

Accomplishing a Meaningful Particular Risks Assessment Document

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ABSTRACT

The Particular Risks Assessment Document (PRA) is the compendium of the assessments accomplished during the development of a new airplane that relate to threats to the airplane from the outside environment (e.g. birdstrike, lightning, hail) and threats to the systems from events originating in other systems (e.g. rotorburst, flailing shafts, tire and wheel burst). These assessments are accomplished to ensure the robustness of the design to survive these threats. An extensive list of threats is developed and teams are formed to evaluate each of them. The results of these studies are collated into a document that provides a single point reference for the new airplane with regard to its ability to survive all known external threats. If PRAs have been accomplished on previous programs they can be used as a starting point for the new assessment, then the systems are reevaluated against the new design and differences created by new design features need to be added to the list. The PRA is not a trivial exercise. It requires a commitment on the part of management and the allocation of resources from the safety and design communities. However, this assessment can greatly add to the robustness of the new design and can reap benefits far into the future as the design continues to be used in the aviation industry.

2.0. INTRODUCTION

Particular risks (also referred to herein as threats) are events or influences which are outside the system(s) concerned but which may violate event independence claims. These particular risks may also influence several zones at the same time, whereas the Zonal Safety Analysis (ZSA) is restricted to each specific zone. Some of the risks may be subject to specific airworthiness requirements (e.g., engine non-contained rotor failures, tire burst, etc.). Others may involve

internal company requirements, such as specific separation requirements. The material herein refers to processes contained in SAE International industry standards ARP (Aerospace Recommended Practice) 4754A and ARP 4761. These should be consulted for further information on this process.

Typical risks to be considered would include, but are not limited to the following.

- Fire
- High energy devices (non-containment):
 - Engine
 - Auxiliary Power Unit (APU)
 - Fans
- High pressure bottles
- High Pressure Air Duct Rupture
- High Temperature Air Duct Leakage
- Leaking fluids
 - Fuel
 - Hydraulic
 - Battery acid
 - Water
- Hail, ice, snow
- Bird strike
- Tire burst, flailing tread

- Wheel rim release
- Lightning strike
- High Intensity Radiated Fields (HIRF)
- Flailing shafts
- Bulkhead rupture

Having identified the appropriate risks with respect to the design under consideration, each risk should be subject to a separate study. The objective of the relevant analysis is to ensure that any safety related effects are either designed out or shown to be acceptable.

The Particular Risks Analysis (PRA) is not a one-time analysis. In order to be meaningful, it should be carried out as an ongoing assessment throughout the aircraft development process for a new aircraft. It should also be carried out for any major modifications to the aircraft that occur during development. Initially, drawings or models should be analyzed, but as the project progresses, the analysis should be based on mock-ups and then the actual aircraft. The analyses will usually be performed by the airframe manufacturer.

The PRA provides documented evidence that the threats identified have been characterized and evaluated. A team is usually formed to accomplish this task. This team evaluates the airplane and its systems for their ability to avoid loss of Continued Safe Flight and Landing (CSFL) capability, given these airplane threats. The threats are finally evaluated against the actual systems layout once firm configuration is established, to ensure that the threats are mitigated in the actual design.

A process is outlined for accepting a deviation to the requirements. This is shown because most companies apply internal program requirements in excess of the regulatory requirements. These internal requirements can be deviated from if the program decides that is the best course of action. Normally, there are few deviations processed.

Unlike the Fault Tree Analyses (FTA) used to show that the probability of occurrence of a failure meets the criteria established based on the severity of the effect on the airplane, the PRA assumes the occurrence of the event in question. In other words, the PRA assumes the occurrence of the event and examines the ability of the design to cope with the consequences of it. The PRA is an evaluation of the design to determine how robust the airplane is, given the failure in question. In cases where a design solution is highly impractical, a probabilistic assessment may be used as part of the approach for acceptance of the design. However, a PRA case would not normally be closed using only a probabilistic approach with no attempt at improving the robustness of the design.

3.0. PROCESS STEPS

The PRA is performed following the flow chart shown in [Figure 1](#). Additional explanation is provided below for each of the steps in the flow chart.

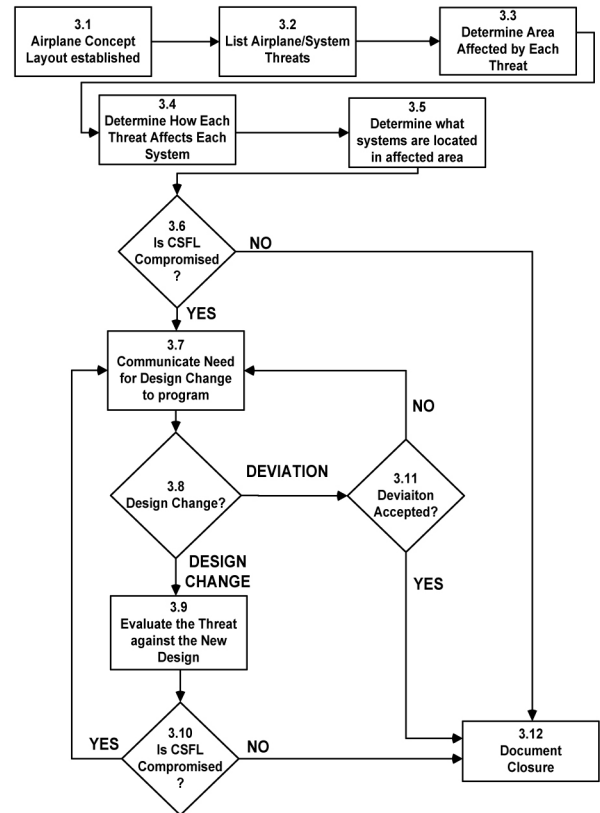


Figure 1. PRA Process Flow

3.1. THE AIRPLANE CONCEPT LAYOUT ESTABLISHED.

The process begins when the airplane concept layout is established

3.2. LIST AIRPLANE/SYSTEM THREATS

Define the details of the airplane/system threat or particular risk to be analyzed. (e.g., tire/wheel burst).

3.3. DETERMINE AREA EFFECTED BY EACH THREAT

The threat may only encompass certain areas of the airplane. For example, birdstrike only affects the forward surfaces of the airplane.