SORA Template

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reference documents

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| --- | --- | --- |
| RD1 | JARUS Guidelines on Specific Operations Risk Assessment | JARUS |
| RD2 | Easy Access Rules for Unmanned Aircraft Systems | EASA |
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|  |  |  |
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abbreviations

| **Acronym** | **Definition** |
| --- | --- |
| AEC | Airspace Encounter Category |
| ARC | Air Risk Class |
| BVLOS | Beyond Visual Line of Sight |
| DAA | Detect And Avoid |
| ERP | Emergency Response Plan |
| EVLOS | Extended Visual Line of Sight |
| FIZ | Flight Information Zone |
| GRC | Ground Risk Class |
| MTOM | Maximum Take Off Mass |
| OSO | Operational Safety Objective |
| RTH | Return To Home |
| SAIL | Specific Assurance and Integrity Levels |
| SORA | Specific Operations Risk Assessment |
| TMPR | Tactical Mitigation Performance Requirement |
| UAS | Unmanned Aerial System |
| VLOS | Visual Line of Sight |
|  |  |

DEFINITIONS

|  |  |
| --- | --- |
| **Air routes** | Recognized route on the airspace followed by an aircraft (also referred as air routes). |
| **Contingency volume** | Area outside of Flight Geography where contingency procedures are applied to return the operation to its desired state |
| **Detect and avoid** | The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action. |
| **Emergency** | Alarm or crisis situation that may involve risk, accident or incident of a serious nature or have public repercussions. |
| **Flight geography** | A geographically defined volume (or chained set of volumes), which can be spatially and temporally defined, that is wholly contained within Operation |
| **Geofence** | A virtual three-dimensional perimeter around a geographic point, either fixed or moving, that can be predefined or dynamically generated and that enables software to trigger a response when a device approaches the perimeter (also referred to as geoawareness or geocaging). |
| **Operational volume** | Is the combination of the Flight Geography and Contingency Volume. |
| **Operator** | A person, organization or enterprise engaged in or offering to engage in an aircraft operation. |
| **Remote pilot** | A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and who manipulates the flight controls, as appropriate, during flight time. |
| **Unmanned aircraft (UA)** | An aircraft intended to be operated with no pilot on board. |
| **Unmanned aircraft system (UAS)** | An aircraft and its associated elements which are operated with no pilot on board. |
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# INTRODUCTION - SORA METHODOLOGY

The Specific Operations Risk Assessment was developed by JARUS (the Joint Authorities for Rulemaking on Unmanned Systems) to provide drone operators a methodology for the risk assessment required to apply for an authorization to operate an Unmanned Aircraft System within the specific category.

The SORA proposes risk barriers to prevent the operation from going out of control and provides harm barriers in case the operation does get out of control (e.g. an emergency response plan). The SORA process starts with defining an operational volume by the operator in which the drone operation takes place. This operational volume is related to airspace adjacent to it and the surrounding area on the ground. The SORA includes both a Ground Risk Model and an Air Risk Model to determine risks to the surrounding area and the adjacent airspace, and to propose mitigating measures that can decrease those risks.

The first step in the SORA process is describing the Concept of Operations for the drone operation that you want to carry out. This CONOPS requires you to collect and provide sufficient technical, operational and human information related to the intended use of the UAS. The CONOPS should not only be a description of your operation but also provide insight into the operational safety culture at the organization.

Basically, you will need to describe the who's, what's and where's of the operation that you intend to carry out. For this you will need information about the drone and supporting equipment that will be used, you will need to know who will pilot the drone, how the organization will make sure that the operation is conducted safely and where the operation will take place.

# CONCEPT OF OPERATION DESCRIPTION (CONOPS) #STEP 1

*[This section should include clear description, in simple form, of the concept of operation, including at least:*

* *Type of activity: Specialized aerial operation or experimental flight.*
* *MTOM of the aircraft/s:*
  + *<2 kg*
  + *2 kg <MTOM< 25 kg*
  + *25 kg < MTOM< 50 kg*
  + *50 kg <MTOM< 150 kg*
  + *>150kg*

* *Flight height.*
  + *≤ 120 m.*
  + *>120 m.*
* *Airspace type.*
  + *Controlled airspace, indicating proximity.*
  + *FIZ: Flight Information Zone*
  + *Outside of the above*

* *Type of area where the operation takes place.*
  + *outside building clusters or assemblies of people*
  + *Building clusters.*
  + *Assemblies of peoples.*
* *Flight schedule.*
  + *Daily*
  + *Overnight*

*If deemed significant for the operation:*

* *Technical information:*
* *Aircraft and limitations.*
* *Navigation.*
* *Control and command.*
* *Communications.*
* *Structure.*
* *Software and equipment.*
* *Training and formation. Competencies.*

*Description, according to the SORA semantic model, of the safety distances both on the ground and in the air to minimize risk.*

*Analyze whether the necessary coordination with third parties is included so that it is formally evidenced.*

*Aspects to be considered in order to establish the dimensions of the semantic model:*

* *To establish the* ***flight geography****, which covers the* ***normal operation****, the following should be considered:*
  + *Positioning errors.*
  + *Accuracy and skill of the pilot or autopilot systems.*
  + *Error in definition of trajectories.*
  + *Any particular relevant hazards (ice, snow, etc.).*
  + *Electromagnetic interference*
* *In order to establish the* ***contingency volume****, which covers the* ***abnormal situation****, the different procedures and systems should be taken into account:*
  + *RTH: Return To Home*
  + *Stationary waiting (multirotor, helicopter) or waiting circling around a point (loitering).*
  + *Automatic landing or at a specific location.*
  + *Distance in case of manual control.*
* *In order to establish the* ***risk margins****, which cover the* ***emergency situation****, the different procedures and systems should be considered:*
  + *Immediate landing.*
  + *Impact energy reduction systems.*
  + *Margin definition:*
    - *Simple distances: calculation including pilot skill, aircraft performances, safe flight termination and emergency termination systems, and their activation system, etc. In any case, at least the above-mentioned rule must be complied with 1:1.*
    - *Tabulating velocities, using, for example, tailwind values in the rows and flight height in the columns.]*

# GROUND RISK PROCESS

## DETERMINATION OF THE INTRINSIC UAS GROUND RISK CLASS (INITIAL GRC) #STEP 2

*[Determination of the intrinsic GRC (Initial), indicating the type of operation envisaged and the size and kinetic energy of the UAS, for the most critical scenarios and aircraft in relation to the intended operation.]*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Intrinsic Index Ground Risk Class of the UAS** | | | | |
| **Maximum UAS dimensions** | 1 m / aprox. 3 ft | 3m / aprox. 10 ft | 8m / aprox. 25 ft | >8m / aprox. 25 ft |
| **Typical kinetic energy expected** | <700 J (aprox.  529 ft lb) | <34KJ (aprox.  2500 ft lb) | <1084KJ (aprox.  800000 ft lb) | >1084KJ (aprox.  800000 ft lb) |
| **Operational scenarios** | | | | |
| VLOS/BVLOS over controlled ground area | 1 | 2 | 3 | 4 |
| VLOS in sparsely populated environment | 2 | 3 | 4 | 5 |
| BVLOS in sparsely populated environment | 3 | 4 | 5 | 6 |
| VLOS in populated environment | 4 | 5 | 6 | 8 |
| BVLOS in populated environment | 5 | 6 | 8 | 10 |
| VLOS over gathering of people | 7 |  | | |
| BVLOS over gathering of people | 8 |

Table 1: Intrinsic Ground Risk Classes (GRC) Determination

## FINAL GRC DETERMINATION #STEP 3

*[Determination of the Final GRC, indicating the damage mitigations applied, if any.*

*This step allows the determination of the final GRC based on the availability of mitigation measures related to the operation. These mitigation measures modify the intrinsic value of the GRC and have a direct effect on the safety objectives associated with a specific operation. For this point it is substantially important to ensure its level of robustness.*

*Applying M1 mitigation, the GRC cannot be reduced to a value lower than the lowest value in the applicable column in Table 1.]*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Robustness** | | |
| **Mitigation sequence** | **Mitigations for ground risk** | Low/None | Medium | High |
| 1 | M1-Strategic mitigations for ground risk | 0: None  -1: Low | -2 | -4 |
| 2 | M2- Effects of ground impact are reduced | 0 | -1 | -2 |
| 3 | M3-An Emergency Response Plan (ERP) is in place, operator validated and effective | 1 | 0 | -1 |

Table 2: Mitigations for Final GRC determination

# AIR RISK PROCESS

## DETERMINATION OF THE INITIAL AIR RISK CLASS (ARC) #STEP 4

*[Determination of the critical AEC (Airspace Encounter Category), i.e., the one that involves a higher risk if the operation is carried out through different AECs, and through the same determine the initial ARC.*

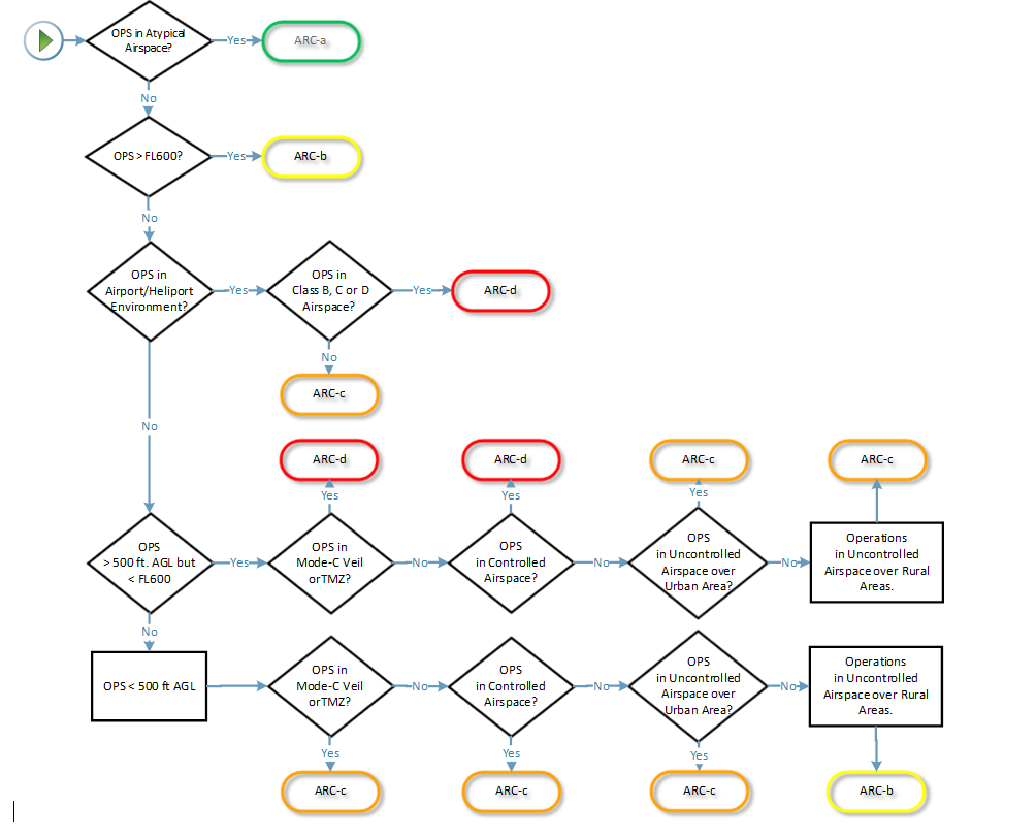


Table 3: ARC assignment process

* ***ARC-a*** *is generally defined as airspace where the risk of collision between a UAS and manned aircraft is acceptable without the addition of any tactical mitigation.*
* ***ARC-b****,* ***ARC-c****,* ***ARC-d*** *are generally defining airspace with increasing risk of collision between a UAS and manned aircraft.]*

## APPLICATION OF STRATEGIC MITIGATIONS TO DETERMINAL RESIDUAL ARC #STEP 5

*[Implementation of strategic mitigations for risk reduction and determination of the Final ARC:*

* *Strategic mitigations for operational restrictions: mitigations that can be implemented by the operator without relying on cooperation with other airspace users.*
  + *Limiting airspace volumes.*
  + *Operation chronology restrictions.*
  + *Flight time or exposure time restrictions*
* *Strategic mitigations for structuring and rules: mitigations that cannot be implemented by the operator alone, as they require the collaboration of all aircraft within the same volume of airspace.*
  + *Common flight rules.*
  + *Airspace structure (air routes, procedures, etc.).]*

## TACTICAL MITIGATION PERFORMANCE REQUIREMENT (TMPR) AND ROBUTNESS LEVELS #STEP 6

*[Tactical mitigation measures are considered to be those procedures or decisions established in a very short period of time during the course of the operation in such a way as to reduce the risk of a mid-air collision.*

* *Description of the approach to a "See and Avoid" scheme: VLOS/EVLOS.*
* *BVLOS- Operations under a DAA system. List proposed tactical mitigation measures, indicating TRMPs where applicable. Level of robustness of TMPR, including:* 
  + *Integrity level.*
  + *Assurance level.*
* *Analysis of equipment effectiveness for the volume of airspace considered.]*

# FINAL ASSIGNMENT OF SPECIFIC ASSURANCE AND INTEGRITY LEVEL (SAIL) AND OSO

## SAIL DETERMINATION #STEP 7

*[Determination of the SAIL (Specific Assurance and Integrity Level).It is possible to derive the SAIL associated with the proposed ConOps.*

*The confidence level represented by SAIL is qualitative, and corresponds to:*

* *Operational Safety Objectives (OSO) to be complied with.*
* *Description of activities that might support compliance with those objectives.*
* *The evidence that indicates the objectives have been satisfied.]*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SAIL Determination | | | | |
|  | Residual ARC | | | |
| Final GRC | a | b | c | d |
| 2 | I | II | IV | VI |
| 3 | II | II | IV | VI |
| 4 | III | III | IV | VI |
| 5 | IV | IV | IV | VI |
| 6 | V | V | V | VI |
| 7 | VI | VI | VI | VI |
| >7 | Category C operation | | | |

Table 4: SAIL Determination

## IDENTIFICATION OF OPERATIONAL SAFETY OBJECTIVES (OSO) #STEP 8

*[List of operational safety objectives (OSO), with their level of robustness. The SAIL represents the level of confidence that the UAS operation will remain under control.*]

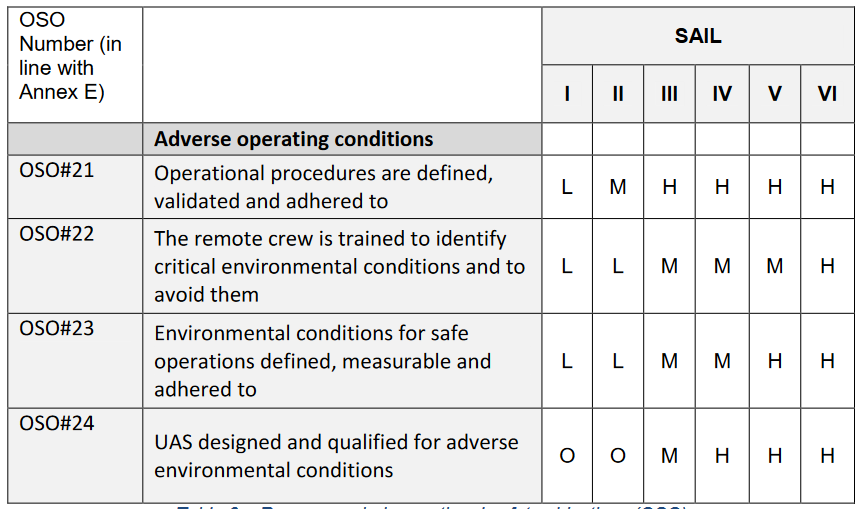
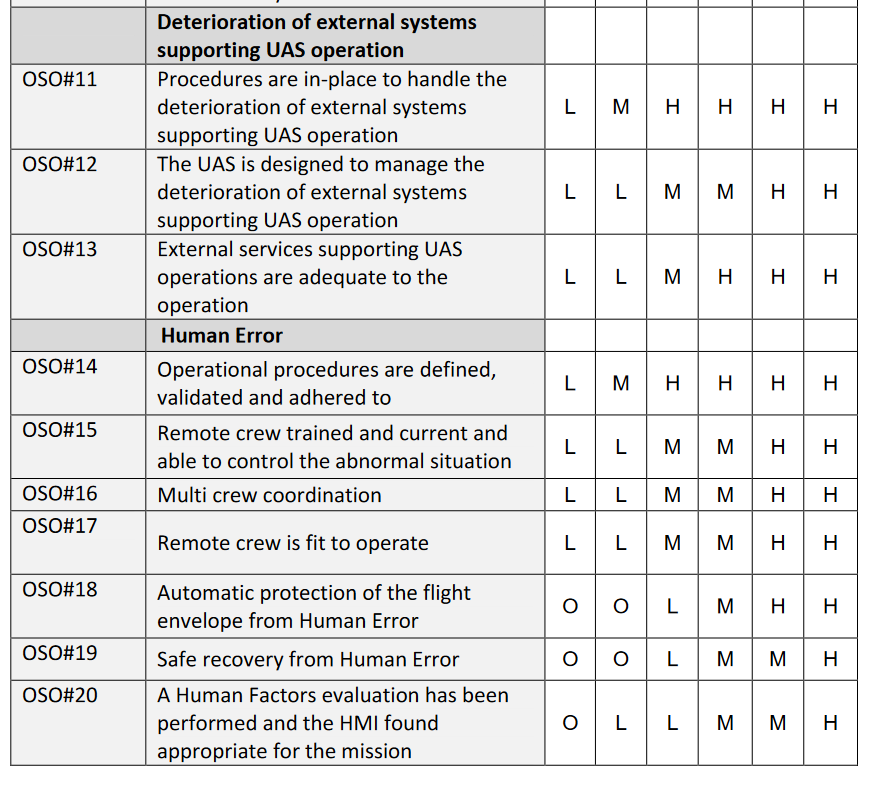
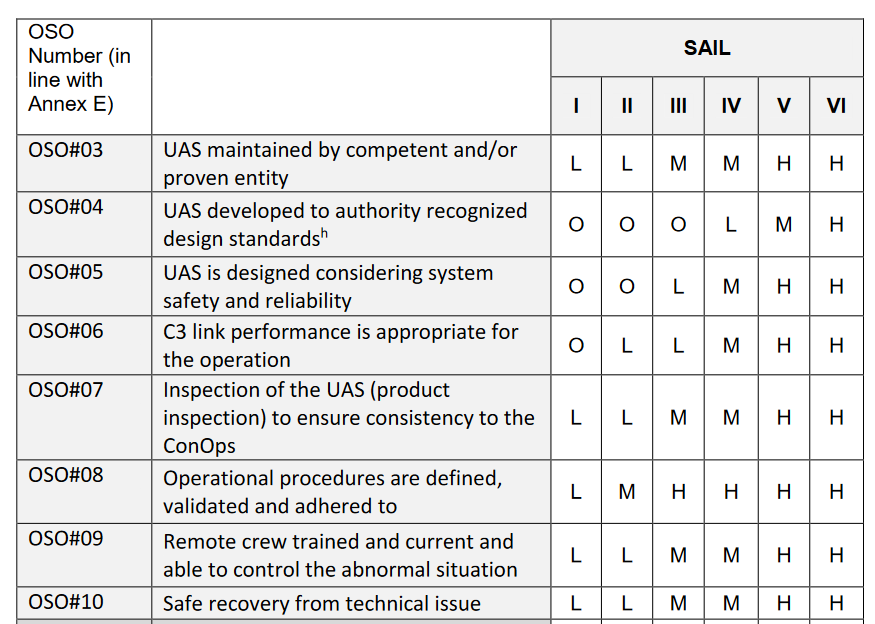
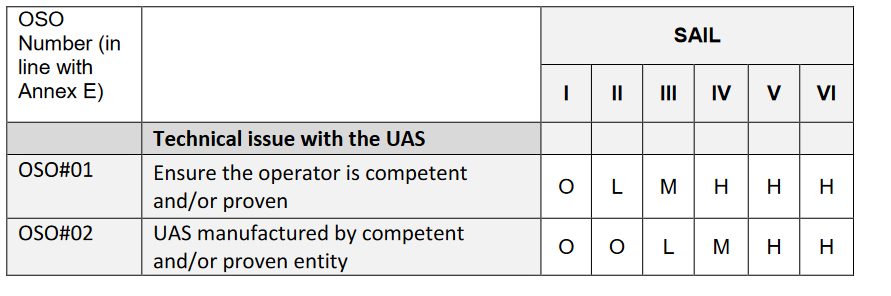


Table 5: Recommended operational safety objectives (OSO)

## ADJACENT AREA/AIRSPACE CONSIDERATIONS #STEP 9

*[Address the risk posed by a loss of control of the operation resulting in an infringement of the adjacent areas on the ground and/or adjacent airspace.*

*Propose containment objectives in the intended volume of airspace, including:*

* *Level of integrity.*
* *Level of assurance]*

# COMPREHENSIVE SAFETY PORTFOLIO #STEP10

*[Describe the satisfactory substantiation of the mitigations and objectives required by the SORA process provides a sufficient level of confidence that the proposed operation can be safely conducted. Those could be listed as:*

* *Mitigations used to modify the intrinsic GRC.*
* *Strategic mitigations for the initial ARC.*
* *Tactical mitigations for the final ARC.*
* *Adjacent Area/airspace Considerations.*
* *Operational safety objectives (OSO) and associated mitigations.*

*The Operator should make sure to address any additional requirements not identified by the SORA process (security, environmental protection, etc.).]*