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Candidate Certification Maintenance Requirement Analysis and Certification Practice

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Abstract

This paper thoroughly studied the methodology of CCMR analysis, clarified the relationship between CCMR analysis, specific risk analysis, and MSG-3 analysis through discussion of a real certification program. Provided a lessons learned case and reference to other aircraft type design and certification.

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Keywords: CMR; CCMR; Type Certification; System Safety Analysis; Specific Risk Analysis; MSG-3 Analysis; Airworthiness

1. Introduction

In the civil aircraft development and type certification, System Safety Analysis (SSA) is one of the most important works. Identifying Candidate Certification Maintenance Requirements (CCMR) as part of SSA aims to compensate the hidden nature of latent failures.

CCMR analysis is the basis of identification of Certification Maintenance Requirement (CMR), which is an important input to the Maintenance Review Board (MRB) process. In aircraft type certification, CCMR is also one of the certification representative's interests. In a recent foreign aircraft Validation Type Certification (VTC) program, confusion of CCMR analysis and other aircraft development activities was noticed. Incorrect analysis process was used and wrong result was deduced. Therefore, a thorough study of CCMR analysis and clarification of the differences with other aircraft development activities are deemed necessary.

This paper thoroughly studied the CCMR analysis process, and clarified the relationship between CCMR analysis and other aircraft development activities, for instance, specific risk analysis and

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Maintenance Steering Group-3 (MSG-3) analysis. Provide a lessons learned case and reference to other aircraft type design and certification.

2. The definition and analysis process of CCMR

2.1. Related Terminologies

Before starting the CCMR analysis process, some terminologies should be clarified:

- Latent Failure and Significant Latent Failure [1]: A failure is latent until it is made known to the flight crew or maintenance personnel. A significant latent failure is one, which would in combination with one or more specific failures, or events result in a Hazardous or Catastrophic Failure Condition.
- CCMR [1]: A periodic maintenance or flight crew check may be used in a safety analysis to help demonstrate compliance with 25.1309(b) for Hazardous and Catastrophic Failure Conditions. Where such checks cannot be accepted as basic servicing or airmanship they become CCMRs).
- CMR [2]: A CMR is a required scheduled maintenance task established during the design certification of the airplane systems as an operating limitation of the Type Certificate (TC) or Supplemental Type Certificate (STC). The CMRs are a subset of the instructions for continued airworthiness identified during the certification process. A CMR usually results from a formal, numerical analysis conducted to show compliance with the requirements applicable to catastrophic and hazardous failure conditions. Compliance may also result from a qualitative, engineering judgment-based analysis.

The CCMRs identified in SSA process should be submitted to the Certification Maintenance Coordination Committee (CMCC). The CMCC then discusses all CCMRs and selects CMRs. As for how to define CMRs from CCMRs is not within the scope of this paper.

Typically, the significant latent failures should be eliminated through design compensation. For instance, adding a practical and reliable monitoring and warning system to turn the latent failure into a dominant failure, and warn the flight crew when failure detected. Then the flight crew could take action following the defined procedure to ensure the flight safety. Another example is adjusting the system architecture by adding system redundancy. However, significant latent failures could not be eliminated completely sometimes due to technique, cost, weight or other factors. Risk management method should then be used to control the significant latent failure. CMR is just one of the feasible and efficient ways of risk management. Therefore, CCMR analysis, as a method of inspection and compensation to the significant latent failures, is important in aircraft design development.

2.2. CCMR Analysis Process

Guidance related with CCMR analysis could be found in Federal Aviation Administration (FAA) Advisory Circular (AC) 25.1309 (Arsenal) [1] /EASA Acceptable Means of Compliance (AMC) 25.1309[3] and FAA AC 25-19A [2]. But neither of the guidance materials gave a detail and clear process for CCMR analysis.

Based on the definition and general requirements in the guidance material, the CCMR analysis process is summarized as below:

The prerequisite of CCMR analysis should be the completion of Fault Tree Analysis (FTA). “Tasks that are candidates for selection as CMRs usually come from safety analyses (e.g., SSA, which establishes whether there is a need for tasks to be carried out periodically to comply with 25.1309, and other requirements requiring this type of analysis. The SSA should identify as CCMRs the maintenance tasks intended to detect latent failures that would, in combination with one or more specified failures or events, lead to a hazardous or catastrophic failure condition.”[2] Therefore, CCMR analysis should start after the