Alaska airlines flight human factors

Environment, Air

The term human factors can be defined as anything to do with humans. In aviation maintenance human conditions like stress, illness, complacency are important because if these factors are not taken care of can lead to fatal accidents. Human factors in aviation industry have become more significant as over the time it has been realized that in most airborne accidents, human error is the main reason rather than mechanical failure. Human Factors are too broad a definition for our understanding of its application in aircraft maintenance. It focuses on a wide range of challenges faced by any human in his/her day to day personal or professional life and when combined how they can lead to human errors and ultimately to a fatal accident.

This report is the case study of one such incident, Alaska Airlines Flight 261, a McDonnell Douglas MD 83, which crashed into Pacific Ocean near Anacapa Island, California killing all 88 people on board. The National Transportation Safety Board (NTSB) determines that the probable cause of this accident was a loss of airplane pitch control resulting from the in-flight failure of the horizontal stabilizer trim system jackscrew assembly's acme nut threads. The thread failure was caused by excessive wear resulting from Alaska Airline's insufficient lubrication of the jackscrew assembly (NTSB (2003). Loss of Control and Impact with Pacific Ocean Alaska Airlines Flight 261. WASHINDTON, DC: NTSB. 180.)

After going through the accident and studying all the possible causes of this fatal accident it has been observed that it was the chain of events that led to one error after the other. The Cheese Error Model is used for analysis to explain the causes.

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Fig 1

(http://www. aviation. unsw. edu. au/about/articles/swisscheese. html)

SYNOPSIS

According to NTSB report 2003, “ on January 31, 2000, about 1621 Pacific standard time, Alaska Airlines flight 261, a McDonnell Douglas MD-83, N963AS, crashed into the Pacific Ocean about 2. 7 miles north of Anacapa Island, California. The 2 pilots, 3 cabin crewmembers, and 83 passengers on board were killed, and the airplane was destroyed by impact forces. Flight 261 was operating as a scheduled international passenger flight under the provisions of 14 Code of Federal Regulations Part 121 from Lic Gustavo Diaz Ordaz International Airport, Puerto Vallarta, Mexico, to Seattle-Tacoma International Airport, Seattle, Washington, with an intermediate stop planned at San Francisco International Airport, San Francisco, California. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan.” (NTSB. (2003). HISTORY OF FLIGHT. In: NTSB Loss of Control and Impact with Pacific Ocean, Alaska Airlines Flight 261. WASHINDTON, DC: NTSB. 1.)

PROBABLE CAUSE

The National Transportation Safety Board carried out an intense investigation to find out what brought the flight 261 down and founded many reasons responsible for this accident. The NTSB report considered the main reason as the loss of airplane pitch control due to the in-flight failure of the horizontal

stabilizer trim system jackscrew assembly’s acme nut threads. The thread failed because of excessive wear resulting from Alaska Airlines insufficient lubrication of the jackscrew assembly. NTSB reports also mentions about the design flaw of McDonnell Douglas MD-80 as it didn’t have fail safe mechanism to prevent the disastrous effects of failure of acme nut threads.

AEROPLANE INFORMATION

The McDonnell Douglas MD-83 is low wing, twin engine commercial aircraft. The horizontal stabilizer is mounted on top of the 18-foot-high vertical stabilizer in a T-tail configuration and controls the pitch movement of an aircraft. The horizontal stabilizer is about 40 feet long and its movement is provided by the jackscrew assembly, which consists of an acme screw and nut, a torque tube inside the acme screw, two gearboxes, motors an alternate and a primary trim motor, and associated components.

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Fig 2

http://www. tailstrike. com/310100. htm

The movement of horizontal stabilizer is controlled either by autopilot automatically when engaged or manually by the pilots by de-pressing either set of dual trim switches (located on each control wheel), moving the dual longitudinal trim handles on the center control pedestal, or moving the dual alternate trim control switches on the center pedestal. Through these controls one of the two electric motors that rotate the acme screw by applying torque to the titanium torque tube that is held fixed inside the acme

screw gets activated. When autopilot senses that the horizontal stabilizer has reached the desired pitch trim condition or when pilot commands are terminated, or when the horizontal stabilizer reaches its maximum travel limits the motor is de-energized. The MD-80 horizontal stabilizer’s design limits are 12. 2° leading edge down, which results in airplane-nose-up trim, and 2. 1° leading edge up, which results in airplane-nose-down trim. In Alaska flight 261, horizontal stabilizers went beyond its design limit plunging the aircraft nose and rolling the plane to 360°.

ANALYSIS AND EVALUATION

The captain and first officer of Alaska Flight 261 were highly qualified and experienced pilots of Alaska Airlines. There were no medical problems or any other drug abuse that could have affected the performance of either pilot. The Alaska Airlines Flight 261 was dispatched in accordance with Federal Aviation Administration (FAA) regulations and approved procedures by Alaska Airlines. Prior to take off and during the initial phase of the flight, the longitudinal trim control system was functioning normally and did not record any problems but as they reached 23, 400 feet pilots realized the horizontal stabilizer on tail plane was not moving and they immediately carried out a standard checklist to try and free the stabilizer. They tried to troubleshoot the problem by repeatedly trying the two switches that operate the stabilizer. The primary motor is activated by both the switch on the control stick known as pickle switch and a longitudinal sliding handle on the pedestal but both the systems were inoperative so they decided to disengage the autopilot and fly the plane themselves. The jammed stabilizer was pushing the nose of aircraft towards the ground therefore it was taking lot of physical

strength for the pilots to keep the plane at level altitude. Meanwhile they contacted ground maintenance to seek advice or if there is any hidden switch or system they are not aware of but dint get any considerable help. As they were approaching to the destination the problems got worst. For one more time pilots tried to free the jammed stabilizer by turning on both alternate and primary motors at same time. The plane plunged downwards for over a minute. Pilots tried to level the plane and they did with lot of efforts. They slowed the plane and informed Air Traffic Controller at Los Angeles and made a decision for emergency landing at Los Angeles. They tried to contact the ground maintenance again but they did not appreciate the significance of the situation and pilots had no appreciable advice from them. They slowed down the plane and headed towards Los Angeles when suddenly the jackscrew holding the horizontal stabilizer broke moving the stabilizer way beyond its aerodynamic limits. The aircraft plunged rapid losing altitude. It rolled 360 degrees and ultimately crashed into Pacific Ocean killing 5 crew members and 83 passengers onboard.

After going through all the incident and report of NTSB, it is clear that it was not just the mechanical failure of jackscrew assembly but it was a sequence of events that ultimately led to failure of acme nut threads which was paid off by the lives of 88 innocent people on board. Number of factors contributed to the crash of flight 261. The summative economical and organizational pressure led Alaska Airlines to increase the lubrication interval of jackscrew assembly and FAA oversight to those extensions and use of unapproved tools and measures. Along with these the maintenance staff falsified the records of work done when actually the work wasn’t done.

This evaluation involves the use of Swiss Cheese Model to explain the chain of events like design flaw, inadequate maintenance, extended lubrication and end play check intervals and deficient maintenance procedures of Alaska Airlines that led the tragic end of Alaska airlines flight 261.

The design of McDonnell Douglas MD-80 had major design flaw to it. The horizontal stabilizer jackscrew assembly did not have the fail safe mechanism to prevent the disastrous effects of failure of acme nut thread. The Federal Aviation Administration (FAA) certification procedures for DC-9 did not sufficiently considered the consequences of excessive wear in context to horizontal stabilizer jackscrew assembly. Designers of the system presumed that at least one set of the jackscrew assembly’s acme screw and nut threads would always be sound and engaged to act as a load path. Therefore, the consequences of stripped acme nut threads and the corresponding effect on the airplane (including the possibility of the acme screw disengaging from the acme nut) were not considered in the design of the horizontal stabilizer trim system.

After the accident the investigators recovered the wreckage from 700 feet underneath the sea. The horizontal stabilizer jackscrew assembly were found intact and attached to the horizontal stabilizer’s front spar. The acme screw was found cracked but attached to the support assembly. Metallic filaments were found wrapped around the central part of the acme screw.

Fig 3

http://www. aero-news. net/index. cfm? do= main. textpost&id= a406ede6-772f-4c84-a95f-410a0744a8ca

The probable cause of this was the inadequate maintenance procedures of Alaska Airlines. In aviation industry there is enormous pressure to maintain, rectify and deliver the plane on scheduled time to prevent the delay in departure of flight. The economic turn down in early 1990’s had hit the company badly and they started to fly their fleets more intensively thereby sharply increasing the plane’s average daily use and thus altering the maintenance intervals. The initial C-check interval of Alaska Airline was 2, 500 flight hours. The recommended C-check interval according to MRB (Maintenance Review Board) report was either 3, 500 flight hours or 15 months, whichever came first. In 1988, Alaska airlines extended its C-check intervals to every 13 months (which was about 3, 200 flight hours, based on the average airplane utilization rate at Alaska Airlines at the time). In 1996, again the C-check interval was extended to 15 months (which was about 4, 775 flight hours, based on the average airplane utilization rate at Alaska Airlines at the time). The task of lubrication of jackscrew assembly was to be accomplished in every B-check intervals which was increased to 500 hours in 1987 from 350 hours in 1985. However in 1988, Alaska Airlines removed B-checks and the entire tasks of B checks were conjoint with A-checks and C-checks. Lubrication of jackscrew assembly was due at every eighth A-check or every 12, 000 hours of flight but in July 1966 the task of jackscrew assembly lubrication was removed from A-check and was placed on a time-controlled task card with time interval of 8 months. At that time there was no

accompanying flight-hour limit and thus based on airplane utilization rates at that time, 8 months was about 2, 550 flight hours.

Also the investigators found widespread deficiencies within the Alaska Airline’s maintenance procedures. Two years before, during the crashed airliner’s last overhaul one of the lead mechanic at airline’s Oakland maintenance facility had ordered the jackscrew for this particular aircraft. He then went off shift and his recommendation was over ruled by the next shift personnel and the plane was put back to service. It would be 2 years for the next due overhaul but the time ran out and flight 261 faced the fatal consequences.

Fig 3

http://www. ntsb. gov/doclib/reports/2002/AAR0201. pdf

Along with extended intervals Alaska Airlines changed the lubrication grease from Mobilgrease 28 to Aeroshell 33 even after McDonnell Douglas didn’t approve it completely. Alaska Airlines notified FAA about this change but FAA dint reply to this change until the flight 261 accident after which it disapproved the use of grease Aeroshell 33. Not only this, the maintenance personnel at Alaska Airlines were not trained properly for the lubrication task. It was evident when in interview with the mechanic responsible to carry out the lubrication task stated that the lubrication task took about 1 hour, whilst Boeing documents and testimony said that, when properly done, the task should take more than 4 person hours.

INCOMPLETE: small access panel (include in design flaw), important senior manager's positions vacant for 2 years, missing records. ….. Page no 171 of NTSB report. FAA oversight

CONCLUSION

Following can be concluded from the above analysis:

The flight crew on Alaska flight 261 was fully qualified and had received sufficient training as per the federal regulations. Both the pilots did not have any preexisting medical conditions that could jeopardize with flight's safety.

The flight 261 was dispatched in accordance with the FAA's regulations and Alaska airlines procedures.

The weight and balance of the plane was within the limit.

Weather was not the factor for the accident and there was no evidence of fire or bird impact or any other foreign object damage.

Both the engines were functioning normal during the flight.

Air traffic control personnel was properly certified and qualified for the respective jobs.

The horizontal stabilizer was functioning normally during the initial phase of flight but jammed at 23, 400 feet. Neither the pilots nor the ground maintenance staff could understand the reason for this jam.

The worn threads inside the horizontal stabilizer acme nut were incrementally sheared off by the acme screw and were completely sheared

off during the accident flight. As the airplane passed through 23, 400 feet, the acme screw and nut jammed, preventing further movement of the horizontal stabilizer until the initial dive.

As there was no checklist present to land as soon as possible and the circumstances confronting the flight crew, their decision not to return to Lic Gustavo Diaz Ordaz International Airport, Puerto Vallarta, Mexico, immediately after recognizing the horizontal stabilizer trim system malfunction was understandable.

The flight crew’s use of the autopilot while the horizontal stabilizer was jammed was not appropriate.

The flight crew’s decision to divert the flight to Los Angeles International Airport, Los Angeles, California, rather than continue to San Francisco International Airport, San Francisco, California, as originally planned was apposite. Alaska Airlines dispatch personnel appear to have attempted to influence the flight crew to continue to San Francisco International Airport, San Francisco, California instead of diverting to Los Angeles International Airport, Los Angeles, California.

There was no effective lubrication on the acme screw and nut interface at the time of the Alaska Airlines flight 261 accident.