DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE LIFE CYCLE MANAGEMENT CENTER
WRIGHT-PATTERSON AIR FORCE BASE OHIO

BULLETIN
AWB–150B
30 SEP 20
(supersedes AWB-150A)

United States Air Force Airworthiness Bulletin 150B

Subject: Airworthiness Risk Assessment and Acceptance

Attachments: (1) References and Supporting Information
(2) Severity Categories, Probability Levels, Risk Assessment Matrix, and Coordination Requirements
(3) Clarifying Information for Preparing Airworthiness Risk Assessments (AWRAs)
(4) Airworthiness Risk Assessments (AWRAs)

1. Purpose. Documents the process for airworthiness (AW) risk assessment and acceptance.

2. Office of Primary Responsibility (OPR). United States Air Force (USAF) AW Office (AFLCMC/EZZ; USAF.Airworthiness.Office@us.af.mil).

3. Applicability. This airworthiness bulletin (AWB) applies to air systems seeking an AW approval and to air systems covered by an existing AW approval (i.e., fielded air systems).

4. Policy. The following policies relates to USAF AW risk assessments:

4.1. **Air Force Instruction (AFI) 62-601, *USAF Airworthiness*:** Requires resolution of hazards associated with non-compliances to AW criteria or acceptance of their residual risks by the appropriate Risk Acceptance Authorities (RAAs) prior to issuance of an AW approval. Requires risk assessments to use the methodology in MIL-STD-882E, *Department of Defense Standard Practice – System Safety*.

4.2. **MIL-STD-882E, *Department of Defense Standard Practice – System Safety*:** Identifies a Department of Defense (DoD) method for identifying hazards and assessing and mitigating associated risks encountered in the development, test, production, use, and disposal of defense systems.

4.3. **AFI 91-202, *The US Air Force Mishap Prevention Program*:** Establishes a Safety Risk Assessment (SRA) decision-making tool that may be used to communicate and document key elements of risk management decisions required by AFI 62-601, *USAF Airworthiness*.

5. Discussion.

5.1. The AW process identifies hazards and associated risks, utilizing the methodology defined in MIL-STD-882E. The AW process outlined in this bulletin utilizes common terminology, procedures, and documentation wherever practicable.[1]

5.2. This bulletin summarizes the process for AWRAs and risk acceptance decision-making. Key aspects include:

5.2.1. Non-compliance with an applicable AW criterion indicates a potential hazard or limitation in the system design. An assessment of the non-compliance is required to determine if it results in a hazard.

5.2.2. The risk of a mishap associated with a hazard is the combination of the severity of the mishap and the probability of occurrence of the mishap. As it applies to AW, the probability of occurrence of a mishap is defined as the probability of that mishap occurring either during a single flying hour (FH) or during a single sortie or flight cycle. (Without loss of intent, this bulletin consolidates the terms sortie and flight cycle, simply using "sortie.") Exceptions are identified in Section 6.3.

5.2.3. The impact of the risk of a mishap associated with a hazard (also known as the "projected losses") is the estimated cost of that risk over a specified future period of exposure.

5.2.4. The Technical AW Authority (TAA) or Delegated Technical Authority (DTA) approves AW hazards and risk levels (i.e., severities and probabilities) prior to acceptance by the RAA.

5.3. Coordination requirements for Serious and High AW risk assessments are documented in various DoD and USAF policies. This bulletin summarizes those requirements in Attachment 2, Table 5.

5.4. The TAA may approve specific changes of the activities herein to suit special need or purpose or if circumstances warrant.[2]

5.5. Contact the USAF AW Office to coordinate briefings to the TAA and obtain TAA approvals.

6. AW Risk Assessment and Acceptance Process. The Chief Engineer (CE), as defined in AFI 63-101/20-101, *Integrated Life Cycle Management*, has execution responsibility for technical risk management, to include AW risks. The CE in conjunction with the program office (PO) and TAA uses the process identified below to assess and obtain acceptance of AW risks. USAF

[1] The process in this bulletin is not used to influence design requirements, such as those associated with safety critical functions. As required by AFI 62-601, design requirements are based on AW criteria (e.g., MIL-HDBK-516C).
[2] AFI 62-601.

organizations that are not POs (in accordance with AFI 63-101/20-101) shall assign an individual(s) to accomplish this process.

6.1. Identify AW hazards and the associated mishaps that could reasonably occur.

6.1.1. AW hazards are hazards related to AW criteria (e.g., MIL-HDBK-516C, *Airworthiness Certification Criteria*). Hazards may be identified from sources including, but not limited to, non-compliances with applicable AW criteria, non-standard AW assessments, System Safety Group (SSG) findings, fielded aircraft inspection findings, or mishap investigations.

6.1.2. Correlate AW hazards with those tracked by System Safety to prevent redundant risk assessments. A single risk assessment may be used to satisfy both the AW and System Safety process if the identified hazard and risk are consistent, since this bulletin is consistent with the core SRA principles.

6.1.3. Multiple non-compliances with AW criteria may result in the same hazard. Each hazard may be associated with one or more risks.

6.2. Determine the severity category of each mishap associated with the hazard using the definitions in accordance with (IAW) Attachment 2, Table 1.

6.3. Determine the probability level associated with each mishap.

6.3.1. When possible, use the quantitative thresholds IAW Attachment 2, Table 2 and document the use of appropriate mathematical and probabilistic methods.

6.3.1.1. The probability of a mishap's occurrence per FH or sortie may change over time. Efforts should be made to identify an increasing (or decreasing) probability of occurrence. If the probability level changes during the expected life of the air system, document the time at which such a change occurs. (Reference Attachment 3, Note 1)

6.3.1.2. Use Attachment 2, Table 2 with either probability per FH (or sortie) or frequency per 100K FH (or 100K sorties). (Reference Attachment 3, Note 2)

6.3.1.3. Choose whether to evaluate probabilities per FH or per sortie. (Reference Attachment 3, Note 3)

6.3.1.4. For weapon employment/jettison, use Attachment 2, Table 2 with probability per weapon employment/jettison. (Reference Attachment 3, Note 4)

6.3.1.5. For mishaps associated with emergency lifesaving system failures (e.g., escape systems, crashworthy seating, emergency slides, etc.), determine the probability of mishap both (a) per use of the system (assuming system is needed) and (b) per FH (or sortie) using Attachment 2, Table 2. The risk level is based on the greater of the two methods. (Reference Attachment 3, Note 5)

6.3.2. If a quantitative assessment is not possible, identify the qualitative probability level IAW Attachment 2, Table 3, considering the qualitative probability level's corresponding quantitative probability range, and document the rationale.

6.4. Identify the numerical Risk Assessment Code (RAC) and the corresponding risk level (High, Serious, Medium, or Low) at the intersection of the severity category column and probability level row using Attachment 2, Table 4. The first assessment of the risk is the initial risk and establishes the fixed baseline for the hazard. (Non-constant probability levels may result in changes in RAC during the lifecycle of an aircraft.)

6.5. Identify risk mitigation measures (both short-term and long-term) and determine the associated target risks IAW paragraphs 6.2 through 6.4.

6.5.1. Utilize the system safety design order of precedent in MIL-STD-882E. Mitigation measures should include possible operating limitations and/or other mitigating factors.

6.5.2. Determine the risk mitigation measures that will be implemented prior to risk acceptance and the associated event risk (reference Attachment 3, Note 6).

6.6. Determine the risk impact (projected losses) IAW Attachment 3.

6.7. Identify the proposed risk acceptance duration. If the proposed risk acceptance duration is the entire lifecycle, identify a process for:

6.7.1. Periodic re-accomplishment of the AWRA, which validates previous assumptions using accrued data and reassesses potential mitigations considering technological advances and process changes. Identify the date when re-accomplishment is required.

6.7.2. Providing accepted risk information to RAA successors.

6.8. Document the risk assessment(s).

6.8.1. For Serious and High event risks, prepare AWRA using Attachments 3 and 4 of this bulletin.[3] If multiple potential mishaps identified for a single hazard have different severities, the AWRA is written to reflect the mishap that produces the highest event risk. It is imperative the CE ensures the AWRA is complete.

6.8.2. For Low and Medium event risks, document, at a minimum, the hazard and rationale supporting the risk level using a CE-accepted format.

6.9. Obtain TAA or DTA approval of the hazard and associated risk levels (initial, target, and event risk). TAA approval is required for Serious and High initial risks, and risks associated with new aircraft or reportable modification programs. AWB-225, *Airworthiness Delegated Technical Authorities*, establishes DTA approval authorities.

[3] Air Force Research Laboratory programs document risk assessments IAW AFI 91-202_AFMCSUP.

6.9.1. For new air systems or modifications, approval of the associated AW assessment (e.g., compliance report) constitutes approval of the risk level.

6.9.2. For fielded air system Serious and High risks, coordination on the AWRA IAW Paragraph 6.10 constitutes TAA approval of the risk level. For Low and Medium risks, approval of the risk level is documented in a DTA-accepted format.

6.10. For Serious or High event risks, coordinate the AWRA IAW Attachment 2, Table 5.[4]

6.11. Obtain acceptance of the event risk from the appropriate RAA IAW USAF policy. This includes acceptance of the proposed risk acceptance duration, and, if required, the process for re-accomplishing the risk assessment and providing risk information to successors.

6.12. Track and manage all hazards, mitigation status, and on-going risk reduction efforts throughout the lifecycle in the systems engineering system safety hazard tracking process.

6.13. AFI 62-601 establishes notification requirements when Serious or High risks are discovered on fielded aircraft. Within 30 days of initial notification, the CE shall brief the TAA on the plan for developing the AWRA, determining root cause, implementing mitigations, and obtaining risk acceptance.

7. Updating AW Risk Assessments to Maintain AW Approvals.

7.1. POs shall obtain TAA approval of the risk level when re-accomplishing risk assessments, especially when downgrading Serious or High risks. The TAA may review and modify the AW approval to reflect updated risk assessments.

7.2. POs shall ensure risk assessments are accepted and current and are provided to the TAA as necessary, prior to renewal of, or extensions or other updates to AW approvals.

7.3. For air systems possessing a Military Type Certificate (MTC), if a new Serious or High risk is identified, the TAA may rescind the MTC and replace it with a Military Flight Release within one (1) year from risk level approval if the conditions for an MTC are not met.[5] The MTC will be reinstated when the conditions for an MTC are met.

THOMAS M. FISCHER, SES
Director, Engineering and Technical
Management/Services
USAF Technical Airworthiness Authority

[4] Table 5 defines which DoD and USAF policies govern coordination requirements.
[5] AWB-1009, *Airworthiness Flight Authorizations – Military Type Certificate (MTC)/Military Flight Release (MFR)*, establishes conditions for MTCs.

Attachment 1

REFERENCES AND SUPPORTING INFORMATION

References

AFI 62-601, *USAF Airworthiness*
AFI 63-101/20-101, *Integrated Life Cycle Management*, 30 June 2020
AFI 91-202, *The US Air Force Mishap Prevention Program*, 12 March 2020
AFI 91-202_AFMCSUP, *The US Air Force Mishap Prevention Program,* 17 May 2017
DoDI 5000.02T, *Operation of the Defense Acquisition System*, Incorporating Change 7, 21 April 2020
MIL-HDBK-516C, *Airworthiness Certification Criteria*, 12 December 2014
MIL-HDBK-1763, *Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures*, 15 June 1998
MIL-STD-882E, *Department of Defense Standard Practice – System Safety*, 11 May 2012
USAF AWB-225, *Airworthiness Delegated Technical Authorities*, 20 August 2018
USAF AWB-1009, *Airworthiness Flight Authorizations – Military Type Certificate (MTC)/Military Flight Release (MFR)*, 25 March 2016

Abbreviations and Acronyms

AFI – Air Force Instruction
AWRA – Airworthiness Risk Assessment
AW – Airworthiness
AWB – Airworthiness Bulletin
CE – Chief Engineer
DTA – Delegated Technical Authority
DT/OT – Developmental Testing/Operational Testing
DoD – Department of Defense
DoDI – Department of Defense Instruction
FH – Flying Hour
HRI – Hazard Risk Index
IAW – In Accordance With
MIL-HDBK – Department of Defense Handbook
MIL-STD – Department of Defense Standard Practice
MTC – Military Type Certificate
OPR – Office of Primary Responsibility
PM – Program Manager
PO – Program Office
RAA – Risk Acceptance Authority
RAC – Risk Assessment Code
SSG – System Safety Group
SRA – Safety Risk Assessment
TAA – Technical Airworthiness Authority
UAS – Unmanned Aircraft System
USAF – United States Air Force

Terms

Event Risk – The risk associated with a hazard as it applies to a specified hardware/software configuration during an event. Typical events include Developmental Testing/Operational Testing (DT/OT), demonstrations, fielding, [or] post-fielding tests.[6]

Frequency – Number of occurrences of an event during a specified exposure period.

Hazard – A real or potential condition that could lead to an unplanned event or series of events (i.e., mishap) resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.[6]

Hazard Rate – Frequency of a mishap, also known as failure rate. This apparent misnomer (i.e., hazard rate as opposed to mishap rate) is intentional to align the term with the standard probability definition. The specified exposure period may be a FH, sortie, or cycle (or equivalently, when multiplied by 100,000: 100K FH, 100K sorties, or 100K cycles).

Hazard Function – A function that specifies the hazard rate for a given time.

Initial Risk – The first assessment of the potential risk of an identified hazard. Initial risk establishes a fixed baseline for the hazard. [6]

Mishap – An event or series of events resulting in unintentional death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. [6]

Probability – An expression of the likelihood of occurrence of a mishap. [6] Probability is expressed by a number from 0 to 1, with 0 implying no possibility of occurrence and 1 implying certainty of occurrence during a specified exposure period.

Projected Losses – Also known as the impact of the risk of a mishap associated with a hazard. The estimated cost of that risk over a specified future period of exposure which may exceed a single FH or sortie.

Risk – A combination of the severity of the mishap and the probability that the mishap will occur. [6]

Risk Assessment Code – A combination of one severity category and one probability level. [6] While MIL-STD-882E labels RACs as the combination of one severity category and one probability level (given as a numeral from 1 through 4 followed by a letter from A through F, e.g., 1A or 4E), with no loss of significance this bulletin uses a single number from 1 through 20 where 1 through 5 represents High risk, 6 through 9 represents Serious risk, 10 through 17 represents Medium risk, and 18 through 20 represents Low risk. Other sources may term RAC as Hazard Risk Index (HRI).

Severity – The magnitude of potential consequences of a mishap to include: death, injury, occupational illness, damage to or loss of equipment or property, damage to the environment, or monetary loss. [6]

Target Risk – The projected risk level the PM plans to achieve by implementing mitigation measures consistent with the design order of precedence described in MIL-STD-882E, paragraph 4.3.4. [6]

[6] MIL-STD-882E.

Attachment 2

SEVERITY CATEGORIES, PROBABILITY LEVELS, RISK ASSESSMENT MATRIX, AND COORDINATION REQUIREMENTS

Table 1: Severity Categories[7]

SEVERITY CATEGORIES		
Description	**Severity Category**	**Mishap Result Criteria**
Catastrophic	**1**	Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or monetary loss equal to or exceeding $10M.
Critical	**2**	Could result in one or more of the following: permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, reversible significant environmental impact, or monetary loss equal to or exceeding $1M but less than $10M.
Marginal	**3**	Could result in one or more of the following: injury or occupational illness resulting in one or more lost work day(s), reversible moderate environmental impact, or monetary loss equal to or exceeding $100K but less than $1M.
Negligible	**4**	Could result in one or more of the following: injury or occupational illness not resulting in a lost work day, minimal environmental impact, or monetary loss less than $100K.

Table 2: Quantitative Probability Level Thresholds[8]

QUANTITATIVE PROBABILITY LEVEL THRESHOLDS			
Description	**Level**	**Probability per FH or Sortie**	**Frequency per 100K FH or 100K Sorties**
Frequent	**A**	10^{-3} per FH or Sortie ≤ Probability	100 per 100K FH or 100K Sorties ≤ Frequency
Probable	**B**	10^{-4} ≤ Probability < 10^{-3} per FH or Sortie	10 ≤ Frequency < 100 per 100K FH or 100K Sorties
Occasional	**C**	10^{-5} ≤ Probability < 10^{-4} per FH or Sortie	1 ≤ Frequency < 10 per 100K FH or 100K Sorties
Remote	**D**	10^{-6} ≤ Probability < 10^{-5} per FH or Sortie	0.1 ≤ Frequency < 1 per 100K FH or 100K Sorties
Improbable	**E**	0 < Probability < 10^{-6} per FH or Sortie	0 < Frequency < 0.1 per 100K FH or 100K Sorties
Eliminated	**F**	Probability = 0 per FH or Sortie	Frequency = 0 per 100K FH or 100K Sorties

[7] MIL-STD-882E, Table I; and AFI 62-601, Table A2.1.
[8] AFI 62-601, Table A2.2.

Table 3: Qualitative Probability Levels[9]

QUALITATIVE PROBABILITY LEVELS			
Description	**Level**	**Specific Individual Item**	**Fleet or Inventory**
Frequent	**A**	Likely to occur often in the life of an item.	Continuously experienced.
Probable	**B**	Will occur several times in the life of an item.	Will occur frequently.
Occasional	**C**	Likely to occur sometime in the life of an item.	Will occur several times.
Remote	**D**	Unlikely, but possible to occur in the life of an item.	Unlikely but can reasonably be expected to occur.
Improbable	**E**	So unlikely, it can be assumed occurrence may not be experienced in the life of an item.	Unlikely to occur, but possible.
Eliminated	**F**	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.

Note: "Specific Individual Item" is defined as a single, entire air system

Table 4: USAF Airworthiness Risk Assessment Matrix[10]

USAF Airworthiness Risk Assessment Matrix			Severity Category			
Probability Level	**Probability per FH or Sortie**	**Freq per 100K FH or 100K Sorties**	**Catastrophic (1)**	**Critical (2)**	**Marginal (3)**	**Negligible (4)**
Frequent (A)	$10^{-3} \leq$ Prob	100 ≤ Freq	**1**	**3**	**7**	**13**
Probable (B)	$10^{-4} \leq$ Prob < 10^{-3}	10 ≤ Freq < 100	**2**	**5**	**9**	**16**
Occasional (C)	$10^{-5} \leq$ Prob < 10^{-4}	1 ≤ Freq < 10	**4**	**6**	**11**	**18**
Remote (D)	$10^{-6} \leq$ Prob < 10^{-5}	0.1 ≤ Freq < 1	**8**	**10**	**14**	**19**
Improbable (E)	0 < Prob < 10^{-6}	0 < Freq < 0.1	**12**	**15**	**17**	**20**
Eliminated (F)	Prob = 0	Freq = 0	**Eliminated**			

High	RAC = 1 - 5	**Medium**	RAC = 10 – 17
Serious	RAC = 6 – 9	**Low**	RAC = 18 – 20

[9] MIL-STD-882E, Table II.
[10] Based on MIL-STD-882E, Table III; and AFI 62-601, Table A2.2.

Table 5: AWRA Coordination Requirements[11, 12]

Title or Organization	Serious Risk	High Risk
CE-Level and DOE-Level DTA as applicable	X	X
Air Force Safety Center, Aviation Safety Division (AFSEC/SEF)[13, 15]	X	X
USAF Technical AW Authority (AFLCMC/EN-EZ)[13, 15]	X	X
For operational test and operations, Lead Command, Operations, Logistics, and Safety (MAJCOM/A3/A4/SE)[14, 15] For developmental test, Group Commander or equivalent[14, 16]	X	X
PEO[15]		X
For operational test and operations, Lead Command, Commander[14, 15, 17] For developmental test, Center Commander or equivalent[14, 16]		X
USAF AW Authority (AFMC/CC)[13]		X
AF Chief of Safety (AF/SE)[15, 17]		X

[11] Applies to CAE-PEO-PM structured programs. For unique circumstances (e.g., contractor-owned, contractor-operated aircraft), contact the USAF AW Office for additional guidance.
[12] For non-nuclear weapon-related risks, coordinate with the Armament Directorate (AFLCMC/EB) and Non-Nuclear Munitions Safety Board. For nuclear weapon-related risks, coordinate with the AF Nuclear Weapons Center and Nuclear Weapons System Safety Group.
[13] AFI 62-601.
[14] DoDI 5000.02T and MIL-STD-882E require "user representative" coordination.
[15] AFI 91-202.
[16] Aligns with the Test Execution Authority established in AFI 91-202_AFMCSUP.
[17] Required by AFI 63-101/20-101, dated 9 May 2017; however, current version does not contain coordination guidance.

Attachment 3

CLARIFYING INFORMATION FOR PREPARING AIRWORTHINESS RISK ASSESSMENTS (AWRAs)

This attachment provides clarifying information for creating AWRAs.

NOTE 1: Constant hazard rates should be used only when warranted. Examples include, but are not limited to, hazards associated with random external phenomena such as bird strikes or lightning strikes. Hazards associated with the failure of components with break-in (e.g., electronic components) or wear-out (e.g., fatigue, corrosion, wear and tear, etc.) characteristics will seldom have constant hazard rates. Appropriate methods of determining hazard functions include estimation with a Weibull or other distribution.

NOTE 2: The probability and frequency of a mishap are distinct concepts (see Attachment 1, Terms). However, for values less than 10^{-2}, probabilities per FH (or sortie) and frequencies per FH (or sortie) are essentially equal. For example, probabilities and frequencies differ by 0.5% at 10^{-2}, 0.005% at 10^{-4}, and 0.00005% at 10^{-6}. For this reason, it is not problematic to consider the probability and the frequency of a mishap occurrence per FH (or sortie) to be equal, allowing conversion to frequency per 100K FH (or 100K sorties) by multiplying the probability or frequency per FH (or sortie) by 100,000.

NOTE 3: All USAF manned aircraft have average sortie durations greater than one hour. For these, using probability per sortie will be more conservative than using probability per FH by a factor equal to the average sortie duration in hours. This conservatism is deemed appropriate for valuable assets (both monetarily and in terms of crew safety), and thus it is encouraged that manned aircraft programs evaluate probabilities per sortie. Unmanned Aircraft System (UAS) aircraft that fly an average sortie duration of many hours may not deem extra conservatism necessary and therefore justifiably evaluate probabilities per FH.

NOTE 4: Aircraft may experience AW risks due to weapon carriage, employment or jettison, and that risk is governed by this bulletin. During weapon carriage, use Attachment 2, Table 2 with probability determined "per FH" or "per sortie". Upon employment or jettison, until the weapon achieves a safe separation as defined in MIL-HDBK-1763, *Aircraft/Stores Compatibility: Systems Engineering Data Requirements and Test Procedures,* use Attachment 2, Table 2 with probability determined "per weapon employment/jettison." A weapon that has achieved safe separation from the delivery aircraft is no longer an aircraft AW issue, though the weapon may have its own system safety risks (follow guidance in AFI 91-202).

NOTE 5: When determining the probability of mishap per use of the emergency system, system-specific probability level thresholds are required if the AW criteria and associated standards for the emergency lifesaving system do not align with the probability level thresholds in Attachment 2, Table 2 when interpreted per use. System-specific probability level thresholds must be appropriate for the system being evaluated (i.e., based upon the system's design requirements, such as injury metrics) and comply with MIL-STD-882E, Table II. Mishaps associated with other system failures, that require the use of an emergency lifesaving system, are separately considered. Contact the USAF AW Office for additional guidance.

NOTE 6: Event risk is the risk the RAA must accept prior to operations. Event risk accounts for mitigation efforts including operational limitations or restrictions and hardware or software modifications intended to reduce the initial risk to the target risk. Considerations include the modification production break-in schedule, retrofit kit production schedule, retrofit hours, retrofit schedule, etc. (i.e., describe the schedule for the "burndown" of risk), and the potential of accelerating the schedule. Event risk may have a time-phase component as mitigations are implemented.

NOTE 7: For all mishap types with High or Serious risks without credible possibility of further materiel mitigation, provide all options such as operational limitations or restrictions that could potentially mitigate the risk as much as possible.

NOTE 8: AFI 91-202 states, as applicable to the System Safety process, "Program risk acceptance packages and tracking are only necessary for those risks that are inside the design/specification/requirement envelope. Those outside the envelope are handled by using the user's/operator's risk management process." AFI 62-601 requires Major Command Commanders to, "Ensure air system operations are consistent with Technical Airworthiness Authority-issued airworthiness approval(s)". AW approvals are issued based on an established design/specification/requirement envelope. "Outside the envelope" operations require an AWRA (if non-compliant with AW criteria) and an updated AW approval.

Determining Projected Losses:

Attachment 4 includes a section to report "Projected Losses." That section provides insight into the recurring or total cost, both financially and in terms of injuries or fatalities (as applicable), of the aircraft type that operates with the level of risk identified by the AWRA, facilitating RAA risk acceptance (with appropriate coordination), and TAA issuance of an AW approval upon acceptance of all risks at the appropriate level. For example, consider a Catastrophic severity (causing a loss of aircraft) High risk that has a probability of occurrence of 10^{-5} per FH. For a test program scheduled to fly a total of 100 FH, there is approximately a one in a thousand chance of an aircraft loss over the entire test program due to the hazard. However, for an operational fleet that flies 100,000 FH per year, one aircraft can be projected to be lost annually due to the hazard. The RAA and TAA need such information to make the most informed decision.

Step 1 – Determine the most appropriate period of exposure for the program. The most appropriate period of exposure can vary from program to program. For a test program or a program during its test phase, the most appropriate period of exposure may be the entire test period. For programs in the sustainment phase, the most appropriate period of exposure could be a year (particularly for risks with constant probabilities of occurrence) or a period that extends to the next required periodic risk review (particularly for risks with non-constant probabilities of occurrence, such as those affected by the implementation of mitigation strategies, or those worsening over time, such as those affected by increased wear and tear or fatigue). The projected losses calculation requires an exposure period be defined and may consider multiple periods of exposure (to include, perhaps, the entire lifecycle of the fleet).

Step 2 – Determine the projected number of future mishaps due to the risk. For hazard rates expected to be constant over the appropriate period of exposure, find the projected number of

mishap occurrences by multiplying the FH (or sorties) to be flown during the period of exposure by the hazard rate (i.e., frequency expressed as “per FH” or “per sortie”). (If frequency was reported “per 100K FH” or “per 100K sorties,” divide by 100,000 to convert to a frequency “per FH” or “per sortie.”)

For hazard rates not expected to be constant over the period of exposure, the projected number of future mishaps is determined by integration (or numerical integration) of either the hazard function or the probability density function.

NOTE: Integration of the hazard function implies that spare components of the type for which the AWRA is written are available (i.e., replacement of components means the population of components does not diminish with failures). Integration of the probability density function (or, equivalently, evaluating the cumulative distribution function) to determine the proportion of the population expected to fail and multiplying by the number of components in the inventory implies that failed components will not be replaced (i.e., the non-replacement of components implies the population of components diminishes with failures, and therefore the cumulative distribution function, representing the accumulated life of the entire population, is followed). These methods will likely not yield vastly different results, and the difference will be further blurred if a fixed number of spare components are available, but no more.

Step 3 – Determine the projected losses due to the risk. To find the projected losses for the period of exposure, multiply the projected future mishap occurrences determined in Step 2 by the expected cost per mishap (as defined when determining the mishap severity). The cost per mishap may be expressed as loss of life, loss of aircraft, monetary loss, or some combination of the three (or other loss type, such as environmental loss). The projected losses will be reported for the appropriate period of exposure for all likely result types (i.e., report projected loss of life, loss of aircraft, and monetary loss, as applicable).

Attachment 4

AIRWORTHINESS RISK ASSESSMENTS (AWRAs)

Include the following key elements:

1. Background: Broadly describe the situation being evaluated. Include an explanation of the associated mission, operation or system that creates or warrants the exposure to the hazard. Provide sufficient detail so the remainder of the risk assessment is easily understood.

2. Hazard Identification: (Reference AWB-150B, paragraph 6.1). Define the hazard. Include sufficient details (e.g., drawings, dimensions, etc.) that clearly describe the hazard.

3. Initial Risk: Document the initial risk due to the hazard identified above. Attachment 3, Notes 1 through 5 contain clarifying information. Address the following:

3.1. Severity Category. (Reference AWB-150B, paragraph 6.2). Document the mishap severity associated with the hazard. Account for potential adverse consequences to all entities exposed to the hazard, to include operators, participants, and uninvolved parties.

3.2. Probability Level. (Reference AWB-150B, paragraph 6.3). Document the probability level associated with the mishap. If determined quantitatively, show calculation details to include assumptions, inputs, confidence or conservatism of inputs, etc. If the probability level is determined qualitatively, provide supporting technical rationale.

3.3. Risk Level. (Reference AWB-150B, paragraph 6.4). Identify the RAC and corresponding risk level.

4. Mitigation Options: (Reference AWB-150B, paragraphs 6.5 and 6.6). Describe available or obtainable mitigation options, to include reducing exposure, redesign, protective devices to reduce severity of consequences, warnings, training, restrictions and limitations. Consider both taking no further action and not conducting the operation or activity that requires exposure to the hazard, which may include transfer of mission responsibility to other entities. Address the following for each mitigation option:

4.1. Description. Describe the mitigation option.

4.2. Impact. Describe the impacts to cost, schedule, mission accomplishment and other important factors.

4.3. Target Risk. Identify the target risk associated with implementing the mitigation option to include changes to severity category, probability level and risk level (refer to the elements in paragraphs 3.1 through 3.3 of this Attachment).

4.4. Projected Losses. Calculate the projected losses associated with the mitigation option using the instructions in AWB-150B, Attachment 3, *Determining Projected Losses*. Show calculation details.

4.4.1. The projected losses must account for both losses suffered within the system and those imposed on other involved systems, personnel and entities.

4.4.2. If multiple potential mishaps are identified for a single hazard, the projected losses need only be determined for the mishap that produces the highest event risk.

4.4.3. If the exposure period is less than entire lifecycle of the system, consider including the projected losses across the entire lifecycle to provide perspective on the need for mitigation.

4.4.4. If the exposure period is the entire lifecycle of a system, consider including the projected losses that will occur prior to the required date for re-accomplishing the AWRA (if required).

5. Event Risk: (Reference AWB-150B, paragraph 6.5.2). Identify the mitigation option(s) that will be implemented prior to risk acceptance and the associated event risk, to include the severity category, probability level, risk level, and RAC.

6. User and Stakeholder Views: Provide a summary of the views of AFSEC, organizations responsible for users, and interacting organizations that may experience potentially significant losses of assets or injuries to their personnel due to their exposure to the risks.

7. Risk Acceptance Authorities (RAAs): List the RAAs based upon the levels of risk. Cite the supporting policy or direction.

8. Recommendations:

8.1. Propose the mitigation options to implement.

8.2. Propose risk acceptance duration and re-acceptance requirements. State the date when re-acceptance is required (it should be consistent with the defined exposure periods). (Reference AWB-150B, paragraph 6.7).

8.2.1. Where RAA acceptances are sought for the life cycle of a system, propose a process for periodic re-accomplishment of the AWRA. The update should validate previous assumptions using accrued data and reassess potential mitigations considering technological advances and process changes. State the date when re-accomplishment is required.

8.2.2. When an RAA accepts risk for the life cycle of a system, define the requirements to provide accepted risk information to RAA successors.