed was GS 52kt, IAS 32kt (reduction by 15 Kts). The FDR confirms, by a sudden variation of pitch attitude (-4.5°) associated with a load factor of 0.68g and a diminution of longitudinal factor of 0.15g, that the NLG of the aircraft and then the left MLG (at 13h 47mn 03s) touched the hard ground (Longitudinal load factor 0.05g). The crew use elevator to avoid a NLG collapse without success and the NLG is falling into the draining channel. (See report). Then the NLG left the ground (Pitch 5°) and the MLG fell in the draining channel.
- 2.2.12 **At 13h 47min 09s to 12s: Loss of information:** However, Using QAR and FDR data it is possible to complete the trajectory until the aircraft stop.
- 2.2.13 **At 13h 47 min 21s: Aircraft stop:** The aircraft stopped after having crossed the runway 36L. The aircraft stopped at 2072m from the runway threshold and at 224m on the left of runway 36R centreline.
- 2.2.14 **Trajectory:** The final aircraft trajectory has been computed using FDR and QAR parameters (lock, Ground speed, ISA etc), pictures of aircraft marks and Google positioning. The typical points are computed using Google longitude latitude and pictures.

2.3 CVR Analysis

- 2.3.1 There was no arrival briefing conducted for change of Runway to 36R involving right cross wind & tail wind components.
- 2.3.2 During critical phases of flight (below 10,000 ft while engaged in Take off, Climb, Descent, Approach and Landing), "sterile" cockpit concept was not adhered to. Whereas, the extra ordinary casual cockpit environment was prevalent till short of landing.
- 2.3.3 As per the meteorological and weather conditions, preferable runway in use at AllAP, Lahore at the time of approach of PK-788, was 18L. However, PK-688 asked for runway 36R, if traffic permitting. Accordingly, runway 36R was cleared by Lahore.
- 2.3.4 After landing by First Officer, Captain took over the control of aircraft when it was seen not being controlled by First Officer.
- 2.3.5 Cockpit voices while on approach landing and subsequently during runway excursions do not indicate aircrew applying required corrective techniques and control inputs.

2.4 Technical Analysis of NLG

- 2.4.1 NLG of aircraft was investigated by a joint team of ATR and Messier Dowty specialist. Aircraft had crossed over two fences during the runway excursion: a slope/hump of 140 mm and a draining channel of 300 x 300 mm, which are out the specifications. NLG units were removed from MSN 663, consequent to runway excursion for analysis. French BEA and ATR

performed a table examination of the related NLG units to determine potential NLG involvement in the runway veer-off. This table examination was held in Hydrepro facility.

2.4.2 It was conclusively known that Landing Gear System functioned normally as per the commands from the cockpit.

2.4.3 After the investigations, as suggested by ATR, PIAC decided to scrap the NLG and Main Gear on site in lieu of scrap certificate

2.5 Ops Analysis

2.5.1 The aircraft crossed the runway threshold at about 13h46m26s, around 9 meters on the left of the 36R runway centreline, with a ground speed of 131 kt, an indicated airspeed of 121 kt, and a radio-height of 45 ft.

2.5.2 The aircraft touched down between 13h46m35s and 13h 46m36s, around 5 meters on the left of the 36R runway centreline, with a ground speed of 123 kt, and an indicated airspeed of 106 kt;

2.5.3 During all the ground roll phase, the aircraft was on the left of the runway.

2.5.4 The aircraft veered off the runway to the left, at about 13h46m51s, with a ground speed of 95 kt, an indicated airspeed of 77 kt, and a true track of around 352°.

2.5.5 The aircraft crossed a hump, a hard draining area and draining channels around it between 13h47m00s and 13h47m03s. It may have caused the collapse of the nose landing gear and the left main landing gear shock absorber.

2.5.6 The landing was performed with wind components of 16kt of crosswind and 14kt of tailwind. These values are within the aircraft certification.

2.5.7 The touch down of main landing gear was calculated / observed at about 635m after the runway threshold and 6m on the left of the runway centreline.

2.5.8 The attitude, the speed and the load factors of the aircraft were normal at touch down.

2.5.9 From the touch down and until runway veering off, the bank angle of the aircraft was always negative, despite a negative right aileron (to counteract the crosswind). But when the NLG touched the ground, the crew released the control wheel and the right MLG left the ground. In the same time the crew applied a pitch down input to maintain the nose on ground.

2.5.10 The NLG marked the ground due to elevator pitch down input and low or nil loads on right MLG.

2.5.11 The action on the pedal (rudder) to recover the runway heading was always efficient, but the lateral distance with the runway centre line increased due to low or null loads on right MLG.

2.5.12 The crew did not use the option of asymmetrical power to recover the aircraft.

2.5.13 The loss of effectiveness of the nose wheel steering system or brakes describe by the crew could not be found.

3. CONCLUSIONS

3.1 During the landing run, the crosswind induced lateral forces on the aircraft and subsequent negative bank angle. Lack or insufficient input on the control wheel and moderate input on the rudder pedals did not permit to maintain the aircraft on the runway.

- 3.2 **Cause of Occurrence:** Lack of CRM and insufficient aircrew training to handle a simple landing with moderate tail and crossed wind conditions emerges as the cause of the occurrence

4. OBSERVATIONS

- 4.1 Following observations are made:
- 4.1.1 Company SOP for ATR did not exist at the time of incident.
 - 4.1.2 Loose equipments / personal belongings like cell phone etc were not being properly housed / secured in the cockpit. Cell phone of Captain was dropped on Captain's rudder pedal floor when aircraft left prepared surface, its ringing bell could be heard however Operators staff could not locate the cell phone.
 - 4.1.3 Instead of standard two pilot cockpit crew, multiple cockpit crew was being used on ATR.
 - 4.1.4 Cockpit crew was not well aware of relevant contents of CARs, 94 (Chapter XV) while required to produce individual statements after the occurrence.
 - 4.1.5 Aircraft had crossed over two fences during the runway excursion with a slope / hump of 140 mm and a draining channel of 300 x 300 mm.

5. FINDINGS

- 5.1 All defects found on the inspected parts confirm that they have been damaged consequent to the NLG collapse.
- 5.2 No evidence of failure or malfunction of the NLG and associated steering system prior to the event has been found.
- 5.3 Aircrew performed insufficient crab approach procedure to counter RH cross wind.
- 5.4 Aircrew did not discuss landing on Rwy 36R with tail and cross wind conditions.
- 5.5 To maintain aircraft on Runway, the nose was lowered.
- 5.6 Right wheel lifted off twice, after touch down due to insufficient control input which resulted in runway excursion at 95 Kts.
- 5.7 This NLG leg Assembly collapse is due to the Drag Brace lower arm damage, which is the fuse part of the NLG shapset. This kind of rupture at NLG Drag Brace lower arm occurs when excessive drag loads are withdrawn by the leg; such loads were withdrawn during crossing of the fences out of the runway, during the excursion from the runway surface. These results from the loads fences crossed during the excursion of the aircraft over.
- 5.8 Aircraft fire bell started sounding till aircraft was switched off due to sensing excessive dust in the cockpit.

6. SAFETY RECOMMENDATIONS

- 6.1 Simulator training of aircrew is to include greater emphasis on landing in cross / tail wind conditions.
- 6.2 Directorate of Flight Standards, HQ CAA 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 PIA to conduct inquiry to find out as to what caused the delay in preparing the SOP for ATR.
- 6.4 Directorate of Flight Standards, HQ CAA along with PIAC to study merits / demerits of the requirement of "Multiple crew cockpit" for PIAC aircrew marked for accelerated flying, and / or to compensate for average flying hours for the month vis-à-vis compromise on actual flying experience.
- 6.5 PIAC to ensure awareness of all aircrew on the contents of CARs, 94 in general and "Investigation of Accident and Incidents" in particular.
- 6.6 Hump of 140 mm and draining channel of 300 x 300 mm between both the runways be checked for its allowed specifications (Pic-1).
- 6.7 Adherence to sterile cockpit procedures be re-emphasized and ensured.

