

Importance of turbine engines overhaul and repair engineering essay

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Vidal SanchezMr. KahanekPP1. 702Importance of turbine engines overhaul and repairEngine overhaul is the process of maintaining and restoring the engine and its components to serviceable conditions. An engine overhaul consists of disassembly, inspection, reassembly and testing prior to return to service. It is required and essential to check the engines and its components prior to a flight in order to maintain safety. Turbine engines have to be overhauled after certain period of servicing. This period of servicing is called Time between Overhaul (TBO). Time between overhaul is stated by the engines manufacture. For a turbine engine Time Between Overhaul is not always specified, instead some manufactures establish a recommended Time Between Overhaul for individual components or sections. However, an engine is not being operated for a long period of time and it needs to be overhauled before returning to service. If the engine is used less frequently, it can become corroded by moisture and oil corrosives. An engine's time between overhaul can vary depending on the exposure to extreme conditions such as dust, salt water, and high or low climate temperature. One of the most common reasons for engine failure is FOD (Foreign object damage). Foreign Object Damage can occur any time when an external object is drawn into a turbine. The level of inspection in case of Foreign Object Damage depends on the amount of damage. If little damage is made in the turbine, only a borescope inspection is necessary. If a major grade of damage is clearly visible, the engine has to be completely removed and overhauled. Foreign Object Damage can occur anywhere at any time. On January 15, 2009 US Airways Flight 1549 scheduled a commercial passenger flight from New York City to North California. About 3 minutes after takeoff

multiple bird strikes occurred damaging both engines. This caused an immediate and complete loss of thrust. Being unable to reach an airfield, the crew of the aircraft decided to turn southbound and do an emergency landing over the Hudson River. Landing on water is a very difficult maneuver to achieve, but the aircraft landed successfully and all 155 occupants safely evacuated the aircraft. If it wasn't for the crew's ability and experience, this event would have ended in a catastrophic accident. This is just one example of what Foreign Object Damage can cause. (1) Other reasons for engine failures are thermal stress, hot start, internal oil leakage and excessive vibration among others. All of these are causes for engine repair and overhaul. If inadequate or no maintenance is done on an engine when it is needed, the engine can fail during flight. Improper aircraft maintenance contributes to most of aviation accidents. A small portion of maintenance tasks are performed wrong or not performed due to human error. These errors can be missing parts, parts installed incorrectly or skipping necessary checks. Maintenance work requires clerical skills and attention to detail. From 1994 to 2004 42% of fatal airline accidents in the United States were because of maintenance problems. These accidents were caused by a breakdown organization process, culture and decisions. But human error keeps showing as the weakness on maintenance problems due to lack of motivation, fatigue and stress, time pressure, misperception of hazards, inadequate skills, lack of communication, personal life problems, boring repetitive jobs, poor instructions, poor training, design of tools, equipment and workplace, etc. (1. 5) On November 4, 2010 Qantas A380 had to do an emergency landing due to multiple engine failures. The failure was the first

of its kind for this type of aircraft, the world's largest passenger aircraft. It is still the only aviation accident involving this kind of plane. Several minutes after takeoff, the crew reported they heard two simultaneous loud bangs. After the investigation the ATSB (Australian Transport Safety Bureau) found several failures on Number two engine which caused that multiple flight controls were unusable. Some sections of the intermediate pressure turbine disc bored the leading edge of the left wing inboard of engine number two. This caused damage to the leading edge structure, front and upper surface of the wing. It also damaged several system components, fuselage and electrical wiring. Electrical wiring damage affected the operation of hydraulic system, flight controls and landing gear. Also, during the examination, Rolls-Royce found a fatigue cracking within a pipe that feeds oil to a bearing structure causing an oil leak which led to engine fire. The inspectors believe that the cracking was caused for a misaligned region counter-boring within the stub pipe outlet. (2) Another accident caused by poor maintenance took place on December 8, 1998. A Hughes 369D Helicopter was forced to land emergently due to loss of engine power, autorotation. A review of the maintenance records indicated that the last overhaul included the replacement of all turbine rotors. During the investigation it was noted that there was blending in the first stage rotor that was deeper and larger than allowed. This blending caused engine failure that forced the rotor craft to have an emergency landing. Like this case there is many other cases that because of distractions or fatigue a little scratch end up on a catastrophe. (3) On January 20, 2007 in Gatwick, UK, a Dassault Falcon 900B was forced to make an emergency landing when it experienced an engine problem. The

UK's Air Accidents Investigation Branch (AAIB) believe that the probable cause of this event was the fracturing of a stage two low pressure turbine blade due to a casting defect, and that this was probably caused by a defect on a third stage blade. Just before the incident, the crew heard a loud noise coming from the rear of the aircraft and engine fire was present and the number three engine fire warning light was illuminated. The engine had suffered an uncontained breach in the combustion chamber and ejected wreckage from the turbine assembly. This caused a slight but significant damage to the horizontal stabilizer. Detailed examination of the rest of the turbine showed that one of the low pressure stage two blades had evidence of damage before the accident. This defect was identified as "hot tear" that was formed during casting process. This is an example of a poor technique for maintenance of lack of concentration. As said earlier, human error is always the ending point at aircraft accident investigations. (4) Another famous catastrophe is the American Airlines Flight 191. On May 25, 1979 the DC-10-10 operating the flight crashed moments after takeoff from Chicago. Investigators found that just before takeoff, engine number one had detached and flipped over the top of the wing. The engine detachment caused damage to the hydraulic fluid lines. This caused the aircraft control systems to retract and therefore the airplane was out of control and nothing could be done. The National Transportation Safety Board (NTSB) believes that what could cause the accident was the asymmetrical stall because of the uncontrollable reaction of the left wing. The separation of the engine from the wing was caused by damage by improper maintenance procedures. American airlines had a quicker way to mount and unmount the engine by

skipping a lot of important steps and using a forklift to lift the engine. When mounting the engine the shift was made at the most critical moment. Excessive force was applied on the engine mounts causing damage to the airframe. This caused cracks on the engine mounts which led to detachment of the engine. A few minutes after takeoff the airplane had crashed. No one survived to this accident. 273 people died. There were 258 passengers from all ages, 13 crew people and 2 people who were on the ground. The human error in this case was skipping important procedure steps, lack of communication and inadequate equipment. (5) On July 6, 1996 at Pensacola Delta Airlines Flight 1228 experienced a catastrophic engine failure during takeoff. This event caused wreckage from the compressor hub of the left engine to damage the fuselage. The rear cabin passengers heard a very loud explosion and had blast sensation. The pilot stopped takeoff by bringing the throttle control to the idle positions and engaging the brake which stopped the aircraft with no use of the reverse spoilers. After a total and complete investigation, the NTSB found out that the most probable cause of the engine failure was a fluorescent dye penetrant inspection that was not done correctly and a crack on the left engine's compressor fan hub was not detected. And as always the error ends being a human factor. (6) On July 19, 1989 United Airlines Flight 232 crashed in Sioux City, Iowa as a result of a catastrophic failure on its tail engine. The loss of such engine led to damage of hydraulic fluid lines and loss of all flight controls. After a long investigation, the evidence attributed the cause of the accident to a failure of maintenance processes and personnel that couldn't detect a fatigue cracking. An analysis on the crack after the accident showed evidence of

dye-penetrant that was used to detect the crack. This evidence indicated that the crack was present but it was not detected during the inspection prior to flight. In this accident 111 unfortunate people died but 185 survived. Regardless of the lost lives, the accident is considered as an example of successful crew resource management because of the way the flight crew controlled the emergency and also because of the number of survivors. It is unbelievable how and small crack can lead to a catastrophic accident and a lot of lost lives. Not only did the flight lose the passengers lives but also the trust of future passengers. A simple distraction during a repair, overhaul or inspection can lead to this. It is very important to be focused during maintenance. (7)On August 30, 1984 Cameroon Airlines Flight 786 suffered a compressor section failure on engine number two as the aircraft was taking off. Such compressor failure started a fire. Apparently the compressor rotor in the right engine failed destroyed itself. The wreckage of such rotor damaged the wing and perforated the fuel tank. The perforation of the fuel tank caused fuel leakage onto the ground under the aircraft and fuel started to burn. The most probable cause of this accident is also a cracking on engine components that are not detected during repair, inspection or overhaul. All of these accidents are just a few from the many accidents around the world that are caused by poor maintenance on turbine engines. This is why turbine engine overhauls and repairs are very important and vital on the aviation field. Time Between Overhaul is also very important. This time should not be exceeded either on an engine component or the full engine. Any kind of maintenance requires full attention and the proper procedure needs to be followed without skipping any steps or trying to

replace a special tool with another tool. Human factors are the most common error and somehow are very difficult to prevent. Errors and mistakes are normal for human beings. I would say that mistakes are what make us humans and practice makes perfection, but in cases like the ones mentioned above, practice, inexperience or human error should not be taken as a risk for anybody's safety. There are always ways to avoid mistakes and the most efficient way is to always pay full attention to every action and procedure that is being performed. Error cannot be eliminated but it can be reduced by double checking, or checking the necessary amount of times and taking in count that the lives of the passengers and the crew can depend on the safety measurements that have to be taken before each flight in order to maintain safety. It is always better to take extra precautions than to become part of the dozens of accidents that occur for mechanical failures, poor maintenance on turbine engines, and the most common...human error.

Sources http://en.wikipedia.org/wiki/US_Airways_Flight_1549 (1) <http://www.dviaviation.com/maintenance-error.html> (1. 5) <http://www.ainonline.com/aviation-news/2010-12-03/report-recounts-harrowing-experience-crew-stricken-qantas-a380> (2) http://www.nts.gov/aviationquery/brief2.aspx?ev_id=20001211X11630&ntsbno=SEA99FA018&akey=1 (3) <http://www.ainonline.com/aviation-news/aviation-international-news/2009-10-02/engine-failure-forced-emergency-landing>(4) http://en.wikipedia.org/wiki/American_Airlines_Flight_191 (5) http://en.wikipedia.org/wiki/Delta_Air_Lines_Flight_1288 (6) http://en.wikipedia.org/wiki/United_Airlines_Flight_232 (7)