



U.S. AIR FORCE

ASIP Conference 2006



PANEL SESSION: RELIABILITY BASED APPROACHES FOR DESIGN AND SUSTAINMENT



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Panel Session Objectives



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- **Focus on the way ahead for institutionalizing risk based approaches for significant sustainment issues**
- **Evaluate the potential for pursuing reliability based designs**



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Panelists

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Panel Chair:

Charles Babish, USAF, Aeronautical Systems Center

Panel Members:

***Russ Alford, USAF, Warner Robins Air Logistics
Center***

Hal Burnside, Southwest Research Institute

Charles Saff, The Boeing Company

Ravinder Chona, USAF, Air Force Research Laboratory



Approach & Topics



- **Approach**
 - 5 to 7 minute presentations on the topics below
 - Question/answer session for the remainder of the time
- **Topics**
 - *Chuck Babish*, MIL-STD-1530C basis
 - *Russ Alford*, maintenance data collection, storage and analysis
 - *Hal Burnside*, analytical approaches
 - *Charley Saff*, analysis and testing needs to enable reliability based designs
 - *Ravi Chona*, future programs that may drive need for reliability based designs



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MIL-STD-1530C Basis Requirements Related to Risk/Reliability



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MIL-STD-1530C Update Approach Related to Risk/Reliability



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- **Be consistent with MIL-STD-882D and ASC/EN Airworthiness Circular 5, “Airworthiness Certification Risk Evaluation and Acceptance”**
 - Establish system level risk
 - Allocate risk to each function (e.g. aircraft structure)
 - Accept risk at the appropriate authority level
- **Address both aircraft and programmatic risks**



Significant Risk Additions



- **1.1.2 Tailoring**
- **5.1.1 ASIP Master Plan**
- **5.1.7.5 Risk mitigation actions**
- **5.2.16 Initial risk analysis**
- **5.3.4.e Durability tests**
- **5.4.1.1 Risk analysis**
- **5.4.3.2 Inspections**
- **5.4.3.2.1.d Inspection intervals**
- **5.5.6.3 Risk analysis updates**



Design Related



- **1.1.2 Tailoring** ...Tailoring is only permitted when all of the following conditions exist: (only one listed)
 - d. The combined impact of all tailored ASIP tasks and/or elements on aircraft **structural reliability** is determined and achieves the allocated overall aircraft reliability requirement
- **5.1.1 ASIP Master Plan** ...The plan shall also include discussion of unique features, exceptions to this standard and the associated rationale **including risk assessments**, and any problems anticipated in the execution of the plan...



Design Related (Continued)



- **5.1.7.5 Risk mitigation actions** Risk mitigation actions shall be defined and implemented in the program based on an **estimate of the level of risk** associated with the selection of the new materials, processes, joining methods, and/or structural concepts...
- **5.2.16 Initial risk analysis** ...A primary objective of this analysis is to **demonstrate a low risk** of both WFD and loss of fail-safety...
- **5.4.1.1 Risk analysis** When tailoring, as described in 1.1.2, has been accomplished, a **risk analysis** shall be performed and utilized in the initial airworthiness certification...



Sustainment Related



- **5.3.4.e Durability tests** ...The objectives of the full-scale durability tests are to...obtain crack growth data to validate analysis methods and EIFS distribution **data to support risk analyses**
- **5.4.3.2 Inspections** ...At the onset of WFD, inspections are no longer sufficient to protect safety. The **risk analysis** of 5.2.16 shall be used to initially establish the time to onset of WFD...
- **5.4.3.2.1.d Inspection intervals** ...The criteria for the initial and repeat inspection intervals shall be as follow: (only one listed)
 - d. The risk analysis of 5.2.16 and 5.5.6.3 should be used to determine if a reduction in the inspection intervals are required to **control the safety risk** to an acceptable level...



Sustainment Related (Continued)



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- **5.5.6.3 Risk analysis updates** The risk analyses described in 5.2.16 and 5.4.1.1 shall be updated and the results shall be reported for formal acceptance using MIL-STD-882 direction...The **primary reasons to update the risk analyses** are to:
 - a. evaluate detected and anticipated aircraft structural damage...
 - b. Evaluate economic and/or availability impacts associated with maintenance options...
 - c. Determine the structural integrity risk associated with operating the aircraft beyond the design service life.



Probability of Failure Guidance



- **Probability of failure per flight guidance provided in paragraph 5.5.6.3**
 - “A probability of catastrophic failure **at or below 10^{-7} per flight** for the aircraft structure is considered **adequate** to ensure safety for long-term military operations. Probabilities of catastrophic failure **exceeding 10^{-5} per flight** for the aircraft structure should be considered **unacceptable**. When the probability of failure is between these two limits, consideration should be given to mitigation of risk through inspection, repair, operational restrictions, modification, or replacement.”