HQCAA/1901/284/SIB

CIVIL AVIATION AUTHORITY

PAKISTAN

AIRCRAFT ACCIDENT INVESTIGATION REPORT

PAKISTAN INTERNATIONAL AIRLINES

AIRBUS-300 AP-BBA

ON 29 APRIL 2003

AT

PESHAWAR INTERNATIONAL AIRPORT

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FINAL REPORT

ACCIDENT TO PIAC's AIRBUS 300B4 AIRCRAFT REG. # AP-BBA FLT. PK-735 AT PESHAWAR AIRPORT ON 29 APRIL 2003

Authority: Director General Civil Aviation Authority Memorandum HQCAA/1901/284/SIB dated 10th May 2003. (Appendix 'A')

Synopsis: When gears were selected down, while landing Pk-735 at Peshawar, Left Main Landing Gear extended freely in the air with a loud bang. The hydraulic oil of the system depleted and warning light came on. Left landing gear was locked in down position through standby system. On landing the Left MLG actuator was found hanging in broken condition along with other hydraulic pipes ruptured and broken. The aircraft could not be rectified for normal flight due to technical reasons, hence with the approval of CAA airworthiness surveyor it was ferried to Karachi with landing gears down and locked. In Karachi it remained grounded for 17 days for repairs. The complete Left Main Landing was replaced. The broken Left MLG actuator revealed that actuating cylinder separated from the end fitting due to Crosion/Fatigue as Service Bulletin by the manufacturer was not complied.

1. FACTUAL INFORMATION:

1.1 HISTORY OF THE FLIGHT:

1.1.1 PK 735 was a schedule flight.

1.1.2 Before landing when the landing gears were selected, A loud bag was heard and LH Main landing gear came down earlier than the Right Gear. A normal landing was accomplished. After parking on the bay the LH main landing gear actuator was found broken.

1.2 INJURIES TO PERSONS: Nil.

1.2 DAMAGE TO AIRCRAFT:

1.3.1 Complete L/H main landing gear actuator (P.No. C23130-3-7, S.No: 118 destroyed completely.

1.3.2 Down lock actuator P.NO: C23118-1 retune line fitting bracket bolts found pulled from actuator body and line ruptured. Hydraulic leakage observed form down lock actuator return line fitting.

1.3.3 Down lock actuator mounting bush at lower end of the folding side strut found pulled and raised portion of forging found cracked.

1.4 OTHER DAMAGE:

The lower attachments of hydraulic lines were detached

1.5 PERSONAL INFORMATION:

Captain Information:

Name:	Capt. Salman Azhar
P-No:	37500
Date of Birth:	15-12-1955
Validation of License:	Lic/1R Jan 04
Medical Category:	Class-1
Experience on A-300:	330:26-09/08/03
Total Experience:	P-1 6979:09
Mandatory Check:	29/07/2003
License:	ATPL No. 625
Validity of License:	Jan 04
Grand Total:	12605:26

Second Pilot Information:

Name:	F/O Shahzad Ali
P-No:	51744
Date of Birth:	26-09-70
Validation of License:	Lic/1R Jul 04
Medical Category:	Class-1
Experience on A-300:	P-2 1151:04-19/08/2003
Total Experience:	P-2 6155:56
Mandatory Check:	10/06/2003
License:	ATPL No. 1604
Validity of License:	Jul 04
Grand Total:	6472:49

Flight Engineer Information:

Name:	F/E Afridi
P-No:	35899
Date of Birth:	30-07-1953
Validation of License:	Jan 04
Medical Category:	Class-1
Experience on A-300:	10654:05-20/08/2003

- Total Experience: 13471:18
- Mandatory Check: 23/04/2003
- License: F/E Lic No.210
- Validity of License: Jan 04
- Grand Total: 13471:18

1.6 **AIRCRAFT INFORMATION:**

1.6.1 The aircraft was Airworthy at the time of accident and there was no reported defect of the system in the tech log book.

1.7 **METEOROLOGICAL INFORMATION:**

1.7.1 Weather was fit for flight and no NOTAMS were issued.

1.8 **COMMUNICATION:**

1.8.1 A recording of CVR communications was obtained, however due to overlapping of channels and various noises, it could not be reduced to writing.

1.9 **AERODROME INFORMATION:** Non-Factor

1.10 **FLIGHT RECORDER:**

1.10.1 DFDR was available and occurrence was in conformity with the information recorded for different parameters.

1.11 **WRECKAGE AND IMPACT INFORMATION:** Not applicable.

1.12 **MEDICAL AND PHYSIOLOGICAL INFORMATION:**

1.12.1 Not applicable

1.13 **FIRE:** No fire occurred.

2. Technical Investigation:

2.1 **Accident**

2.1.1 On AP-BBA PK-735 when landing gear were extended for approach at Peshawar. The LH MLG actuator broke. The operational cum technical snag recorded that when landing

gears were selected to down position (See Appendix 'B').

2.1.2 A very loud bang was heard by Pilot.

2.1.3 Vibrations were felt in the whole airframe.

2.1.4 The Left MLG indication on both panels became "GREEN" 10 seconds earlier than the indication for right MLG and Nose Landing Gear.

2.1.5 All vibrations disappeared and every thing seemed normal to aircrew.

2.1.6 On finals inbound course Green hydraulic quantity depleted. On landing, it was observed that LH MLG actuator and hydraulic lines were hanging with the aircraft wing. There was lot of hydraulic splashed around the damaged hydraulic lines. The other observation were as follows:

a. L/H main landing gear actuator piston rod (Part No: C 69029-2, item 250, Messier Dowty CMM chapter 32-34-48) at its attachment fork end fitting with aircraft structure found broken and detached. Location of broken rod is shown at Appendix 'B'. Actuator piston found in gear up configuration. Restrictor (Part No C.24273-3-1, S.No.P.095/88) found leaking from body.

b. Down lock actuator (part No.C.23118-1-0, S.No. P-095/88) return line fitting bracket bolts found pulled out from actuator body & hydraulic lines found ruptured. Hydraulic leakage observed from down lock actuator return line fitting.

c. Down lock actuator mounting bush at lower end of the folding side strut found pulled out. The raised portion of forging found cracked.

d. Fuel leak observed at No.1 tank from wing lower skin front spar area under access panel 512Kb inboard of pylon & rear spar rib.1.

2.2 Release of aircraft for Ferry Flight

2.2.1 The aircraft was ferried from Peshawar to Karachi, with safety pin installed and Landing Gears in down and locked position, As a flight with safety pins installed is not covered by MEL, therefore, it was done with the approval of CAA after inspections.

2.3. Identification of Landing Gear Actuator

2.3.1 The landing gear actuator is a serial numbered item, which is provided by manufacturer on an identification plate. As no such plate was found on the broken actuator, hence its serial number was traced out from the original documents of the aircraft. These were provided to the document section at the time of delivery of the aircraft in 1980. The serial number was found to be as U118 at page 72 (Appendix 'E'). The records of MLG shop since1992 to 2001 did not include this serial number. (Appendix 'F') The appendix shows that S. NO. 98, S. No. 26, S.No. 77, and S. No. 115 came to the shop three times where as S.No.77 was inspected in the shop twice during last 10 years. The data indicate that Landing gear shop did not have any system for monitoring the condition of MLG actuators installed on aircraft since their induction in PIA. It also exposes the low reliability of rectifications carried out by the Landing Gear Shop.

2.4 Hydraulic Fluid Testing

2.4.1 A sample of hydraulic fluid was taken from failed MLG actuator. The fluid was found with high particulate contamination. (Exhibit 'G'), For instance particle count of more than 100 micron was 465 against the recommend Airbus limit of 64; almost 700% more than the limit. The testing could not indicate the nature of contamination. It may be noted that the fluid inside the actuator can not be contaminated unless some seal is in bad shape i.e. contaminant has a passage to enter. The contaminants are a source of Fatigue initiation which results in fatigue failure.

2.5 Restrictor Filter

2.5.1 The restructure filter can also cause material failure of end fitting or rod assembly. However as the restrictor is responsible to apply a controlled hydraulic force on the assembly, hence any restrictor malfunction would give rise to jerky movements and ultimately an early instantaneous failure. The restrictor could not be given functional test due to non availability of complete set of LG actuator. The subject restrictor has been installed on other aircraft and working satisfactorily (Appendix-'H').

2.6 Working of MLG Actuator

2.6.1 Main Landing Gear actuator is installed at one end to aircraft wing structure and to MLG at other end. In addition to its attachment design with wing and MLG, It encompasses a cylinder inside its main body, which increases or decreases the total length of the actuator assembly thereby causing extension and retraction of MLG. The end fitting is attached to cylinder body through a threaded portion, which enables adjustment of the actuator length as shown on page 10 of (SB 470-32-730) Appendix 'L'. This portion is covered with a lock nut after tightening it to required limit. The lock nut can not cover the entire threaded portion due to design limitation. Hence the exposed threaded portion are covered with a sealant to avoid initiation of any nick, moisture scratch and corrosion. See Appendix 'C-1' page 100-00-for complete actuator.

2.7 Examination of Fractured Surfaces

2.7.1 The fractured surface photographs are at Appendix 'J-1' to 'J-6'.

2.7.2 Appendix 'J-1' shows the MLG actuator in two broken parts. Appendix 'J-2' shows a close view of fractured surface of the end fitting-inner view showing cup of tensile fatigue failure. Photographs in Appendix 'J-3' and 'J-4' also very clearly show the fractured surfaces.

2.7.3 Fractured surface can be divided into two distinct portions i.e. one dull but smooth with lines or beach marks. The second portion of fractured surface is shining-bright and is of rough surface. This entire texture is a typical Fatigue fracture. Appendix 'J-5' and 'J-6' are side and top views of the same fractured part exposing the fractured surface for visual examination.

2.7.4 The presence of fatigue crack was initially confirmed with the help of a magnifying glass. The comparison of two distinct areas i.e. dull VS shining appeared to be 40-60 It explains that 40% cross–section area has failed earlier due to Fatigue and remaining 60% failed on the day of occurrence as an instantaneous failure.

2.8 Discussion on Causes of Fatigue Failure

2.8.1 The real cause of Fatigue o is yet to be determined by metallurgists. However there are number of hypothesis / postulates which are considered to be the cause of Fatigue. The basic research on fatigue is based on the fact that no material can be produced without any flaw in its micro structure. These flaws are termed as "discontinuities" in the lattice formation. However due to multiple causation factors, if these discontinuities are precipitated at one place and form a "critical length crack", then under the action of cyclic loads the crack length increase and spreads to weaken the effective stress bearing area and ultimately the remaining area fails. In such an eventuality the fatigue is attributed to some metallurgical deficiency.

2.8.2 The second most common cause of fatigue failure is presence of an stress raiser or source of stress concentration. It could be present by design in the form of abrupt change of cross section of the part, however in case under discussion the failed assembly is smooth except the threads. The other common source of stress is maintenance error, which could be a scratch, nick or minor corrosion. These initiate at the surfaces exposed to environments and workers.

2.8.3 In our case the origin of Fatigue is from the periphery i.e. it had a surface opening. Appendix 'J-4' and 'J-3', the pictures of Fatigue

texture very clearly show that Fatigue process started from a surface perpendicular to the plane of tensile loading.

2.9 Metallurgical Examination at Airbus Industries

2.9.1 The metallurgical examination could have been carried out in Pakistan as there was no obligation on PCAA to dispatch MLG actuator to Airbus France. However it was done on the recommendations of Airbus Industries taking into consideration their experience, background, knowledge and information on the entire population of actuator; the same was requested by Airbus. The failed MLG was dispatched in June 2003 to Airbus.

2.9.2 Airbus Industries has taken more than one year for the task and yet the actual report is awaited. It sent following information through a telex (Appendix 'W').

> "A fatigue process has damaged the rod of A300 MSN 114. In fact, the plane of fatigue is perpendicular to the axis of the rod and shows that the initiation is due to tensile loading and that fatigue initiation occurs early in the part life (probably before 4000 flight). The initiation sites are located at the root of the first thread. From 3mm to 15 mm crack length 37000 cycles have been measure. Then the thread of the rod was stripped off under the effect of the propagation of cracks initiated at the thread roots".

2.9.3 The telex in the end suspects the restrictor filter and promises to provide feedback by week 35. The feedback and detailed report is still awaited.

2.10 History of Similar Defect

2.10.1 The MLG actuator is an on condition item as per the maintenance categories of overhaul inspection defined by FAA (Appendix 'Q') On-Condition means that the part will be overhauled if found with some defect during a specified inspection. Additionally the vendors

and manufacturer i.e. Messier Bugatti for Main Landing Gear Actuator and Air Bus Industries for Air Bus 300, monitor the condition of the entire population of parts in service. After receiving occurrence information on the component, they gather information from all operators and after analysis, issue service letter (SL), and Service Bulletin (SBs). These contain the reasons for, related information, actions required, parts needed, manufacturer requirement and time frame within which the SB is recommended for implementation. At initial stages the contents are for information and at latter stage these are approved by regulatory bodies. In this case recommendations were approved by Director General. DE-LAVIATION CIVILE (DG AC).

2.10.2 The history of a similar defects on MLG actuator was traced out. It was learnt that in 1989, a main landing actuator of A-300 B-4 broke in a similar manner. At that time it was considered to be as isolated case but it was enough to trigger a series of condition monitoring activities by Vendor (Messier BUGATTI), Manufacturer of Air Bus and operators around the globe. All activities were aimed at avoiding a recurrence. The investigation into the 1989 occurrence by Messier Bugatti and closely followed by Air Bus Industries, revealed that absence/damage of rubber sealant in the areas shown Appendix 'K' was cause of the failure. Therefore, it was addressed to all operators. Contents of this service letter is reproduced here for appreciating the subject investigation.

2.11 "The free fall extension of a main landing gear occurred during the L/G operation sequence on approach, without any detrimental effects on safety. On the actuating cylinder it was noticed that the end fitting threads had been stripped as a result of corrosion, which caused the end fitting to become detached from the rod. This is considered currently an isolated case. The examination of the actuating cylinder has revealed the absence of rubber sealant in the areas shown on the figure on page 3. The purpose of this Service Letter is to remind the operators that they should visually inspect the rubber sealant and note its condition on the joint lines

between the end fitting and the nut, and between the nut and the sleeve (refer to the figure on page 3).
A request for information on the condition of the rubber sealant has been made through the MESSIER-BUGATTI fax No. 4557/90 dated December 1990 and the AIRBUS INDUSTRIES OIT reference ST/999-0292/90 dated January 04, 91".

2.12 **Failure to respond the Inspection Campaign initiated through SL 470-32-714 dated 15 April 1991.**

2.12.1 The subject Service letter was simply a post occurrence action. A request by Messier Bugatti for inspecting the condition of rubber sealant bead of all MLG actuators and despatching the information as per Performa attached to it. It required PIA to Inspect all MLG actuator and furnish information as follow:

A/C	MLG ACTUA. CYL.		POSITION	TIME SINCE		PLACE OF	INSPECTION OF SEALANT	
MSN	P/N	S/N	LH/ RH	NEW	OVHL	OVHL	DATE	CON-DITION

2.12.2 Messier Bugatti had earlier requested for the same information through Fax No. 4577/90 dated December 1990 and the Air Bus Industries OIT reference ST/1999-02 92/90 dated January 04 91. A sheet was attached that the service letter did not require any action by the operator who had already conducted inspection and had also sent information sheet (filled) to the vendor as a response. PIAC engineering could not produce these documents. The service letter was a formal means to collect the same information after inspection of Landing Gear sealant and following was to be communicated to the vendor.

> "Weather the rubber sealant bead is complete and in good condition in both areas mentioned above the rubber sealant beads are crazed or insufficiently adherent there is a partial or full absence of the rubber sealant."

2.12.3 PIAC Engineering (Technical Library) did receive this service letter but it could not be established as to when it was distributed. Manager Quality Control, witness number 7, Engineer Sheikh Muhammad Yousuf P-18127 who had worked in hydraulic shop for 30years states that he had never seen this Service Letter and he held Engineering Development (aerospace) responsible for this omission.

2.13 Importance of Sealant and its Good Condition at joints of MLG Actuator.

2.13.1 The rubber sealant is applied at the peripheral joint lines between sleeve and nut, and, at nut end fillings. This sealant is actually a' final fix or fit' in the assembly/testing of MLG actuator. It seals the otherwise exposed surfaces of end fitting rod assembly, nut and check nut along with threads. Any crazing, breaking, missing of rubber sealant would expose the critical surfaces to moisture dirt, grease and dust. It increases possibilities of developing stress raisers through maintenance malfaction in the form of nicks, scratches, and cuts by tools add pebbles which hit LGs during take off and landing. These nicks scratches, cuts or other damages of even micro sizes become a source of stress concentration and become a catalyst to fatigue phenomena which is unavoidable. Damage to the important rubber sealant was determined as a cause of occurrence and was treated as an isolated case in 1989. However by the service letter dated April 15 1991, data on entire population was requested for future action. However PIAC engineering did not act on service letter and a chance to know the state of all MLG actuators health in PIAC's A-300 B-4 fleet was lost.

2.14 Non-Compliance of Service Bulletin

2.14.1 After collecting information through Service Letter 470-32-714 dated 15th April 1991; Messier Bugatti issued a Service Bulletin No 470-32-730 which Titled, Inspection and reconditioning of the threads at rod/end fitting attachment. It may be noted from earlier discussion and investigation into service letter

that sealant seals the critical surfaces. In service use it is either broken, crazed or turn into poor condition at the rod/end fitting attachment. There by exposing critical surfaces to environment. The Service Bulletin explained these reasons and recommended that special inspection be carried out with in 4 months for all actuators which are more then $5_{1/2}$ years old (see page 4 of SB 470-32-730 dated 10th April 1992 attached as Appendix 'L'. Since all PIA A-300 aircraft were older than $5_{1/2}$ years in 1992(Manufactured in 1980), the inspection should have been carried out.

2.14.2 Even if the action on Service Letter 470-32-714 had been missed out, a professional attention to the contents of Service Bulletin SB 470-32-730 could have provided an opportunity to inspect condition of rubber Sealant on all MLG actuator of A-300 fleet of PIA. It required the following effort.

> "One Mechanic for two hours to Inspect the Sealant at the sleeve/lock nut/end fitting Joining lines and apply first-adhesion sealant. The cost of this effort was negligible. It is again emphasised that the action on subject SB should have been taken within 4 months after receipt of the SB. The same interpretation was given by Manager Engineering Development (AE) Mr Feroz Akhtar (Reference Answer to Q. No. 14.) and airworthiness inspector (witness No.8)".

> During Investigation, a detailed scrutiny of the contents or actions required by the SB 470-32-730 revealed that it was not read by a competent person. A paragraph at the end of page 14 is reproduced.
> **"SEND ALL THE RESULTS OF SEALANT INSPECTION AND CORROSION INSPECTION TO MESSIER-BUGATTI PRODUCT SUPPORT (DC/VA/A) FAX 33(1) 46298531 BY MEANS OF THE INFORMATION SHEET ATTACHED TO THIS SERVICE BULLETIN".**

2.15 Information sheet, intended to collect data, was designed comprehensively by the vendor that it ensured a foolproof inspection of the MLG actuator problematic areas. However no action was taken due to reasons to be mentioned latter. Two interesting Paragraphs from SB 470-32-730 (Appendix 'L') are reproduced here Page 2 Para! B(3) (Reason).

a. "It is recommended to accomplish this special Inspection service Bulletin within the times indicated in paragraph C. (2)". i.e 4 months for PIAC A-300 aircraft. Para I.D. Page5.Approval.

b. "This Service Bulletin has been approved by the DIRECTION GENERAL DE L' AVIATION CIVIL (DGAC)-FRANCE".

2.16 **Non Compliance of another Follow-up SB by Messier Bugatti**

2.16.1 "Messier-Bugatti issued yet another Service Bulletin SB – 470-32—725 on 30th April to include "threads on the end fitting lock nut" for cadmium plating". This was to be accomplished in the workshop during a repair or revision in the main landing actuating assembly. The SB attached as Appendix 'K' is still outstanding

2.17 **Maintenance philosophy of Service letters and Service Bulletins**

2.17.1 To appreciate the core purpose of SL and SBs, one has to understand three basic general design requirement / considerations for aircraft / aircraft parts. These are:

a. Static – Strength requirement / Considerations.

b. Dynamic or cyclic load considerations.

c. Service life i.e environmental effects consideration.

2.17.2 It also included the culture/behaviour of workers, skill level, attitude and response to technical literature.

2.17.3 In aircraft design the first two considerations are taken care through basic design parameters ie strength of materials, dimensions and shapes of parts in accordance with expected spectrum of static and dynamic loads. For last consideration continuous monitoring of the condition of entire population of parts in service is carried out .by operators. It may be noted that the landing gear and its actuator are critically exposed to three kinds of loads static, dynamic and service life effects.

2.17.4 The environmental effects are minimised either through protective film of painting, plating, sealing or covering the metals through adhesive chemicals However this is not possible at certain places where relative motion takes place or where parts are joined by threads and locked by nuts. Landing gear actuator is one such example hence the basic purpose of rubber sealant application was an application of design requirements. The moment it brakes due to environmental effects such as crazing, it exposes the inner parts for multiple attacks of environment, including accidental hit by foreign material during landings and take offs, initiating stress concentrations, which expedite the process of Fatigue and ultimately result into material failure under normal operation.

2.17.5 Two independent departmental inquires same findings

2.17.6 The purpose of rubber sealant application and its continuous good condition was to protect exposed areas from environment. To ensure this the Vendor issued a series of instructions through SL and SBs but action at PIAC was missed out due to number of reasons. It is interesting to note that within few days of the occurrence two parallel inquiries were conducted into the failure; one by directorate of airworthiness, CAA and other by Quality Control Department of

PIAC Engineering. Both were departmental inquiries and were conducted independently with out any collaboration. Accidentally and interestingly both inquiries found that SBs were missed (Appendices 'X' and 'y').

2.17.7 Investigations established that action on the SBs, received in 1992 was not taken due to lapses on part of procedures and individuals. Compliance of the Service Bulletin could have avoided this occurrence. It was also noted that during initial investigation, Quality Control department failed to provide factual information to the director engineering resulting in misconception regarding these SBs at higher level.

2.17.8 SB 470-32-725 and 470-32-730 explain that breakage/ damage / absence of a sealant on the joint end fittings and actuator cylinder of landing gear actuator can lead to initiation of corrosion at threads which are used to attach actuating cylinder with hand fitting (see picture). This sealant was to be inspected and depending on the results appropriate action was required. As this SBs were missed not / not evaluated by PIA hence no inspection was carried out at the entire fleet of Airbus 300 B4. PIA is now incorporating these relevant inspection which were suppose to be actioned in 1992.

2.18 Cause of Failure to comply SBs and SLs

2.18.1 There are number of causes which lead to non-compliance of Service Bulletin and one of the basic cause is that Engineering and Maintenance Procedure Manuals (EMPA) is not being followed systematically.

2.18.2 It would be very interesting to read the policy of Modification control record on Page-2, Para-4 EMPM volume 8 (Development Engineering division. Following policy is reproduced to appreciate the root cause of such weaknesses such as failure to follow service bulletin issued by vendors/manufacturer.

"Since the effectiveness and utility of a Service Bulletin is directly judged by the personnel undertaking the overhaul repair or maintenance and is monitored by Quality Control associates, they have to extend a positive contribution in SB evaluation committee. Development Engineering provides background information like industry experience, possible alternates, effect on other systems and operational parameters; and Engineering Analysis. As Development Engineering is the focal point for all such literature, information and records, it is their prime responsibility to ensure evaluation recording and dissemination of all SB's evaluation. Maintenance Manager (Mod) provides cost and material requirement information in the evaluation process, Central Records of all modification information, its literature, initial evaluation, final evaluation and feedback on incorporation-floor to Development Engineering. Development Engineering to manufacturer / vendor, shall be available upto date with the Development Engineering Division. While incorporation of an evaluated modification shall be responsibility of the shop concerned, a timely feedback to the Development Engineering shall also be ensured by the same shop. However information to the manufacturer or vendor shall be the responsibility of the Development Engineer in order to update the catalogue (IPC&MM) supplied by the manufacturer."

2.19 Categorisation / Evaluation Form

2.19.1 Form No 10.007A dated 04-01-1989 an evaluation notice is shown as Appendix 'O'. It shows how technical literature of vendor is evaluated. It is either categorised as mandatory time barred, mandatory, essential, information only, deferred, not desired etc. The Service Letter 470-32-714 and SBs 470-32-730 and 470-32-725 were neither evaluated nor categorised. Appendix 'P' shows PIAC form 10-002A which shows evaluation

committee recommendation / actions required. As these SBs were not even categorised hence no action or recommendations were made by any evaluation committee. Vendor SB / SIL standard distribution list shown as Appendix 'X' for Messier Bugatti also does not contain SL 714 and SBs during that period.

3. Conclusion

3.1 The MLG actuator broke due to Fatigue which was initiated due to environmental effects on the rod and end fitting joints. PIAC Engineering, firstly failed to monitor the Condition of MLG actuators of it fleet and secondly missed the opportunity to react to the condition of MLG actuator, provided by a series of technical literature sent by Messier Bugatti and Airbus Industries. It caused an abnormal loss of 0.8 million US $ by conservative estimates. The occurrence could have been avoided by following Engineering Maintenance and Procedures Manual. It defines the evaluation procedure for Service literature and the control and implementation of aircraft and component modifications originated from within PIA or received from out side source.

3.1.1 **Observations**

Visits of Representatives from Messier Bugatti

3.1.2 Two Representative of Messier Bugatti Mr Ben EE. Senior Technical Support Engineer and Mr Siva K. Adminsitrateur Support du Client Visited CAA and had a meeting with President SIB and PIA's Technical member. During the meeting a number of queries were raised by President SIB and reps of Messier Bugatti promised to provide information. However they are yet to responsed after elapse of one year. Their understanding on the subject whether SBs are issued for isolated cases or after collecting data thorough entire population was contradicting. At one stage they said that SBs could be issued on a single isolated occurrence. When asked as to why SBs were not issued on a number of single occurrences in PIAC, they adopted the position that SBs would have been issued only if there were a number of occurrences. Subsequently, they pointed out that the SB on MLG actuator was issued after noticing some problem on similar parts of the aircraft. On our questioning as to which are the other parts and why information on them has not been provided, the vendor's representative promised to provide information. The same has not been received yet. As a matter of fact the meeting did not serve any purpose for material failure investigation. It now appears that these reps were not investigators rather interested in supply of parts.

Detailing Members for Investigation

3.1.2 AME Mr. Javed Ansari was detailed as member of Investigation Board on 10th May 2003, whereas the individual was to proceed on deputation in June 2003.

3.1.3 Mr. Javed Ansari was replaced by Engr. Aftab Zafar who was to proceed on LPR.

Flight Safety Awareness

3.1.4 PIA technicians and engineers are generally found good at their work centers, however their knowledge of engineering materials, design requirement, safety philosophy and technical literature is inadequate.

3.1.5 The vigour, dedication and inquisitiveness to investigate cause of occurrence/failure and then use it for educating others to avoid

recurrences was missing. The attitude towards accident investigation was indifferent.

3.1.6 Evidence of occurrences was not preserved in the form of photographs by Technical Services or Corporate Safety for records/education purposes.

Departmental Behavior

3.1.7 At a number of stages it was felt that attitude of PIAC Engineering personnel coordinating Investigation activities, was defensive and indifferent.

3.1.8 In first stage the Landing Gear Engineer Javed Ansari, provided incomplete SB 470-32-730. He provided only one page of subject SB which was only the summary and not the SB itself which consisted of 14 pages. This was learnt only when a copy was obtained from Main Library.

3.1.9 Later, while the Production and Quality personnel understood that important SB were not incorporated and their timely implementation could have avoided the occurrence; they provided wrong and incomplete information to Director Engineering PIAC. In this regard response by PIA Engineering to PSIB, is reflective of this defensive behavior. The SIB CAA letter and PIAC Engineering response are attached at Appendix 'U' and Appendix 'V' respectively. SIB in its letter addressed to Chief Pilot Corporate Safety drew their attention to material failure due to inadequate maintenance and lack of skills to perform structural testing and evaluation. PSIB cautioned against the possibility that the facts might be covered by vendor / manufacture if the MLG is sent with out the investigator from SIB.

3.1.12 These genuine concerns and apprehensions which were expressed by PSIB for ensuring impartial investigation by vendors However PIA engineering wrote a letter containing contradictory and incorrect information and expression of complacency. (See pages 4,5 and 6) of Appendix 'V'.

3.2 FINDINGS

Occurrence

3.2.1 Aircraft AP-BBA was operating PK-735 Islamabad-Peshawar on 29-04-2003.

3.2.2 When landing gear lever was selected to down position there was a loud bang and airframe vibrations. The (LH MLG green indication) came 10 second earlier than indication of landing gears on panels for NLG and RH MLG.

3.2.3 Later all gears indication were normal and on final approach green hydraulic (quantity depleted) light/quantity.

3.2.4 In post flight inspection the L/H MLG Actuator (P No C 23130-3-7) was found broken and detached at its attachment fork end fitting.

A/c Documents

3.2.5 There was no identification plate on MLG actuator to indicate its serial number, part number and other identification details.

3.2.6 The failed hydraulic landing gear actuator had not gone to the LG shop for any inspection since its installation on AP-BBA by manufacturer in 1980.

3.2.7 S.No. of MLG actuator, was traced from the aircraft delivery documents, (Brief Rundown on SL, SBs after isolated case in 1989).

Handling of SBs and SLs (Manufacturer/Vendor)

3.2.8 Service letter SL 470-32-714 was available at Technical Publication Department but the same was not distributed. Where as SBs 470-32-725 and 470-32-730 were distributed as per distribution list (Witness No.5).

3.2.9 Non-compliance for procedure of handling SBs and ADs given in Engineering & Maintenance Procedure Manual (EMPM) Vol 8 chap 8-4-00-=14 dated 17 Nov 1996 resulted in non-evaluation of SB 470-32-725, SL 470-32-714 and SB 470-32-730.

3.2.10 Engineering Development (Aerospace) could not produce the Evaluation Record of SBs 470-32-725 and 470-32-730.

3.2.11 Engineering Development's practice for evaluating vendors SBs is in contradiction with the PIAC policy document EMPM 8-4-00-14 (para 4).

3.2.12 Service letter 470-32-714 was not evaluated as per para C-5(a) page 7 of EMPM. Had it been evaluated even as a Non-Mandatory Document, the required Inspection could have detected presence of Stress Concentration.

3.2.13 Inspection of MLGs for the purpose of providing information to vendor as requested vide SL 470-32-714 could have resulted in substantial savings i.e. cost of repair and loss of revenue due to grounding of aircraft for 17 days.

3.2.14 A complete updated record of all technical literature received, evaluated or deferred is not being maintained by Quality Control (QC) of each section. The same is not being monitored centrally by Engineering Development.

3.2.15 The action on SB 470-32-730 was completely missed out by Engineering Development (Aerospace) who is suppose to be the focal point for monitoring and recording all activities concerning ADs. SBs etc. (EMPM volume & chapter 8-4-00=14 Page 8 dated 17 November 1996 item 7).

3.2.16 SBs No. 470-32-725 and No. 470-32-730 were received but not categorised/classified as essential, not Desired or even Deferred as per para B-5 page 2-3 of EMPM.

3.2.17 SBs and other service literature received in the main Technical Literary (Development Engineering) is not vetted or Compared with any master index of the total releases of the SBs by the vendor/manufacturer to detect deficiencies.

3.2.18 Engr. Sheikh Mohd Yousuf witnesses No.7 had worked in component overhaul shop for thirty years (1967 to 1997). He states that SBs on Hydraulic components are received in shop from technical library directly and evaluated by quality and production engineers. In case they decide its non-implementation, no action other then placing it in the library is taken.

3.2.19 Vendors Modification/Evaluation Committee meeting is not held regularly as per contents of EMPM volume 8, section 8-4-00-14 dated Nov 17, 1996. No such meeting to evaluate vendors SBs was held since 1992.

Material Failure

3.2.20 43% of the 430 actuators inspected globally by Vendor/Manufacturer were found with the worn out rubber sealant or sealant not in place.

3.2.21 The hydraulic fluid from failed actuator showed high particulate contamination.

3.2.22 Main Landing Actuator's rod assembly P NO C69029, which is threaded into Fitting end P No C-66510-4, failed due to fatigue.

3.2.23 The rod assembly failure is categorised as Fatigue Failure).

3.2.24 Possibility of any metallurgical deficiency as a cause of Fatigue is ruled out through analysis of fractured surfaces by Airbus France.

3.2.25 The Fatigue had started in the early life of the component i.e. since 4,000 cycles and continued for another 34,000 cycles.

Inordinate Delay in analysis of Material Failure

3.2.26 The actual report on material analysis has not yet been received from airbus customer services in spite of lapse of $1_{1/2}$ year.

3.2.27 The extracts from the Material Analysis of Fatigue failure provided by customer service are incomplete and contradictory.

3.2 28 Metallurgical Examination of the failed MLG actuator was conducted in the absence of technical Investigator contrary to ICAO Annex 13 recommendations due to inadequate co-ordination by PIAC.

Directorate of Airworthiness

3.2.29 Airworthiness checklist to conduct ''C of A'' inspection at PIAC aircraft is dependent upon a certificate submitted by CEQC STATING THAT NO MANDATORY INSPECTION IS OUTSTANDING.

3.2 30 The present procedure of airworthiness can neither ensure that all ADs SBs or SLs are evaluated nor detect if any AD, SL or SB is missing from list submitted by CEQC.

Corporate Safety – PIAC

3.2.31 The role of corporate safety in promoting positive attitude towards safety amongst engineers and technicians is missing. There are no visible efforts to learn from occurrences.

Finalisation of Accident

3.2.32 The occurrence is finalised as

a. Avoidable - Human Factor.

b. Material failure due to non-compliance of laid down procedures given in Engineering Maintenance and Procedures Manual Vol. 8

3.2.33 The cost of damage is approximately US $ 888,246: It includes.

a. Cost of failed MLG actuator: ($ 56126.00)

b. Loss of revenue due to Aircraft being on ground repairs for 17 days: ($ 776520.00)

c. Cost of man-hour. ($ 55600)