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AEROSPACE INFORMATION REPORT

SAE AIR6110

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Contiguous Aircraft/System Development Process Example

RATIONALE

This document provides additional supporting material for the implementation of the processes described in ARP4754A/ED-79A.

FORWARD

ARP4754A/ED-79A contains information which places the information in this AIR in context. This AIR should be used in conjunction with the main body and the appendices of ARP4754A/ED-79A. In addition, this example shows the interrelationships with ARP4761.

1. INTRODUCTION

1.1 Scope

This AIR provides a detailed example of the aircraft and systems development for a function of a hypothetical S18 aircraft. In order to present a clear picture, an aircraft function was broken down into a single system. A function was chosen which had sufficient complexity to allow use of all the methodologies, yet was simple enough to present a clear picture of the flow through the process. This function/system was analyzed using the methods and tools described in ARP4754A/ED-79A. The aircraft level function is “Decelerate Aircraft On Ground” and the system is the braking system. The interaction of the braking system functions with the aircraft are identified with the relative importance based on implied aircraft interactions and system availabilities at the aircraft level. This example does not include validation and verification of the aircraft level hazards and interactions with the braking system. However, the principles used at the braking system level can be applied at the higher aircraft level. The methodologies applied here are an example of one way to utilize the principles defined in ARP4754A/ED-79A. The function chosen was the braking system. Other formats may be used to accomplish the documentation, so long as the principles outlined in ARP4754A/ED-79A are followed.

This example contains references to documentation that a company may use to assure itself of the safety of its products but does not include the documentation that the Original Equipment Manufacturer (OEM) would be required to submit at the aircraft level for aircraft certification. Some of these documents are submitted to the regulatory agencies for the purpose of certification (e.g. the Wheel Brake System FHA). Other documents are internal to the company and not required to be submitted for certification. No implication is made that these documents should be submitted to a regulatory agency and none should be implied, although all documents should be available for submission if requested by the regulatory agency. Safety and Certification are not synonymous terms. The example shows the systems engineering process as applied to the development of an aircraft, including some processes that are beyond certification requirements.

Figure 1 depicts the flow of activities within this example. This figure provides a guide to the structure of this AIR and should allow the reader to quickly find specific areas within the example using the cross references.

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Figure 1 includes the top aircraft level tasks to provide the reader a reference point. The detailed example in Section 3 of this AIR covers only the activities related to the braking system. Figure 1 presents a sequence of activities found in a typical development program. In a real development program, the development process is usually far more complex. For example, in a real development program, development of the different levels (aircraft, system and item) often occurs concurrently, rather than serially as depicted in example flow.

The top row of Figure 1 represents the activities that will occur within the aircraft development. The middle row represents the activities that occur within the wheel brake system development. The bottom row represents the activities that are covered for the subsystem-level Brake System Control Unit (BSCU) development, as well as the integration and verification activities at the higher levels.

The Figure 1 example flow also shows where major artifacts from the System Safety Process (ARP4761) will be utilized. The example flow shows how the sections and artifacts are laid out and represents the step by step process detailed in ARP4754A/ED-79A. In a real development program, the System Safety Process occurs concurrently with ARP4754A/ED-79A, constantly receiving inputs from the ARP4754A/ED-79A process and providing feedback to ARP4754A/ED-79A processes.

Figure 1 also shows a box titled Integral Processes to illustrate to the reader that the integral processes are utilized throughout the development process. The reader is encouraged to use this example flow diagram to help navigate the example. This will allow the reader to either read the example in its entirety or use it as a quick reference guide in order to quickly find the desired section.

1.2 Document Format

This AIR contains the following sections and appendices:

Section 1 is an introduction to the document, giving the scope, format, references to other documents, an acronym list, and a description of the example aircraft function being developed.

Section 2 describes the overall example aircraft development process, focusing on activities leading to the development of the braking system. The hypothetical aircraft in this example is introduced and its basic requirements are given. Aircraft-level planning documents are identified. Top-level aircraft functions are decomposed to determine the functions required of the braking system. The aircraft level safety assessment process, including the aircraft FHA and the Preliminary Aircraft Safety Assessment (PASA), is conducted. The PASA assigns development assurance levels to aircraft functions. These functions are allocated to the braking system as part of the overall aircraft architecture. Aircraft requirements relevant to the braking system are validated. The braking system is integrated and validated with the other systems on the aircraft. (Note: PASA is introduced in ARP4754A/ED-79A, but detailed guidance for completing it awaits the release of ARP4761A. This AIR does not conduct the PASA; it just uses its results).

Section 3 contains the detailed example development process for the braking system. The system is introduced and its planning elements are identified. System functions and requirements are developed. The system safety assessment process, including the system FHA, PSSA and SSA, is conducted. The braking system architecture is developed and selected from among candidate architectures on which trade studies have been conducted. The PSSA leads to assignment of the development assurance levels for the Braking System Control Unit and the other systems and items comprising the system architecture. Braking system requirements are captured and derived requirements are identified. Interface requirements are identified both external to the system and between the items of the system. Requirements are allocated to the items, and the system requirements are validated. System integration, process assurance and configuration management examples are given.

Section 4 describes the verification of the braking system and the associated aircraft-level verification of the system as installed on the aircraft.

Appendix A is an example of an aircraft-level development plan.

Appendix B is an example of a braking system requirements management plan.

Note: For the sake of brevity, the appendices contain only a subset of the plans which would be generated for an aircraft development program.

This AIR contains a number of artifacts (documents, tables, etc.) that would be produced by following the process in ARP4754A/ED-79A. These artifacts are enclosed in boxes to distinguish them from explanatory text.

Editorial comments are provided in italics. Where necessary, the reader is directed to the appropriate section of ARP4754A/ED-79A or ARP4761 for further guidance on the process involved.

If there are any differences between this AIR and ARP4754A/ED-79A, ARP4754A/ED-79A will take precedence.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

The following documents are referenced in this AIR. Reference to 14CFR herein implies reference to equivalent CS regulation.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP4754A Guidelines for Development of Civil Aircraft and Systems

ARP4761 Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment

2.2 Code of Federal regulations (CFR)

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-0000, www.gpoaccess.gov.

14CFR 25.1309 / CS 25.1309

14CFR 25.735 / CS 25.735

2.3 EUROCAE Publications

Available from EUROCAE, 102 rue Étienne Dolet, 92240 Malakoff, France, +33 1 40 92 79 30, www.eurocae.net.

ED-79A Guidelines for Development of Civil Aircraft and Systems