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AIRWORTHINESS AND SAFETY RESIDUAL RISK IDENTIFICATION AND ACCEPTANCE

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1 INTRODUCTION

1.1 GENERAL

The airworthiness (AW) process follows the methodology defined in the DAAA regulations AER(EP).P-2, AER(EP).P-16, AER(EP).P-21 and AER(EP).P-22.

In particular, for each of the AW requirements identified in the applicable Certification Basis, a compliance statement, and inherent supporting evidence, is provided by the System Design Responsible (SDR, as per AER(EP).00-00-5 regulation), Military Design Organization Approval (MDOA, as per AER(EP).P-21 regulation) Company or Military Type Certificate Holder (MTCH, as per AER(EP).P-21), in order to achieve the airworthiness certification of a Military Aircraft configuration.

In carrying this task, a few cases may be encountered, where the design maturity of the System does not consent a full compliance with the specific AW requirements. In such occurrences, an AW Risk is identified in the form of a hazard, which needs to be adequately mitigated through System design changes, implementation of bespoke attention getters (warnings, safety switches, etc.), operational limitations or pilot workaround procedures. As explained in the regulation AER(EP).P-516 Annex M, such condition may actually occur throughout the entire development life-cycle (and not just at the requirement verification phase, in the so called “right-hand side of the V”), where non-compliances may be pre-emptively identified by the SDR/MDOA/MTCH and discussed and pre-mitigated with the Authority, to the point of achieving a preliminary acceptance of the risk.

In general terms, irrespective of the life-cycle stage where this evaluation occurs, the SDR/MDOA/MTCH and the DAAA shall collectively work to identify and mitigate the initial AW and Safety Risks (AWSR), hence resulting into a set of Residual Risks.

A similar approach, on a different scale and with bespoke peculiarities, is also applicable for the identification, mitigation and acceptance of any risks deriving from the following additional cases:

- continued/continuing AW tasks;
- application of repairs;
- conversion of Technical-Operational Certifications (CTO, as per regulation AER(EP).P-9) into Type Certifications (as per AER(EP).P-2 and AER(EP).P-21);
- evaluation of the aircraft fit-for-purpose characteristics, throughout the qualification phase, where a performance non-compliance may result into the imposition of an operational limitations/restrictions in order to ensure safety (in holistic terms) and facilitate the safe conduct of a mission;
- operations in times of crisis.

1.2 PURPOSE

The purpose of this regulation is to define the process for AW and Safety Residual Risk (AWSRR) identification and acceptance.

1.3 APPLICABILITY

The present regulation is applicable to all the Italian Military aircraft flying under the DAAA responsibility. It is important to stress that the regulation covers the risks from a purely technical perspective. Operational implications related to the employment of the specific System under scrutiny, along with additional operational mitigations, are evaluated under the responsibility of the Italian Military Aviation Authority and the Italian Armed Force/Armed State Corp operating the aircraft[1]. This concept specifically applies in times of crisis, as further debated in Annex D.

The evaluation of AWSRs applies at different stages of a certification lifecycle:

- initial airworthiness – release of a Military Type Certificate (MTC), Restricted MTC (R-MTC), Operational Military Permit to Fly (O-MPtF);
- continued airworthiness – approval of configuration changes;
- release of Permit to Fly in accordance with AER(EP).P-7 or AER(EP).P-21;
- continuing airworthiness – approval of repairs or maintenance plans in accordance with AER(EP).00-00-5 or AER(EP).P-21;
- conversion of a CTO into a regular Certification as per AER(EP).P-2, AER(EP).P-7, AER(EP).P-9, AER(EP).P-21;
- evaluation of the aircraft fit-for-purpose characteristics, throughout the qualification phase;
- testing activities.

More generically, the regulation applies to every risk to safety (in holistic terms) identified throughout the entire operational use of aircraft, including the times of crisis. It is not a DAAA responsibility to identify and acknowledge these crisis conditions, as such duty belongs to operational/political realm.

1.4 VALIDITY

The present edition supersedes the first issue in 2023 and shall enter into force on the date of its approval.

1.5 DEFINITIONS AND GLOSSARY

- ***Aircraft category:*** *see AER(EP).P-516 Annex M.*
- ***Airworthiness, Certification Basis:*** refer to AER(EP).P-2, AER(EP).P-21, AER(EP).P-22 regulations.
- ***Airworthiness risk:*** it refers to the risk acceptance matrix, interleaving the probability of occurrence of a particular hazard or failure condition versus the inherent severity, estimated after the application of the mitigations (procedural, technical, operational, etc.) captured in the documentation prepared in support of the clearance for a flight mission. For further details about the general definitions of risk matrix, severity, etc. refer to AER(EP).P-2 and AER(EP).P-516 regulations.

[1] To note, this position applies also to the aircraft registered under a foreign country military registry and employing the Italian Air Space. In this case, the original flight limitations imposed by the Airworthiness Authrotity of the country of origin will be further implementd by whatever risk mitigations are determined by DAAA and the Italian Military Aviation Authority

- ***CONOPS*/*ORS:*** it is a programmatic document defining the scenario and the operational need which generate a particular set of high level technical and operational requirements, to be fulfilled through the achievement of a novel operational capability. It generally entails the information and indications about the aspired flight envelope, the mission planning, execution and reporting, the sustainability, maintainability, logistic support, etc.
- ***Military aircraft, aircraft equivalent to a military aircraft or aircraft of military use:*** refer to definitions included in the Code of Aerial Navigation at reference [1], articles 744, 746 and 748. For brevity, in the rest of the document it will be generically referred to as "the System".
- ***Military Aviation Authority:*** it is identified with the AVIAMM Office at the Italian Air Staff.
- ***Software Criticality Index* (SwCI)*:*** refer to MIL-STD-882 for the classification of the level of rigour expected to the software.
- ***Times of crisis:*** as debated in the Military Airworthiness Authority Forum and in the NATO Aviation Committee, the term refers to high-intensity scenarios where adaptive and urgent measures may be taken, as opposed to the European Military Airworthiness Requirements (EMAR), conceived for peace-time, low intensity situations.

1.6 ACRONYMS

AWSR	Airworthiness and Safety Risk
AWSRI	Airworthiness and Safety Risk Index
AWSRL	Airworthiness and Safety Risk Level
AWSRR	Airworthiness and Safety Residual Risk
AWSRRI	Airworthiness and Safety Residual Risk Index
AWSRRL	Airworthiness and Safety Residual Risk Level
CONOPS	Concept of Operations
CTR	Certification Technical Report
DAAA	Military Aiworthiness Authority
EASA	European Aviation and Safety Agency
EDA	European Defence Agency
FDAL	Functional Design Assurance Level
FH	Flight Hour
FMECA	Failure Mode, Effects, and Criticality Analysis
IAW	In Accordance With
IDAL	Item Design Assurance Level
MAA	Military Aviation Authority
MDOA	Military Design Organization Approval

MTC	Military Type Certificate
MTCH	Military Type Certificate Holder
O-MPtF	Operational Military Permit to Fly
OR	Occurrence Report
ORS	Operational Requirements Specification
R-MTC	Resctricted Military Type Certificate
RPAS	Remotely Piloted Aircraft System
SC	Safety Case
SDR	System Design Responsible
SwCI	Software Criticality Index
TA	Technical Assessment
TDS	Technical Data Sheet
CTO	Technical Operational Certification
TP	Technical Procedure

1.7 REFERENCE DOCUMENTS

[1] Code of Aerial Navigation, approved through R.D. 30 March 1942, n. 327 (and subsequent amendments)

[2] MIL-STD-882E Department of defense standard practice: System Safety

[3] ARP-4761 Guidelines and methods for conducting the safety assessment process on civil airborne and equipment

[4] ARP-4754 Guidelines for development of civil Aircraft and Systems

1.8 CORRELATED DAAA REGULATIONS

AER(EP).00-00-5	Configuration control processes for the preparation, evaluation and approval of amendments to material under GDAA responsibility
AER(EP).P-2	Military Type System Certification, Qualification and Fit-For-Installation
AER(EP).P-6	Instructions for the compilation of Technical Specifications for Military Aircraft
AER(EP).P-7	Registration of military aircraft and management of the Military Aircraft Register (RAM)
AER(EP).P-9	Technical Operational Certification and Homologation
AER(EP).P-16	Procedure for Military Type Certification

AER(EP).P-21	Certification and Qualification of Military Aircraft and related Products, Parts and Appliances, and Design and Production Organizations in the EMAR construct
AER(EP).P-22	Certification of Military Remotely Piloted Aircraft Systems
AER(EP).P-516	Criteria for the Definition of the Airworthiness Requirements
AER.Q-2010	Definizione delle sigle, dei vocaboli e delle locuzioni comunemente impiegate nelle pubblicazioni tecniche della DAAA
EMAD 1	Definitions and acronyms document
AER(EP).00-01-6	Instructions for Compilation, Delivery and Management of Occurrence Reports on Aeronautical Materiel

2 PROCEDURE DESCRIPTION

2.1 GENERAL

The key aspects of the AWSRR identification and acceptance process include:

- non-compliance with an applicable AW and Safety criterion (or requirement) indicates a potential hazard;
- the risk of an event of hazard is the combination of its severity and probability of occurrence. As it applies to AW and Safety, the probability of occurrence is defined as the probability of that event occurring either during a single flying hour (FH) or during a single sortie;
- for those hazards or failure conditions where the estimation of a probability of occurrence is not appropriate (for instance, those modelled by systematic errors or non-linear phenomena), an alternative method is established for the determination of the relevant AWSR;
- the DAAA approve AW and Safety hazards and risk levels (i.e., severities and probabilities) prior to issue of an MTC, an R-MTC or an O-MPtF;
- a qualitative AWSRR assessment is carried out by the DAAA also in the case where no certification artefacts are actually produced; for instance, in support of the release of a flight authorization for Remotely Piloted Aircraft Systems (RPAS) belonging to the certification category military open (in accordance with the AER(EP).P-22 regulation), where a Certification Basis is not defined;
- an AWSR and AWSRR may be identified at every stage of the aircraft design life-cycle;
- each AWSRR is assigned a risk level (AWSRRL), ranging from High, Serious, Medium to Low;
- the required level of approval for each AWSRR is proportional to its level.

The following paragraphs will present more details with regard to this approach, by making a clear distinction between the non-compliances which can be entirely and comprehensively modelled by a numerical probability of occurrence (for instance those associated to equipment failure rates as derived from an Failure Mode, Effects and Criticality Analysis), from those cases, more qualitative, where such practice is not valid.

It is important to highlight that each of the presented activities are allocated to the DAAA, supported by the Company/MTCH.

It is also fundamental to remark that each programme will respond to the safety requirements defined in the AER(EP).P-516 through its own System Safety Program and relevant safety Special Conditions, where the safety rules, definitions and infrastructure, shall be concurred with DAAA and may differ from those explicated in the DAAA regulations.

2.2 AWSRs MODELLED BY SEVERITY AND PROBABILITY

The main steps are hereby described:

- identify AW and Safety hazards and the associated mishaps that could reasonably occur. AW and Safety hazards are related to AW and Safety criteria and/or requirements and may be identified from sources including non-compliances with applicable AW and Safety criteria and/or requirements, non-standard AW and Safety assessments, fielded aircraft inspection findings or mishap investigations;
- correlate AW and Safety 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 the System Safety process if the identified hazard and risk are consistent. Multiple non-compliances with AW and Safety criteria and/or requirements may result in the same hazard. Each hazard may be associated with one or more risks;
- determine the severity category of each event by using the definitions in accordance with (IAW) the AER(EP).P-516 regulation[2],
- determine the probability level associated with each event by using the quantitative thresholds IAW the AER(EP).P-5163. In this context, choose whether to evaluate probabilities per FH or per sortie and observe that such values may change over time. Efforts should be made, in this case, to identify an increasing (or decreasing) probability of occurrence. For weapon employment/jettison, use probability per weapon employment/jettison4. For events associated with emergency lifesaving system failures (e.g., escape systems, crashworthy seating, emergency slides, etc.), determine the probability of the event both per use of the System (assuming the System is needed) and/or per FH (or sortie), depending on the availability of information from the Company/MTCH;
  If the available data do not consent a quantitative calculation of the hazard probability, identify the corresponding qualitative level and document the rationale;
- identify the numerical initial AWSR Index (AWSRI) and the corresponding AWSRL (High, Serious, Medium or Low) at the intersection of the severity category column and probability level row. An example of AWSRI, and of the corresponding AWSRL, is shown in Table B-1 in Annex B, specific for each aircraft category. This 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 AWSRI during the lifecycle of a System);
- identify risk mitigation measures (both short-term and long-term), that will be implemented prior to risk acceptance, and estimate the associated event risk[5];

[2] Or the safety table/level used for the specific programme.
[3] Or the specific probability levels defined for the programme.
[4] Aircraft may experience AW and Safety risks due to weapon carriage, employment or jettison. During weapon carriage, use probability determined “per FH” or “per sortie”. Upon employment or jettison, until the weapon achieves a safe separation, use 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.
[5] Using the same order of precedence as in MIL-STD-882/ARP-4761, in terms of design improvements, attention getters implementations, introduction of flight limitations or pilot compensation procedure. On this regard, it is important to highlight that the source of the mitigation, if any, may derive from different stakeholders (MAA, aircraft user, maintenance organization, etc.)

- re-assess the AWSRI and AWSRL after the application of such measures, in order to determine the resulting mitigated AWSRRI and AWSRRL, by re-running the same table as per the initial risk assessment;
- identify the proposed risk acceptance duration. If the proposed risk acceptance duration is the entire lifecycle, identify a process for periodic re-accomplishment of the AWSRRL, 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.

2.3 AWSRs NOT MODELLED BY PROBABILITY

2.3.1 Software, Firmware

The increased level of complexity introduced by digital technologies such as software, complex electronic hardware, or Multicore Processors makes it difficult to examine the behaviors and properties of a system by direct inspection, analysis or test. The classical concept of deducing random failure rates, used in traditional System Safety methodologies, result in an incomplete safety assessment, as the failures of the digital technologies are mostly characterized by systematic failures, which are hard to predict and quantify.

One methodology to control systematic failures, and in particular those caused by design and implementation errors, is presented in the ARP-4754 (reference [4]) and consists into the achievement of an adequate level of rigor and assurance for the subsequent and inherent development process (Functional/Item Development Assurance Level, FDAL/IDAL). Another method is proposed in the MIL-STD-882 (reference [2]), with the introduction of the “software criticality index”.

Independent from the adopted methodology, a design shortfall/AW non-compliance detected on a software/firmware carries a different level of AW and Safety risk, depending on its expected IDAL/SwCI (examples shown in Table B-2 and Table B-3 in Annex B).

2.3.2 Structures

Similar considerations as per software apply also to the evaluation of the risks associated to structural failures and shortfalls.

Depending on the significance of the structure in terms of airworthiness, any relevant non-compliance will have a different effect on the characterization of the initial and the residual risk.

For instance, a shortfall identified on a safety-of-flight structural element can bear remarkable consequences on the aircraft, and normally leads to significant limitations and restrictions in the MTC accompanying Data Sheet. If unmitigated, such issues open to a potentially high residual risk, which needs to be formally acknowledged and accepted.

For more information about the categorization of an aircraft structure, refer to AER(EP).P-516 regulation. For an example of Risk Level definitions of risks introduced by structural problems see Table B-4 in Annex B.

2.3.3 Establishment of the most suitable method

Similar considerations as per paragraphs 2.3.1 and 2.3.2 apply, for instance, to other disciplines like the ElectroMagnetic Compatibility and Interference.

Due to the vast range of subjects potentially falling into the category of AWSR not modelled by severity and probability, this regulation cannot be excessively prescriptive and granular. Nevertheless, the key message to extrapolate from this argumentation lies on the necessity, for the DAAA Certification Team, to establish the most suitable method to estimate the AWSR for each individual topic.

2.4 AWSR acceptance

After the identification and estimation respectively of the AWSRI, AWSRL, AWSRRI and AWSRRL as per previous paragraphs, the DAAA Certification Team will document the risk assessment and the adopted rationale.

The last step of the process consists into obtaining the approval of the associated initial and mitigated AWSRI and AWSRL. The minimum acceptance level for each AW and Safety Risk Level is shown in table B-5.

It is anticipated that a particular aircraft configuration, given the extent of the non-compliances and of the AWSRRLs, may not achieve certification.

A bespoke module mapping AWSRI, AWSRL, applicable mitigations and resulting AWSRRI and AWSRRL is shown in Annex A. This module should accompany the produced deliverables in support of every clearance and signed by the certification Authority, IAW the applicable level of approval as per Table B-5.

2.5 INITIAL AIRWORTHINESS

For the initial airworthiness process, the AWSRs shall be identified and managed throughout the entire development lifecycle, in accordance with the process described in paragraphs 2-1 to 2.4 and in Annex C.

2.6 CONTINUED/CONTINUING AIRWORTHINESS

For modifications to aircraft, changes to maintenance plans and repairs to an approved configuration, a process as per para 2.4 shall be applied.

In these cases, the potential introduction of new AWSRs will be evaluated, along with the effects on the extant AWSR (and relevant AWSRRL).

Before submitting any formal change/repair approval request (Prescrizione Tecnica Ditta, Engineering Change Proposal, Service Bulletin, etc.), the Company/MTCH is therefore recommended to pre-emptively concur with the DAAA the most suitable way forward to certify the particular change, especially in terms of application of this regulation and the extend of the evidence, analyses and artifacts to be submitted in support of a bespoke risk identification and acceptance.

For what regards the continuing airworthiness, every Category 1 Occurrence Report (OR) should also trigger an investigation activity which involves the Company/MTCH and the DAAA in order to identify and mitigate any derived risk. To note, the acceptance of

such risks, if pertaining to the single tail number rather than affecting the overall type design, may be delegated to the individual Armed Force/Armed State Corp originator of the OR. Same applies for particular maintenance tasks, like for instance the inspection waivers. In all these cases, a bespoke agreement with the DAAA shall be sought.

2.7 CONVERSION OF THE CTO

AWSRs may also derive from the process of converting a CTO into a regular Military Type Certification as per AER(EP).P-9. This is due to the fact that the CTO process generally accepts design and operational tradeoffs for the sake of achieving a capability in response to an urgent operational need.

The process described in the paragraph 2.4 shall therefore be applied, with the scope of identifying such risks, and the relevant level of mitigation and acceptance.

2.8 SAFETY RISKS

As anticipated, this regulation can also be applied in more holistic terms whenever a risk to the safety (in holistic terms) is identified throughout the certification and qualification tasks carried by the DAAA, regardless whether such risks originate and link to a specific requirement captured in the Type Certification/Qualification Bases. For instance, if an infra-red camera installed onboard an aircraft does not work as expected, it will not affect any airworthiness requirement, but may adversely impact the air-to-air refueling operations, thus increasing the risk to conduct the mission.

The mechanism to identify, classify, rate, mitigate and accept the risks therein captured shall be the same as in the previous cases, the only difference consisting into the possible consultation with the operational requirement generator (Armed Forces, etc.) for the definition of tradeoffs in terms of performance and operational restrictions.

The DAAA role in this task is to provide the necessary technical support, alongside with the activities carried to achieve the qualification of the aircraft.

2.9 AWSRs IN EXPERIMENTAL ACTIVITIES

Regulations AER(EP).P-7 and AER(EP).P-21 define the list of documents propaedeutic to the release of an Experimental Marking and/or a Permit to Fly, including a comprehensive safety analysis and a preliminary compliance evaluation against the applicable certification/airworthiness requirements.

In this context, the AWRs associated to the conduct of the experimental activity shall be identified, mitigated and accepted by DAAA as defined in the present procedure.

The particular connotation of a test activity will provide for a set of mitigations normally more effective with respect to the production fleet (time at risk, presence of flight test instrumentation, chase aircraft, telemetry, controlled air space, etc.) whereas the yet unconsolidated configuration of some of the items will introduce risks naturally ruled out at later stages of the respective lifecycle.

3 UPDATING THE AWSRRL

The AWSRRL matrix can be updated/extended at the occurrence of any of the following cases:

- the Company/MTCH propose a design change/improvement which affects the corresponding AW and Safety criteria and/or requirements (as described in paragraph 2.3);
- the deadline for reviewing the AWSRRL matrix is expired;
- the Company/MTCH propose a re-visitation of any of the AWSRRL (based on new evidence, for instance).

4 LEGACY PROGRAMMES

For legacy programmes where a dedicated AWSR acceptance table may not be present, the process described in this regulation has to be tailored and an appropriate risk matrix be determined (for instance by adopting MIL-STD-882E), supported by an adequate rationale.

5 CONTRACTUAL PENALTIES

Although this regulation aims at providing guidelines for the definition and acceptance of the AWSRs, it should not be perceived as a workaround manoeuver to relax the certification and AW demands on a Company/MTCH.

On this regard, it is important to stress that a Company/MTCH should always aim at the resolution of every AW and Safety hazard before achieving a full, unrestricted MTC.

From this standpoint, the Certification Team is responsible to liaise with the procurement and contractual articulations of the DAAA, in order to stimulate the inclusion of specific penalties in the contracts.

ANNEX A

AW/Safety Residual Risk Identification and Acceptance Module

Non Compliance/Risk	Hazard related to the Non-Compliance/Risk	AW/Safety Risk Level	Mitigations	AW/Safety Residual Risk Level	Required minimum Approval Level

ANNEX B

Tables

Aircraft Category[6]: S1 – S2 – S3 – S4					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S5					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S6					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S7 – S8					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S9					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S10					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Aircraft Category: S11					
AWSRI	Severity category				
Probability level	(1) CAT	(2) CRIT	(3) MAJOR	(4) MINOR	(5) NO SAFETY EFF.
(A) FREQUENT	1A	2A	3A	4A	5A
(B) PROBABLE	1B	2B	3B	4B	5B
(C) OCCASIONAL	1C	2C	3C	4C	5C
(D) REMOTE	1D	2D	3D	4D	5D
(E) IMPROBABLE	1E	2E	3E	4E	5E
(F) ELIMINATED	1F	2F	3F	4F	5F

Table B – 1: Risk Acceptance Matrices for Aircraft Category for risks modelled by a probability

[6] See AER(EP).P-516 Annex M for the category definition

SwCI / IDAL	AWSRL
SwCI 1/ IDAL A	High
SwCI 2/ IDAL B	Serious
SwCI 3/ IDAL C	Medium
SwCI 4/ IDAL D	Low
SwCI 5/ IDAL E	No Risk

Table B – 2: AWSRL and AWSRRL for risks introduced by software (irrespective of aircraft category)

Risk Levels	Description of Risk Criteria
	A software implementation or software design defect that upon occurring during normal or credible off-nominal operations or tests:
High	• Can lead directly to a catastrophic or critical mishap, or • Places the system in a condition where no independent functioning interlocks preclude the potential occurrence of a catastrophic or critical mishap.
Serious	• Can lead directly to a marginal or negligible mishap, or • Places the system in a condition where only one independent functioning interlock or human action remains to preclude the potential occurrence of a catastrophic or critical hazard.
Medium	• Influences a marginal or negligible mishap, reducing the system to a single point of failure, or • Places the system in a condition where two independent functioning interlocks or human actions remain to preclude the potential occurrence of a catastrophic or critical hazard.
Low	• Influences a catastrophic or critical mishap, but where three independent functioning interlocks or human actions remain, or • Would be a causal factor for a marginal or negligible mishap, but two independent functioning interlocks or human actions remain. • A software degradation of a safety critical function that is not categorized as high, serious, or medium safety risk. • A requirement that, if implemented, would negatively impact safety; however code is implemented safely.

Table B – 3: Risk Level definitions for risks introduced by software (irrespective of aircraft category) (source MIL-STD-882E)

Risk Level	Description of Risk Criteria
High	• Can lead directly to a catastrophic hazard
Serious	• Can lead directly to a critical/hazardous mishap, or • Places the system in a condition where there is a single point of failure for the potential occurrence of a catastrophic hazard or • Influences indirectly a catastrophic hazard
Medium	• Can lead directly to a major mishap • Places the system in a condition where there is a single point of failure for the potential occurrence of a critical/hazardous hazard • Influences indirectly a critical/hazardous hazard
Low	• Can lead directly to a minor mishap • Influences indirectly a major mishap

Table B – 4: Risk Level definitions for risks introduced by structural problems (irrespective of aircraft category)

Minimum Acceptance Level	AWS Risk Level				
	High	**Serious**	**Medium**	**Low**	**No Risk**
DAAA Director	NO acceptance				N/A
DAAA Vice Technical Director	NO acceptance	X			N/A
Head of Certification and Qualification Office	NO acceptance		X	X	N/A

Table B – 5: AWSR – Minimum level of acceptance

ANNEX C

AW/Safety Residual Risk Acceptance Procedure

Compliance Verification

The Residual Risk Acceptance Process shall be used if a system is Non Compliant (NC) or Partially Compliant (PC) to any requirement of the Airworthiness Certification Basis or in the case of identified safety issues derived from the aircraft technical shortfalls.

Evaluation of the mishap severity and probability

If the NC/PC is related to a safety requirement (section 1309), the Failure Condition (FC) severity and probability is already available and can be taken from the Company/MTCH Safety Risk Assessment (SRA).

If the NC/PC is related to other AW or Safety requirements (except for AW risks not modelled by probability like the ones related to software, structure, etc.), the mishap severity and probability can be defined in a qualitative manner using the following steps:

- verify if the FC is already in the Company/MTCH SRA;
- if the FC is not present in the Company/MTCH SRA, to define the severity, the following shall be evaluated:
    - the effects on airplane;
    - the effect on third parties;
    - the effects on occupants other than flight crew;
    - the effects on flight crew.

  The worst case has to be used as the severity of the FC (see AER(EP).P-516);
- to identify the probability of a FC, it is possible to use qualitative and quantitative evaluations based on: service history of the fleet, engineering judgement, analysis and elaboration of the Company/MTCH data, etc.

  To Note, even in the mission-related condition where the FC is generated by a performance shortfall, the effects will still be on the safe conduct of the flight mission, so impacting, as a minimum, the airplane and the first party.

Identification of the Airworthiness and Safety Risk Level (AWSRL)

Evaluated the severity and probability, the AWSRL will be identified on the DAAA Risk Acceptability Matrix for the specific Aircraft Category (see Table B-1 in Annex B).
For the software, the AWSRL will be evaluated using Table B-2 a Table B-3 in Annex B.
For the structure, the AWSRL will be evaluated using Table B-4 in Annex B.

Identification of the Airworthiness and Safety Residual Risk Level (AWSRRL)

If it is possible, the Company/MTCH presents the applicable risk mitigations in order to lower the AWSRL.
If there are no Company/MTCH proposal to mitigate the risk, the analysis will be performed by the Vice Technical Directorate supported, if necessary by the Italian Air Force Flight Test Center (only from the operational stand point).
Identified the AWSRRL, the acceptance of the risk performed as for Table B-5 in Annex B.

Risk Mitigation

As a guidance for the Risk Mitigation see the “Risk Mitigation Guidance Material” on page C-3.
In the case of a hardware mishap, if the risk mitigation is based on an inspection, it is necessary:

- to identify the timeframe for the first inspection and the inspection intervals;
- to decide if the inspection has to involve other aircrafts in the case the problem has been found on one aircraft only.

In the case of a hardware mishap, if the risk mitigation is based on a redesign, it is necessary:

- to identify the timeframe for the modification;

- to decide if the inspection has to involve other aircrafts in the case the problem has been found on one aircraft only.

Notes:
Usually, for an hardware mishap, a redesign allows the system to be compliant to the requirement. In this case, the analysis reported in this Annex is mainly related to the period before the modification.
The inspection intervals have to be based on the Company/MTCH analysis: evaluation of the crack propagation up to an acceptable maximum, static load analysis, etc.
In the case of risks derived from general safety considerations (not necessarily AW PC/NC), follow the same steps here described, and take into consideration, at step e., that possibile mitigations (including operational restrictions) will/may have to be discussed and concurred with the Armed Force/Armed State Corp operating the aircraft.
In addition, regardless of all the mitigations defined by DAAA, the Armed Force/Armed State Corp operating the aircraft have the faculty of applying additional operational restrictions. As further discussed in Annex D, these mitigations and restrictions may even be overridden/overruled in times of crisis.

Risk Mitigation Guidance Material (source MIL-STD-882E):
Identify and document risk mitigation measures. Potential risk mitigation(s) shall be identified, and the expected risk reduction(s) of the alternative(s) shall be estimated and documented in the Hazard Track System. The goal should always be to eliminate the hazard if possible. **When a hazard cannot be eliminated, the associated risk should be reduced to the lowest acceptable level within the constraints of cost, schedule, and performance by applying the system safety design order of precedence**. The system safety design order of precedence identifies alternative mitigation approaches and lists them in order of decreasing effectiveness.

- eliminate hazards through **design selection**. Ideally, the hazard should be eliminated by selecting a design or material alternative that removes the hazard altogether;
- reduce risk through **design alteration**. If adopting an alternative design change or material to eliminate the hazard is not feasible, consider design changes that reduce the severity and/or the probability of the mishap potential caused by the hazard(s);
- **incorporate engineered features or devices**. If mitigation of the risk through design alteration is not feasible, reduce the severity or the probability of the mishap potential caused by the hazard(s) using engineered features or devices. In general, engineered features actively interrupt the mishap sequence and devices reduce the risk of a mishap;
- **provide warning devices**. If engineered features and devices are not feasible or do not adequately lower the severity or probability of the mishap potential caused by the hazard, include detection and warning systems to alert personnel to the presence of a hazardous condition or occurrence of a hazardous event;
- **incorporate signage, procedures, training, and PPE**. Where design alternatives, design changes, and engineered features and devices are not feasible and warning devices cannot adequately mitigate the severity or probability of the mishap potential caused by the hazard, incorporate signage, procedures, training, and PPE. Signage includes placards, labels, signs and other visual graphics. Procedures and training should include appropriate warnings and cautions. Procedures may prescribe the use of PPE. For hazards assigned Catastrophic or Critical mishap severity categories, the use of signage, procedures, training, and PPE as the only risk reduction method should be avoided.

ANNEX D

Residual Risk
Acceptance Procedure in times of crisis

General

The definition of “times of crisis” presumes the potential necessity of procedural and technical openings performed by the Military Airworthiness Authorities towards emergency measures and decisions, to the extent of adopting waivers or deviations to the extant regulatory framework.
In fact, during high-intensity warfare, relying solely on the established peace-time oriented requirements, processes and procedures could result insufficient and circumstances may force authorities and operators to deviate to continue operations and project necessary capabilities on the battlefield. In this context, aviation safety is seen as a system of checks and balances between its domains, airworthiness, training and licensing, operation and airspace services.
The consequences of any deviations from the established regulatory eco-system in aviation safety domains need to be identified and can then be used to support the risk assessment and decision-making processes required by operators and authorities for the identification of respective mitigation measures.

Scope

A list of disciplines and products potentially subject to the mentioned bespoke measures and resolutions in times of crisis is hereby presented (see figure D-1 for a case analysis carried by the European Defense Agency):

- Initial Airworthiness
    - permanent Permit to Fly for crisis;
    - Certificate of AW for individual aircraft, no type-related certificate;
    - issue of expedited (Restricted) MTCs based on incomplete/partial evidence or with a consistent number of Partial/Non Compliances;
    - flying the aircraft outside the envelope defined in the Technical Data Sheet[7], including the possibility to fly degraded modes;
- Continued Airworthiness
    - simplified Modification release;
    - modification release for crisis for changes of individual aircraft;
- Continuing Airworthiness
    - establishing “Special Maintenance Procedures” to keep the aircraft in the frame of the MTC or to divert from it, at the cost of life limit reduction;
    - Air Battle Damage Repair procedures;
- Wartime/Crisis Minimum Equipment Lists (Wartime/Crisis MEL) to allow less redundancies and less restrictive time limits for corrective measures;
- emergency military aircraft Maintenance License for crisis/wartime;
- less restrictive requirements for organization approvals;
- less restrictive requirements for “MAA recognitions”;
- configuration management
    - tracking mechanism of the exceedances, waivers and deviations from the regular maintenance, inspections, time limits, loads, envelopes captured in the applicable pubbs;
    - restoration of the approved Type Design and individual aircraft configuration after the crisis;

[7] This also includes the flight authorization behind the time limits set in the applicable technical pubbs

- re-convergence of the aircraft and fleet configuration management (including inspections, time limits, etc.) into the framework of the approved pubbs.

The previously listed disciplined are applicable to the aircraft registered in the Italian Military Registry; hoverer, similar types of evaluations extend also to the aircraft belonging to a foreign nation which has declared the status of "crisis". In this case, conceding the Diplomatic Clearance to an aircraft treated by the foreign Airworthiness Authority with some workaround/emergency procedure due to the persistency of high intensity scenarios/conditions also constitutes a potential source of risk and shall be recognized, pondered and adequately addressed by DAAA and the involved competent organs[8].

Irrespective of the scope and type of activity/deliverable/product impacted by the specific critical operational context, the common element among all listed disciplines resides into the necessity of building a number of bespoke safety cases, where a risk-based approach drives the relevant approvals and authorizations[9].

Scope of the present Annex is therefore to frame, adapt and tailor, where necessary, the contents and procedures defined in this regulation to the high-intensity times of crisis.

Principles

As explained, the fundamental requirement in times of crisis resides in the possibility to deviate from the regulatory framework, thus generating a number of non-compliances and risks which need to be adequately regulated, defined, understood, mitigated and accepted.

With respect to the process described in the body of this regulation, the following main differences emerge:

- the source, background and context of the AWSRs are wider and also embrace disciplines normally not covered during the certification process (i.e. restoration of the pre-crisis Type Design, less restrictive conditions for MAA recognitions and/or organization approvals);
- these risks do not necessarily trigger an AW and Safety hazard in the classical term, but may embrace mission-related and operational considerations, more generically referred to as "impacts"; to note, the impact assessment will require the involvement of the Armed Force/Armed State Corp operating the aircraft, thus sourcing the risk;
- likewise, the identification of the possible risk mitigations, the relevant ownership and liability and, above all, the acceptance of the residual risks may fall outside the DAAA area of responsibility, and involve the Armed Force/Armed State Corp articulations;
- particular emergency conditions may also leave the option to the Armed Forces/Armed State Corps to not involve the DAAA for the flight mission authorization, or override and/or further implement the purely technical mitigations and recommendations formulated by the DAAA, which assume the form of "non-technical objections" against the proposed particular measures and waivers;
- a potential risk source is therefore constituted also by the possible inobservance of the recommendations provided by the DAAA, due to operational and mission-effectiveness considerations; such risks cannot be managed by the present DAAA Annex, as they are owned outside the DAAA area of responsibility; to note, the aircraft configuration restoration after the end of the crisis shall take into account that some operations may have been performed out of DAAA control, and the risk of this task be unsuccessful be recognized;

[8] In fact, the status of "crisis" may not be mutually acknowledged between the Italian and the foreign country governments, or there may not an established recognition between the two involved Airworthiness Authorities; these instances may represent sources of risk

[9] For instance, the issue of an MTC with Partial Evidence, the flight authorization outside the approved envelope, the deviation/overlook of a specific maintenance task, the acceptance of life limit exceedances, the concession of accelerated military licenses, can all be effectively authorized upon the identification, mitigation and acceptance of the associated risks.

- given the exceptional high-intensity circumstances, the level of tolerance with respect to the residual risk acceptance may shift and, depending on the recognized impact, the DAAA may accept and approve high residual risk levels, whereas such resolution is not admitted in low-intensity scenarios.

Risk mitigation process

From what above, the following procedural elements can be deducted:

- in the body of the text, the term “hazard/fault condition” will be converted into “impact”, the relevant concepts of severity and probability shall be adapted to account for the additional effects in terms of safety/mission survivability and to allow the involvement of the aircraft operator for a proper assessment[10];
- the matrix headers in Annex A will be modified (underlined changed text), to account for the wider scope and the different role and liability allocated to the DAAA:

Risk	<u>Impact</u>	Risk Level	<u>Technical</u> mitigations and recommendations (*)	Residual Risk Level	DAAA minimum <u>Technical</u> Approval Level

<u>(*) subject to potential override/further implementation by the aircraft operator</u>

Table D – 1: Acceptance module for residual risks in times of crisis

- the risk acceptance matrixes and risk levels defined in Annex B for each aircraft category will remain unchanged and more generically used for the wider scope of the risk sources; however, the residual risks falling into the red zones may also be accepted and endorsed by DAAA and are not automatically deemed unacceptable;
- the approval levels defined in table B-5 will therefore be adapted to the new context, as hereby shown:

Technical Acceptance Level	Risk Level				
	High	Serious	Medium	Low	No Risk
DAAA Director	X (*)				N/A
DAAA Vice Technical Director	NO acceptance	X			N/A
Head of Certification and Qualification Office	NO acceptance		X	X	N/A

<u>(*) subject to a case-by-case argument</u>

Table D – 2: Levels of technical acceptance for residual risks in time of crisis

[10] It is likely that, in such operational context, only qualitative probability levels are assigned

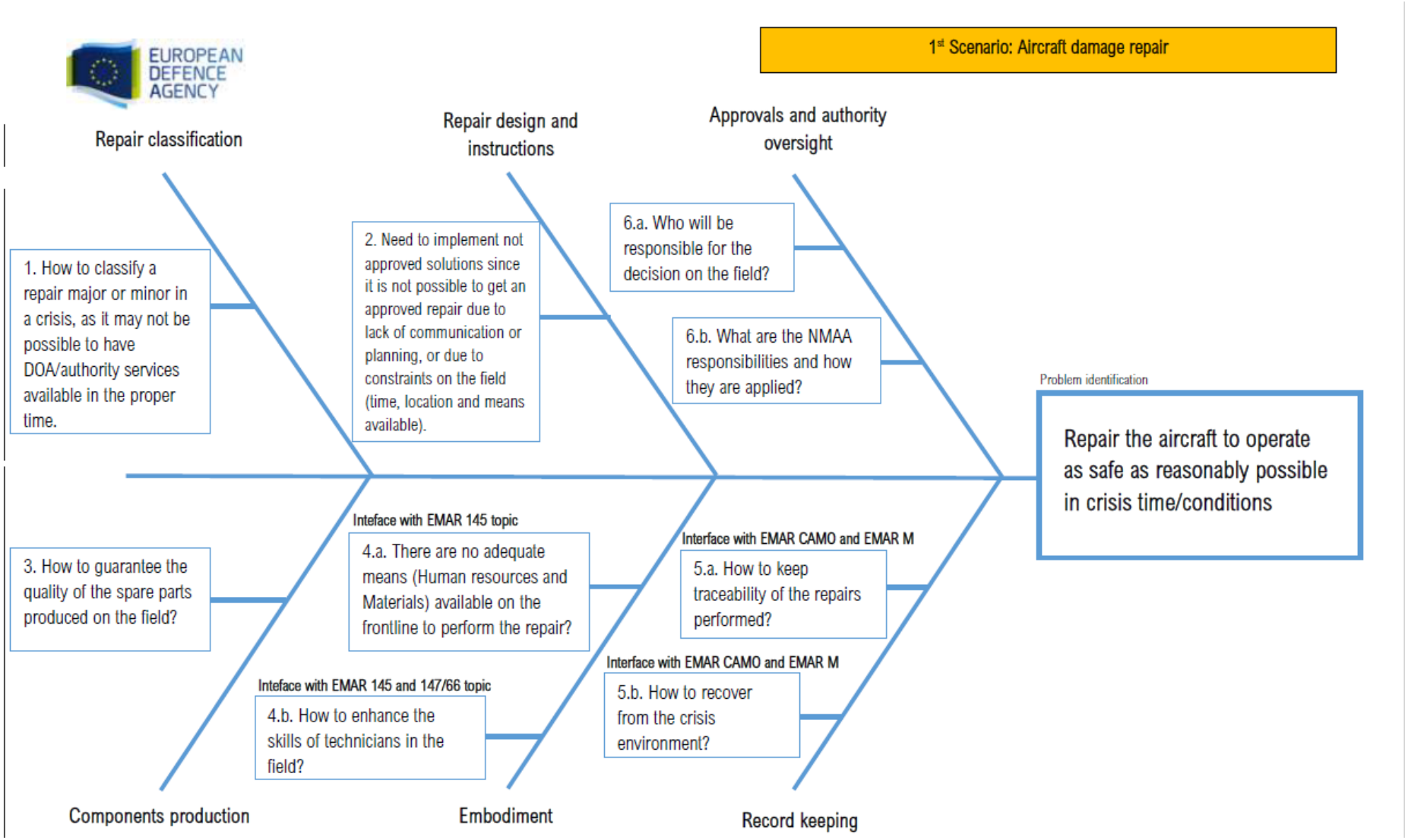

Figure D-1: Fishbone diagram of causes and effects regarding aircraft repairs in case of crisis