FINAL INVESTIGATION REPORT

ACCIDENT OF PIAC AIRCRAFT ATR 72-212A REG NO AP-BKW AT JIAP KARACHI DURING GROUND RUN-UP PERFORMANCE CHECKS ON 24 NOVEMBER 2018

SCOPE

Safety Investigation Board (SIB), Pakistan investigations are conducted in accordance with Annex-13 to the ICAO Convention on International Civil Aviation and Civil Aviation Authority (CAA), Pakistan Rules 1994 (CARs 94).

The sole objective of the investigation of an accident or incident under above stated regulations is the prevention of future accidents and incidents of similar nature. It is not the purpose of such an investigation to apportion blame or liability. Accordingly, it is inappropriate that SIB reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

This report contains facts which have been determined up to the time of publication. This information is published to inform the aviation industry and the public of the general circumstances of civil aviation accidents and incidents.

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THE SIB PAKISTAN ICAO ANNEX 13 SAFETY INVESTIGATION BOARD TEAM

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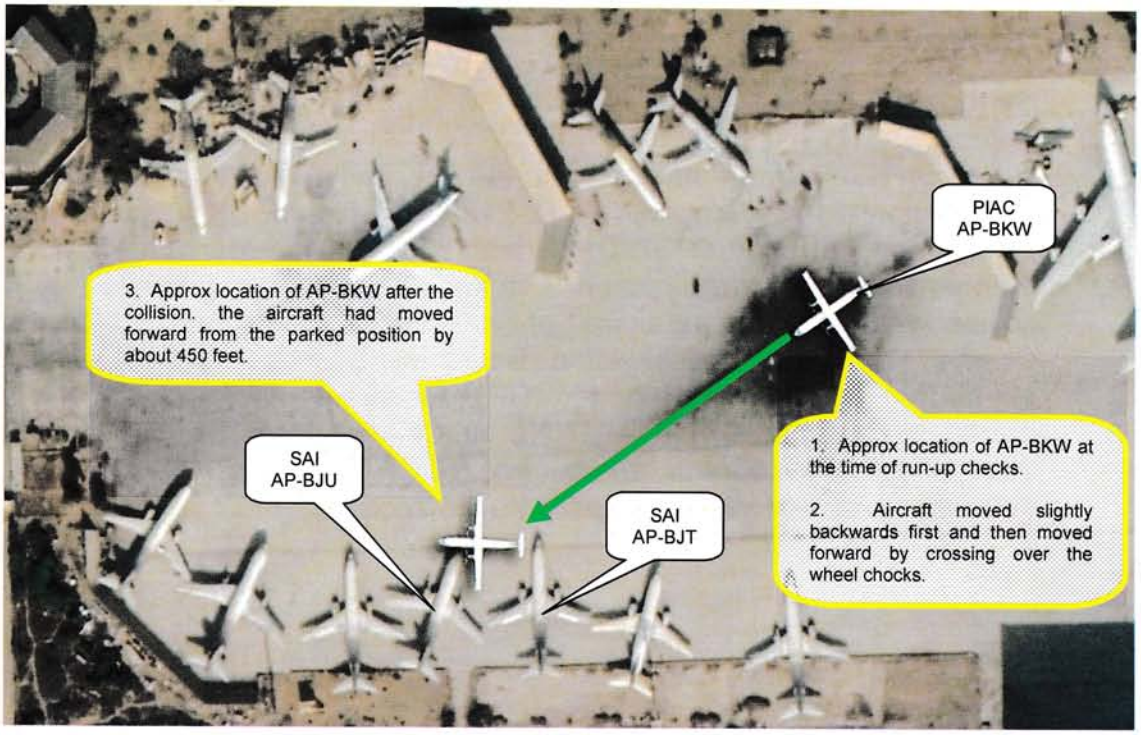
Synopsis

On 24 November 2018 at JIAP Karachi, a Pakistan International Airlines Corporation (PIAC) aircraft ATR 72-212A Reg No AP-BKW was undergoing engines' performance ground run-up. The aircraft initially rolled rearwards for about 10 feet and then moved in forward direction. The aircraft after moving forward by about 450 feet, collided with two dormant aircraft of Shaheen Air International (SAI). The accident was reported to Safety Investigation Board (SIB) Pakistan by the operator through Mandatory Occurrence Report (MOR). Government of Pakistan (Aviation Division) issued memorandum and corrigendum authorizing SIB Pakistan to investigate the accident.

1. FACTUAL INFORMATION

1.1. **Description of Accident**. On 24 November 2018, PIAC aircraft ATR 72-212A Reg No AP-BKW, at JIAP Karachi, after both engines replacement and scheduled Check-A inspection, was undergoing engines' performance ground run-up, as a follow up of the completed maintenance. The aircraft was parked at engine run-up bay No 01. During engines' performance check at maximum reverse setting, the aircraft initially moved backward by about 10 feet and then, because of wrong selection of the engine controls, it started moving forward. The aircraft did not stop with parking brakes (already ON) as well as with the application of pedal brakes. The wheel chocks used during the activity were of smaller than the recommended size. The maintenance engineer could not control the situation and the aircraft continued forward movement. It's left wing tip first made contact with a dormant / parked aircraft (SAI B737-400, Reg No AP-BJT) between Captain and First Officer's windshield. After this it continued moving forward and hit the nose radome of another dormant / parked aircraft (SAI B-737-400, Reg No AP-BJU). Subsequently, the rotating No 1 Engine propeller got embedded into the fuselage of second parked aircraft, and it came to a stop after about 450 feet. The collision of AP-BKW with the two parked / dormant aircraft resulted in substantial structural damage. The aircraft last operated flight was PK-537 (Mohenjo-Daro to Karachi) on 31 August 2018 (84 days prior to this accident).

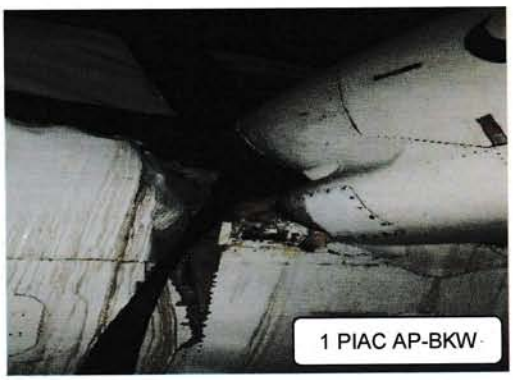
1.1.1. An overview of the accident site has been marked in the picture below:-



1.2. **Injuries to Persons**. Minor injury to left leg of senior technician, sitting on observer seat occurred during ground collision of aircraft due to sudden stop and falling over to central pedestal.

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	01	Nil	Nil
None	02	Nil	03

1.3. **Damage to aircraft**. Damage to AP-BKW and two SAI dormant aircraft is as shown below:-



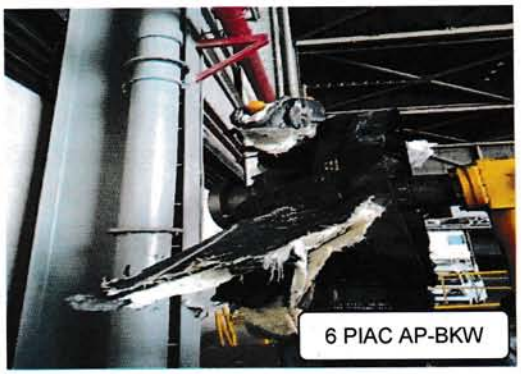
1 PIAC AP-BKW

2 PIAC AP-BKW

3 PIAC AP-BKW

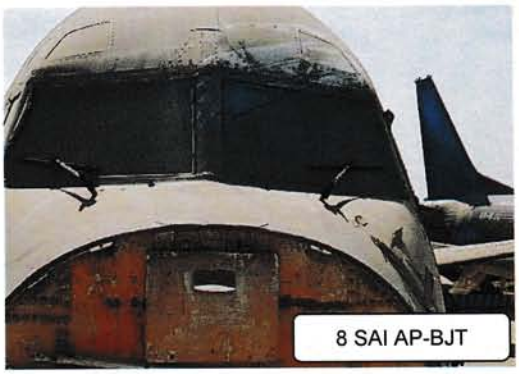
4 PIAC AP-BKW

5 PIAC AP-BKW



6 PIAC AP-BKW

7 SAI AP-BJU



8 SAI AP-BJT

S No	Description of pictures given above
1 & 2	AP-BKW propeller No 1 embedded into fuselage of dormant AP-BJU
3	Inner ply of AP-BKW cockpit LHS # 3 window got shattered
4	Rubbing marks observed on fuselage of AP-BKW left hand side from captain aft windshield up to cabin window # 11
5	Left wing tip of AP-BKW which made first contact with AP-BJT
6	All 06 blades of AP-BKW propeller No 1 damaged
7	Damaged nose radome of AP-BJU after separating from AP-BKW
8	Marks of first contact of AP-BKW left wing tip on AP-BJT

1.4. **Damage Assessment by OEM.** Subsequent to the initial evaluation by SIB, a detailed damage / repair assessment was done by the OEM (M/s ATR, France).

1.5. **Other Damage.** Two dormant B737-400 aircraft of SAI (AP-BJT & AP-BJU) were hit and got damaged during the course of forward travel of PIAC's ATR.

1.6. **Personnel Information.**

1.6.1. Aircraft Engineer was the in-charge of engine ground run-up on the date of occurrence. He is a certified staff of PIAC under category B1. He was certified on ATR-42 series. His AMEL and Certification Authorization indicates that he had ample experience to handle any emergency situation and his authorization was valid on the date of occurrence.

1.6.2. Senior Technician: (Assisting engine ground run-up and occupying F/O seat)

1.6.3. Senior Technician: (Assisting balancing on observer seat)

1.6.4. Three Senior Technicians: (outside the aircraft)

1.6.5. Aircraft Engineer: (B2 person only during earlier stage of engine ground run-up)

1.7. **Aircraft Information**. The aircraft was being maintained by PIAC in accordance with the OEM prescribed procedures and regulations of Pakistan Civil Aviation Authority, except omissions that resulted in the accident, and are described in this investigation at later stage. Aircraft data / information is as follows:-

Aircraft Make & Model	ATR72-212A
Registration Marking	AP-BKW
Manufacturer Serial No.	1036
Year of Manufacture	July, 2012
C of A (expiry date)	29/06/2019
Weekly Check inspection	31/08/18 at Islamabad (ISB)
Pre Flight Check	31/08/18 at Mohenjo-Daro (MJD)
Total Aircraft Hours	9619:15
Total Aircraft cycles	7338
Total Landings	7338

1.7.1. **Information on the Removed Components.** Not applicable.

1.8. **Meteorological Information.** There was no contribution of weather towards the accident. The weather at the time of accident was within permissible limits for safe conduct of ground run-up.

1.9. **Aids to Navigation.** Not applicable.

1.10. **Communications.** Not applicable.

1.11. **Aerodrome Information**. Not applicable.

1.12. **Flight Recorders**. CVR & Solid State FDR data were downloaded and used as reference for investigation and analysis purposes.

1.13. **Wreckage and Runway Marks Information**. An overview of the accident site has been at para 1.1.

1.14. **Medical and Pathological Information**. Injury to Sr. Technician occurred while sitting on observer seat due sudden stop of aircraft. He fell down on central pedestal. X-ray of left leg revealed no abnormality. Post accident medical examination of Aircraft Engineer was undertaken.

1.15. **Fire**. There was no fire after the occurrence.

1.16. **Survival Aspects.** Not applicable.

1.17. **Tests and Research.** Not applicable.

1.18. **Organizational and Management Information.** Engineering Management, Line Maintenance and QA of PIAC were involved in this accident.

1.19. **Additional Information.** Not applicable.

1.20. **ATC Tape Extracts.** Not required.

1.21. **Useful and Effective Investigation Techniques.** Standard investigation techniques were used.

2. ANALYSIS

2.1 The aircraft was grounded since 31 August 2018 primarily for Check-A maintenance which is accomplished after every 500 flight hours (refer Maintenance Planning Document (MPD)). This maintenance activity generally takes 02 working days, however during this grounding of AP-BKW, it's major components including brake assemblies, engines & propellers etc were cannibalized to service deficiencies on other aircraft.

2.2 Whenever any major component pertaining hydraulic system is removed, air goes into the hydraulic lines due to bleeding out of hydraulic fluid. Accordingly, once the hydraulic component is installed back, the trapped air in the hydraulic lines is required to be taken out so that the hydraulic system / components perform their intended functions.

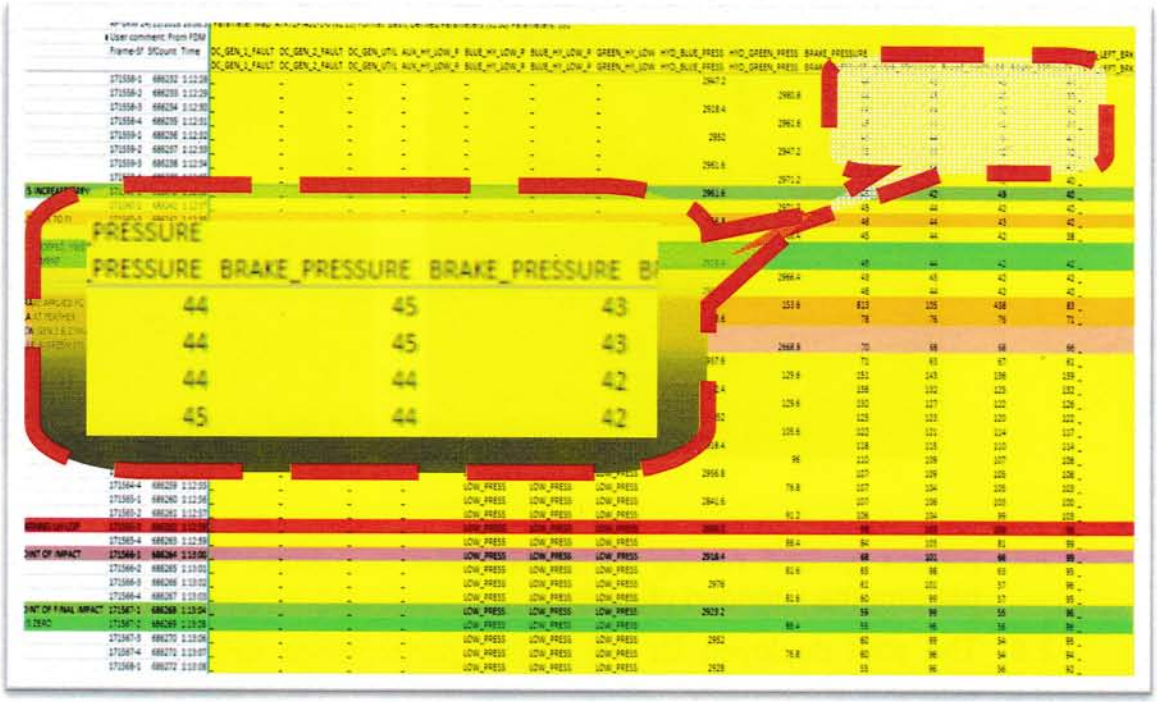
2.3 After completion of Check-A maintenance, as part of recovery plan, all the removed components including brake assemblies, engines and propellers etc were installed back. During this process, the important task of brakes High Pressure (HP) line bleeding / purging was essentially required as per JIC 32-42-00-BLD-10010. According to the Aircraft Technical Log Book (ATLB) the said task was undertaken prior to towing of the aircraft / engines run-up etc. ATLB contains documentation of following activities related to the said task.

2.3.1 Page-32-33 dated 10/11/18 ***"brake assembly HP bleeding to be carried out"***

2.3.2 Page-51 dated 23/11/18 ***"brake assembly operational check of normal braking to be carried out"***

2.4 The mentioned bleeding / purging of the brake system after the said maintenance was either not performed at all or it was performed in an inadequate manner, and it led to brake failure during engine ground run-up checks.

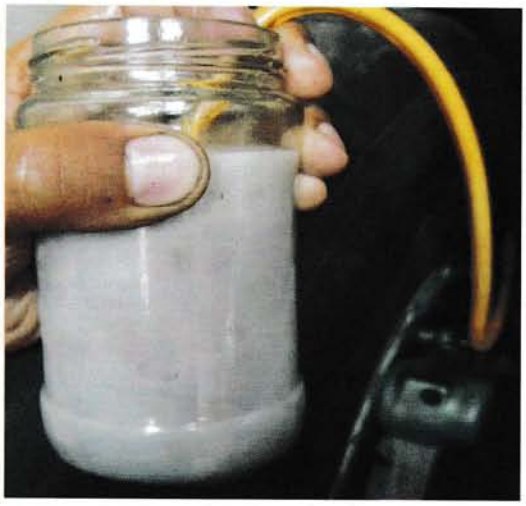
2.5 FDR was downloaded. The brake pressure throughout engine performance run-up was recorded between 39-45 psi, whereas it was required to be 3000 psi this supports the fact that there was no or very little hydraulic in brake system thus resulting in its in-effectiveness (for both normal and emergency operation). FDR data screen snapshot is as shown below: -



2.6 After the accident, bleeding / purging of the brake hydraulic system was carried out and following tests were performed in accordance with respective technical references:

Brakes High Pressure Line Bleeding	JIC 32-42-00 BLD 10010
Normal Braking Operational / Functional Test	JIC 32-42-00 OPT 10000
Emergency Braking Operational Test	JIC 32-45-00 OPT 10000
Functional Test for Emergency Brake System to Detect Degradation of Brake Pressure Loss	JIC 32-45-00 FUT 10000
Emergency Braking Leakage Test	JIC 32-45-00 CHK 10000

2.7 The above mentioned tests indicated that high pressure lines were filled with air with only very little hydraulic fluid in the system. Result of bleeding / purging is as shown below:-



2.8 Engine ground run-up permission was requested for duration of 03 hours to perform the intended checks.

2.9 The staff deployed for the engine performance run-up was authorized as per in-vogue procedures.

2.10 The engineering staff towed the aircraft and conducted this high performance ground run with major deficiencies in maintenance as well as documentation (e.g. support equipment, spares, maintenance practices, documentation and competence of personnel to perform critical maintenance tasks).

2.11 Non-standard / incompatible wheel chocks Part No W-88 (Dimensions: Height 5.5 inch, Width: 7 inch, Length: 24 inch) were placed only in front of left and right main wheels. For the nose wheel, one small rubber chock (Dimensions: Height: 7 inch, Width: 6.5 inch, Length: 12 inch) was placed in front and one wooden chock at it's back (dimensions: Height: 4 inch, Width: 5.5 inch, Length: 12 inch). It is worth mentioning here that both the chocks used for the nose wheel were meant to be used for GPU and not for the aircraft.

2.12 The OEM recommends Part No 98S10000016011 (Description: Weight: 7 Kg, Dimensions: Height: 31.5 inch, Length: 9.84 inch, Width: 9.84 inch) for ATR performance ground run-up (to be placed both at front and back of the wheels). These wheels chocks were not procured by PIAC Engineering since induction of the ATR aircraft.

W-88 wheel chock placed in front of main wheels

Non-standard chocks (GPU chocks) used for nose wheel

2.13 The wheel chocks used during the ground run-up checks were smaller than the recommended ones, were used only in front of the wheels and not at the back side of the wheels, and were and therefore did not serve the purpose.

2.14 During first ground run-up, TCAS defect was observed. Consequently, the B2 aircraft engineer (sitting on FO seat) left the cockpit for referring Trouble Shooting Manual (TSM).

2.15 During second engine ground run-up, upon selection of Power Lever for reverse position, the aircraft moved backwards for about 10 feet (owing to ineffectiveness of brakes and no chocks at the back of main wheels).

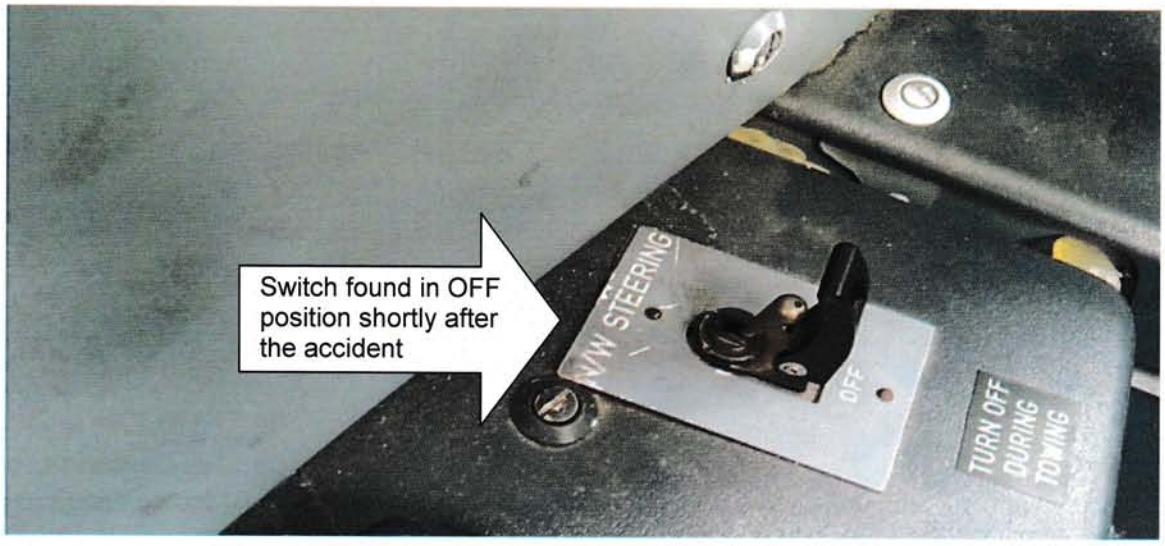
2.16 The operating ground crew (being in panic) moved Power Levers (PL) to Flight Idle (FI) instead of moving that to Ground Idle (GI) or moving Condition Lever to Fuel Shut Off position. This wrong selection of the PL at FI generated enough thrust to move the aircraft in forward direction. Consequently, the aircraft rolled over wheel chocks and continued forward travel for approximately 450 feet in an almost straight line with a ground speed of 19 knots.

2.17 Aircraft did not stop with parking brakes ON as well as with the application of pedal brakes and it's left wing tip first made contact with a dormant SAI aircraft B737 Reg No AP-BJT.

2.18 It continued to move and collided another dormant SAI aircraft B-737 Reg No AP-BJU at it's nose radome. Due to momentum AP-BKW continued rubbing its the fuselage forward section with dormant AP-BJU nose radome, and it stopped with its No 1 Engine propeller getting stuck / embedded into right forward portion of fuselage.

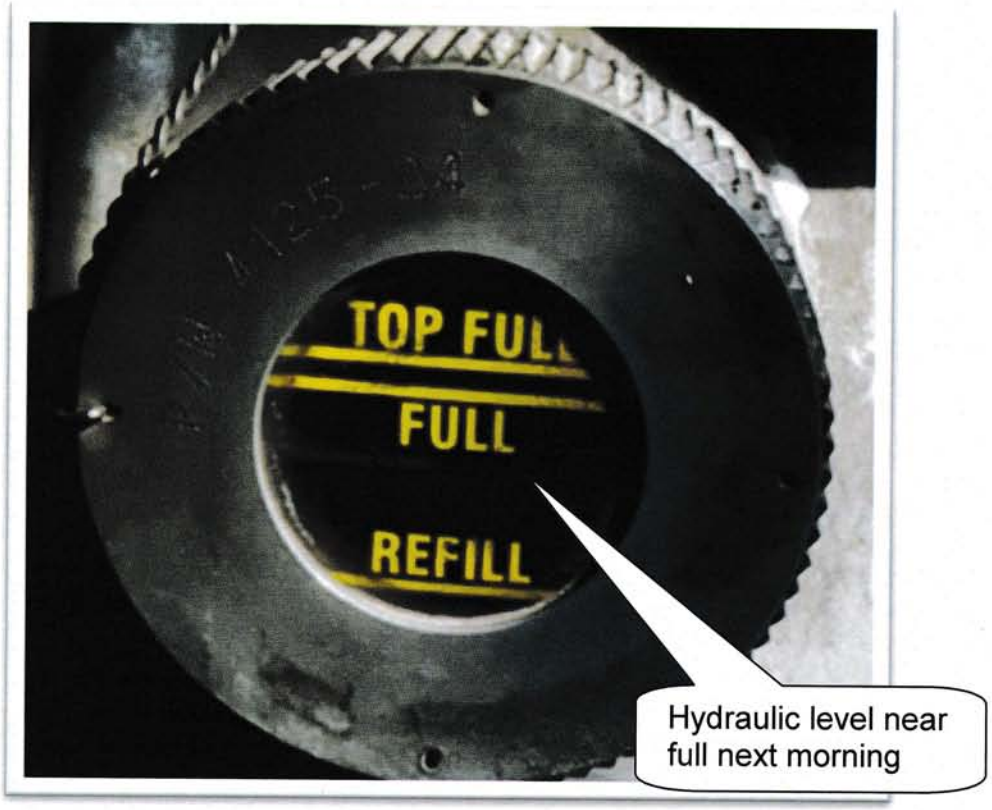
2.19 After collision of the aircraft at this time, both engines' Condition Levers (CL) were selected to Fuel Shut off position.

2.20 During cockpit inspection at the time of occurrence it was observed that Nose Wheel Steering (NWS) switch was OFF instead of ON position. Therefore the nose wheel steering was not available during the forward movement of the aircraft.



2.21 After the accident, aircraft brake system was inspected. The hydraulic reservoir quantity was found at refill level. Additionally upon opening of hydraulic reservoir

filler cap, there was no strainer. Next morning it was found filled up and a strainer was placed inside with its locking clip.



3. OBSERVATION

3.1 For the conduct of ground run-up of ATR aircraft, PIAC has incorporated a procedure. Out the pool of available, qualified and experienced maintenance engineers, few are selected and after a process (including theoretical tests / interviews and related paper work) are issued by PIAC QA with an authorization / permit to conduct ground run-up of ATR aircraft. It has been observed that this authorization (for such a critical and important activity / task) is issued without any practical tests / evaluation, conducted on the aircraft to assess the individual's competence.

4. CONCLUSIONS

4.1 **Findings.**

4.1.1 The aircraft was grounded on 31 August 2018 (since last 84 days) primarily for Check 'A' maintenance which takes generally 02 working days to complete.

4.1.2 During this grounding of the aircraft, components including engines, propellers and brake assemblies etc were taken out to fill up deficiencies on other aircraft in PIAC.

4.1.3 The engineering staff towed the aircraft and conducted this high performance ground run with major deficiencies in maintenance as well as documentation.

4.1.4 Non-standard / incompatible set of wheel chocks (smaller than recommended) were placed for nose, left and right wheels. The wheel chocks used for the nose wheel were meant to be used for a GPU and not for the aircraft ground run. No chocks were placed behind the main wheels. The chocks recommended by the OEM were never demanded / procured by PIAC since induction of the ATR.

4.1.5 The High Pressure hydraulic lines were required to be subjected to bleeding / purging after replacement of brake assemblies. The activity was documented but was either not performed at all or was performed in an inadequate manner.

4.1.6 The hydraulic lines remained filled with air and there was very little hydraulic fluid in the system. Consequently, the normal as well as emergency brakes were not effective.

4.1.7 The brake pressure throughout engine performance run-up was recorded between 39-45 psi whereas it was required to be 3000 psi.

4.1.8 Nose wheel steering was not made available.

4.1.9 The aircraft initially moved rearwards by 10 feet during a planned maintenance task of Thrust Reversal Check.

4.1.10 Seeing this rearward movement of the aircraft, the ground run operator (being in panic) shifted the power level to Flight Idle position instead of moving it to Ground Idle or moving Condition Lever to shutoff position.

4.1.11 In the absence of effective wheel brakes, proper sized wheel chocks, and nose wheel steering; and in the presence of designed thrust at Flight Idle position, the ground run operator could not control the aircraft. The aircraft continued forward movement for about 450 ft, and came to a stop after colliding with two dormant aircraft belonging to SAI.

4.1.12 The evidence of low hydraulic level in the reservoir was found alleviated next morning. A strainer in the filling neck of hydraulic reservoir, which was missing after the accident, was found to be in place next morning.

4.2 **Causes of Occurrence.** The occurrence was caused due to: -

4.2.1 Non-adherence to the laid down maintenance procedures by PIAC – in which important task of bleeding / purging of brake system was either not performed or was performed in an inadequate manner.

4.2.2 Deficiency in required maintenance support equipment at the organization level – in which recommended wheel chocks were not procured and therefore were not available for use.

4.2.3 Lack of professionalism of maintenance crew of PIAC – in which the maintenance engineer was unable to judge situation correctly and could not initiate a corrective action at an early stage.

4.2.4 Inadequate assessment process for authorization of technical personnel for engine ground run-up of ATR aircraft.

5. SAFETY RECOMMENDATIONS

5.1 M/s PIAC is required to ensure compliance of OEM requirements and approved company procedures in letter and spirit essentially required for conducting high performance ground run-ups.

5.2 M/s PIAC is required to ensure an immediate procurement of the OEM recommended chocks in adequate quantity at all applicable stations for the ATR aircraft.

5.3 M/s PIAC is required to revisit the in-vogue procedure for issuance of the license for ground run-ups for the engineers. In this regard, it is recommended that practical evaluations may be done on the aircraft prior to issuing ground run permits.

5.4 All currently licensed ground run-up operator's of PIAC may be re-assessed by including practical evaluations on the aircraft.

5.5 M/s PIAC is required to ensure that in the event of any serious incident / accident, the evidence is adequately preserved and secured.

5.6 Directorate of Airworthiness, PCAA is requested to undertake an audit of PIAC maintenance of ATR aircraft specifically for availability of support equipment, spares, maintenance practices, documentation and competence of personnel to perform critical maintenance tasks.