Joint Authorities for Rulemaking of Unmanned Systems

JARUS guidelines on Specific Operations Risk Assessment (SORA)

Executive Summary

DOCUMENT IDENTIFIER : JAR-DEL-WG6-D.04

Edition Number	**:**	**1.0**
Edition Date	**:**	**30.01.2019**
Status	**:**	**Final / Public Release**
Intended for	**:**	**Publication**
Category	**:**	**Guidelines**
WG	**:**	**6**

SORA - Executive Summary

The SORA approach

The Specific Operations Risk Assessment (SORA) provides guidance to both the competent authority and the applicant as to what is required for an NAA authorization required to fly an Unmanned Aircraft System (UAS) in a given operational environment. The SORA is primarily aimed at the "Specific" category of UAS (as defined by EASA Technical Opinion 01/2018).

Risk in this context is understood to be the combination of the frequency (probability) of an occurrence and its associated level of severity. Safety means a state in which the risk is considered as acceptable. The way to reach an acceptable risk may differ for the "Open", "Specific" and "Certified" categories, considering both Unmanned Aircraft Systems (UAS) design integrity and the kind of intended operations. However, the safety level (i.e. probability of potential fatalities on the ground or in the air) shall remain the same for the three categories.

The operational volume is defined as including both the "Flight geography" (i.e. the UA flight path under normal operations) and the "contingency volume" (i.e. the projected UA flight path under abnormal conditions handled through contingency procedures). An out of control operation means that the UA is flying out of this operational volume (not including risk buffer), potentially leading to harm to third parties in the air or on the ground.

In order to show that the operator can keep control of the Unmanned Aircraft (UA) within the intended "operational volume" and that the operations have reached an acceptable level of risk, the SORA provides an adequate combination of design and operational mitigation mechanisms for known areas of harm to either people on the ground or in the air.

These mitigations have to be met with a Level of Robustness (Low, Medium, High) that is commensurate with the determined Ground and Air Risks classes. The level of robustness corresponds to an appropriate combination of the levels of integrity and the levels of assurance. The level of integrity is the safety gain achieved by the mitigation and the level of assurance is the method of showing that the level of integrity has been met.

The SORA methodology

The SORA methodology consists of ten systematic steps:

Step #1: ConOps Description

The CONOP contains all the relevant technical, operational, and system information needed to assess the risk associated with the intended operation. It includes such things as the flight path, airspace, air and ground density maps, Air Navigation Service Provider (ANSP) interface, and other information related to the intended use of the UAS. For a complete description, see Annex A of the SORA document.

Step #2 and Step #3: Determination of Ground Risk Class (GRC)

- Step#2: The Intrinsic Ground Risk Class (scaled from 1 to 10) is first determined, depending on the UAS weight and physical dimensions, (with indication of typical expected kinetic energy released upon ground) as well as the intended operation.
- Step#3: The Final Ground Risk Class (that may be higher or lower than the intrinsic Ground Risk Class) is determined considering design aspects which may have a significant effect on the lethality of the drone and three mitigation measures (as described in Annex B):
  1. Strategic mitigations based upon ground risk buffer and overflown population density.
  2. Mitigations intended to reduce the effect of a ground impact.
  3. An Emergency Response plan to address and limit the effect of an operation out of control.

Step #4 and #5: Determination of the Air Risk Class (ARC)

Both the initial and the residual risk after mitigations are applied.

- Step 4: The initial ARC is assessed based on the airspace requested in the CONOPS. The parameters that define the airspace class are: atypical (e.g. segregated) versus typical airspace,

altitude, controlled by air traffic versus uncontrolled, airport environment versus non-airport, and airspace over urban versus rural environments.

- Step 5: The Residual ARC is the residual air risk after applying strategic mitigation measures. Two types of strategic mitigations measures (as described in Annex C) exist in the SORA. Air risk mitigations are either operational restrictions (e.g. boundaries, time of operation) controlled by the UA operators or by structure of the airspace and the associated rules controlled by the relevant authorities. Strategic mitigations are applied before flight.

Determination of ARC requires full coordination with and agreement by the ANSP for the given operation.

Step #6: Tactical Mitigation Performance Requirement (TMPR) and Robustness Levels

Tactical mitigations are applied during the conduct of the operation, and are used to mitigate any residual risk of a mid-air collision that may remain after the strategic mitigations have been applied.

Tactical Mitigation Performance Requirements (TMPR) address the functions of Detect, Decide, Command, Execute and Feedback Loop (see Annex D), for each Air Risk Class. These mitigations range from simple, for example relying on UTM infrastructure, to more complex TSO (Technical Standard Order) DAA equipment that addresses the risk of non-cooperative air traffic (those without transponders) and cooperative air traffic.

Step #7: SAIL determination

A SAIL (scaled from I to VI) is then determined using the proposed CONOPs, and the consolidation of the final GRC and residual ARC.

Step #8: Identification of Operational Safety Objectives (OSO)

For the assigned SAIL, the operator will be required to show compliance with each of the 24 OSOs, although some may be optional for lower SAILs. Each OSO shall be met with a required Level of robustness (High, Medium or Low), depending on the SAIL. OSOs cover the following areas:

- UAS Technical Issue
- Deterioration of external systems
- Human Error
- Adverse environmental conditions

Integrity and Assurance Level Criteria (Low, Medium, High) for each OSO and SAIL level are provided in Annex E.

Step # 9: Adjacent Area/Airspace Considerations

Compliance with safety requirements associated with technical containment design features required to stay within the operational volume regardless of the SAIL. This addresses the risk posed by an operational loss of control that would possibly infringe on areas adjacent to the operational volume whether they be on the ground or in the air.

Step #10: Comprehensive Safety Portfolio

A comprehensive Safety Portfolio is the SORA safety case submitted to the competent authority and the ANSP prior to final authorization. The Safety Portfolio contains the following information:

- Mitigations used to modify the intrinsic GRC
- Strategic mitigations for the Initial ARC
- Tactical mitigations for the Residual ARC
- Adjacent Area/Airspace Considerations
- Operational Safety Objectives

If compliance with the required safety objectives is not achieved for the given SAIL, additional mitigation measures may be needed to further reduce the GRC or/and ARC or a change to the operational volume and CONOPS may be required.