Discussion on APS Theory of Aircraft Maintenance Management and Prevention of Human Error

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ABSTRACT

One of the main purposes of maintenance management is to reduce human error and improve the safety of aircrafts. On May 2014, China Southern Airline puts forward the APS theory of Aircraft Maintenance Management. Data on large aircrafts collected since 2013, shows that due to the application of APS, the safety assurance of the aircrafts has steadily improved. In 2016, accidents caused by human were eliminated. This paper illustrates how APS ensures the safe operation and prevents human error.

INTRODUCTION

Safety is the life of an aviation enterprise. The factors that arise to safety issues are usually the unsafe human behavior and the unsafe parts. With the aircraft design and the development of manufacture technology, civil aviation accidents caused by aircraft’s design and manufacturing defects, decrease at a high speed. Meanwhile, accidents due to the Human Factors in operation increased very fast, from 20% to 80% in the past years [1]. The Human Factors becomes the number one danger to the civil aviation operation safety. According to data from 2005 to 2015, 16.7% of the 473 civil aviation accidents occurred in China were due to inadequate production arrangement, 38.7% were related to not strictly implementing construction programs, and 44.6% were related to improperly implementation of work standards [2].

Ensuring aviation safety and operational efficiency are the most important parts of maintenance work. On May 2014, China Southern Airline carefully examined its historic practice and documents of its aviation maintenance system, and put forward the APS theory of Aircraft Maintenance Management.

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The theory is that the production is arranged (A), the construction is programmed (P), and the work is standard (S).

**THE CONCRETE CONTENT OF APS THEORY**

**Production Arrangement**

Overall production arrangement is the premise of maintenance work, which is reflected in both macro and micro levels.

At the macro level, the "A" in APS covers the following five areas: 1) Aircraft use and maintenance plan; 2) Analysis and forecast of production capacity of aviation maintenance enterprises; 3) Reasonable work division structure; 4) Aviation material planning and preparation; 5) Maintenance safety management.

At the micro level, the "A" in APS covers the identification of safety risks in man, machine, material, method and environment (4M1E), which reflects the comprehensiveness of the production. Identify safety risks and ensures the 4M1E production in advance, can avoid human errors caused by haste.

**Construction Program**

The APS theory through the optimization work flow and the standard operation steps enhances the maintenance program.

At the macro level, construction programs are designed to optimize maintenance schemes and production planning control.

At the micro level, construction programs are designed to solve problems of a single maintenance project flow optimization. For a specific maintenance project, the waste caused by conflict of resources in the maintenance process can be effectively reduced by reasonable arrangement of procedures.

In order to ensure the smooth landing of the "Construction Program" at the micro level, two problems should be solved: One is to emphasize the execution ability. The maintenance card and the standard construction operation procedure in the technical manual must be carried out according to the regulations. The other is to emphasize the inspection, for the maintenance projects tend to repeat grade events. Supervisory reviewing link should be set and authorized personnel should be assigned to perform the inspection.

**Work Standard**

Work should be standardized. How the work standards are implemented directly affects the maintenance results.

At the macro level, the civil aviation maintenance system needs to have quality management and reliable monitoring system.

At the micro level, for a specific maintenance project, especially a high-risk maintenance project, it is necessary to establish a working standard with strong pertinence, and carry out and improve the standard in actual operation. The content of the APS practice guide is to integrate and refine the existing operating standards, and to provide clear methods and procedures. The front-line staff can use it as technical job guidance.
USING APS TO MANAGE MAINTENANCE CAN REDUCE HUMAN ERROR

APS Theory Increases the Defense Level of the Reason Model

The Reason model likens human systems to multiple slices of Swiss cheese [3]. In Reason model, most accidents can be traced to one or more of four failure domains: organizational influences, supervision, preconditions and specific acts, just like the four slices of Swiss cheese. The holes in the slices represent weaknesses in each system part. The holes size and position will always change as the system operated. When the holes in each slice line up, the accident occurs. In order to drop incidence of accidents, the main method is to increase the defensive layer and reduce the level of loopholes. APS sets up three defensive layers in which production arrangement, construction program and work standard should be set. At the same time, there are Small defense layers in each defensive layer. For example, in production arrangement defense layer, there are personnel qualifications standard defensive layer, tools and equipment intact defensive layer, and airworthiness data defensive layer effectiveness etc.

APS Theory Reducing the "Hidden Iceberg" in the Iceberg Theory

The core idea of the Iceberg Theory of accident is that there are 30 accidents, 300 accident symptoms and 1,000 unsafe incidents behind a major accident. The need to reduce the amount of apparent ice exposures on the surface of the sea must be reduced to the size of the hidden iceberg beneath the surface of the sea. APS solves this issue. Risk identification can be found through the "behavioral safety observation and communication", or through the SMS analysis and identification derived. It can also be found through the data, past lessons learned, and the use of maintenance manual warnings. Refined "risk warning" as a work guide is reflected in the APS card and gives warning to construction staff.

CONCLUSION

APS ensures the safe operation of the production factors. The application of the three defensive layers of APS prevents human error. One of the uses of APS is to improve the safety literacy of employees by standardizing their thinking habits and behavior, and eventually form an excellent safety maintenance culture that can reduce incidents.

Since 2013, the operation data of the China Southern Airline large aircrafts has shown that because of the application of APS, the maintenance safety assurance of the aircraft has been steadily improving. In 2016, the occurrence of accidents caused by human has been eliminated.

REFERENCES


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