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Systems

JARUS guidelines on Specific Operations Risk Assessment (SORA)

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Abstract

This document recommends a risk assessment methodology to establish a sufficient level of confidence that a specific operation can be conducted safely. It allows the evaluation of the intended concept of operation and a categorization into 6 different Specific Assurance and Integrity Levels (SAIL). It then recommends operational safety objectives to be met for each SAIL.

Keywords

SORA, SAIL, Specific, Risk, Ground Risk, Air Risk, Containment

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1.0	26.06.2017	Version for Public Release	All
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Annex C: Strategic Mitigation Collision Risk Assessment	1.0
Annex D: Tactical Mitigations Collision Risk Assessment	1.0
Annex E: Integrity and assurance levels for the Operational Safety Objectives (OSO)	2.5
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Annex G: Theoretical Basis for the Air Risk Model	In preparation
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EXECUTIVE SUMMARY

The SORA approach

The Specific Operations Risk Assessment (SORA) process is intended to provide a risk-proportionate method to determine the required evidence and assurances needed for an Unmanned Aircraft System (UAS) to be acceptably safe within the “Specific” category of UAS Operations (defined as Category B in the JARUS document “UAS Operational Categorization”).

The SORA provides structure and guidance to both the competent authority and the applicant to support an application to operate a UAS in a given operational environment. The benefit of this process is that both the applicant and competent authority can allocate their available resources and time proportional to the risk of the operation.

The SORA uses a holistic safety risk management process to evaluate the risks related to a given operation and then provide proportionate requirements that an operation should meet to ensure a Target Level of Safety (TLOS) is met. This TLOS is defined for people and aircraft uninvolved in the operation and is commensurate with existing manned aviation levels of safety to these same stakeholders. These values were chosen to ensure that UAS operations would not pose more risk to third parties than manned aviation which are seen as socially acceptable rates (see Section 5(f) in the Scoping Paper to AMC RPAS 1309 Issue 2 and Section 1.2.1 in Annex F version 2.5):

i. For ground risk - less than one fatality per million hours (1E-6 fatalities per hour) (See Annex F, Section 1.2.1 for more details),
ii. For air risk - less than one mid-air collision per 10 million flight hours (1E-7 mid-air collisions per flight hour) for operations that primarily occur under self-separation and see-and-avoid (primarily uncontrolled airspace). For operations that occur with separation provided by an Air Navigation Service Provider (primarily controlled airspace), the TLOS is one mid-air collision per billion flight hours (1E-9 mid-air collisions per flight hour).

The SORA has been developed using assumptions expected to be both credible and conservative across a wide range of UAS Operations.

Under the “specific” category, different operations will have different levels of inherent risk and thus will need to demonstrate varying levels of ability to maintain control of the operation to meet the TLOS. To do this, the SORA has developed the Specific Assurance and Integrity Levels (SAIL), which maps the maximum allowable loss of control rate to operational, organisational, personnel, design, and manufacturing risk controls that, when implemented correctly at the required level, ensures that an operation meets the TLOS. This means a UA operating in a high-risk environment (example: over a large city near an airport) would have to demonstrate more to the competent authority than the same UA operating in a low-risk environment (example: at a closed test range and below 50 feet).

The SORA methodology

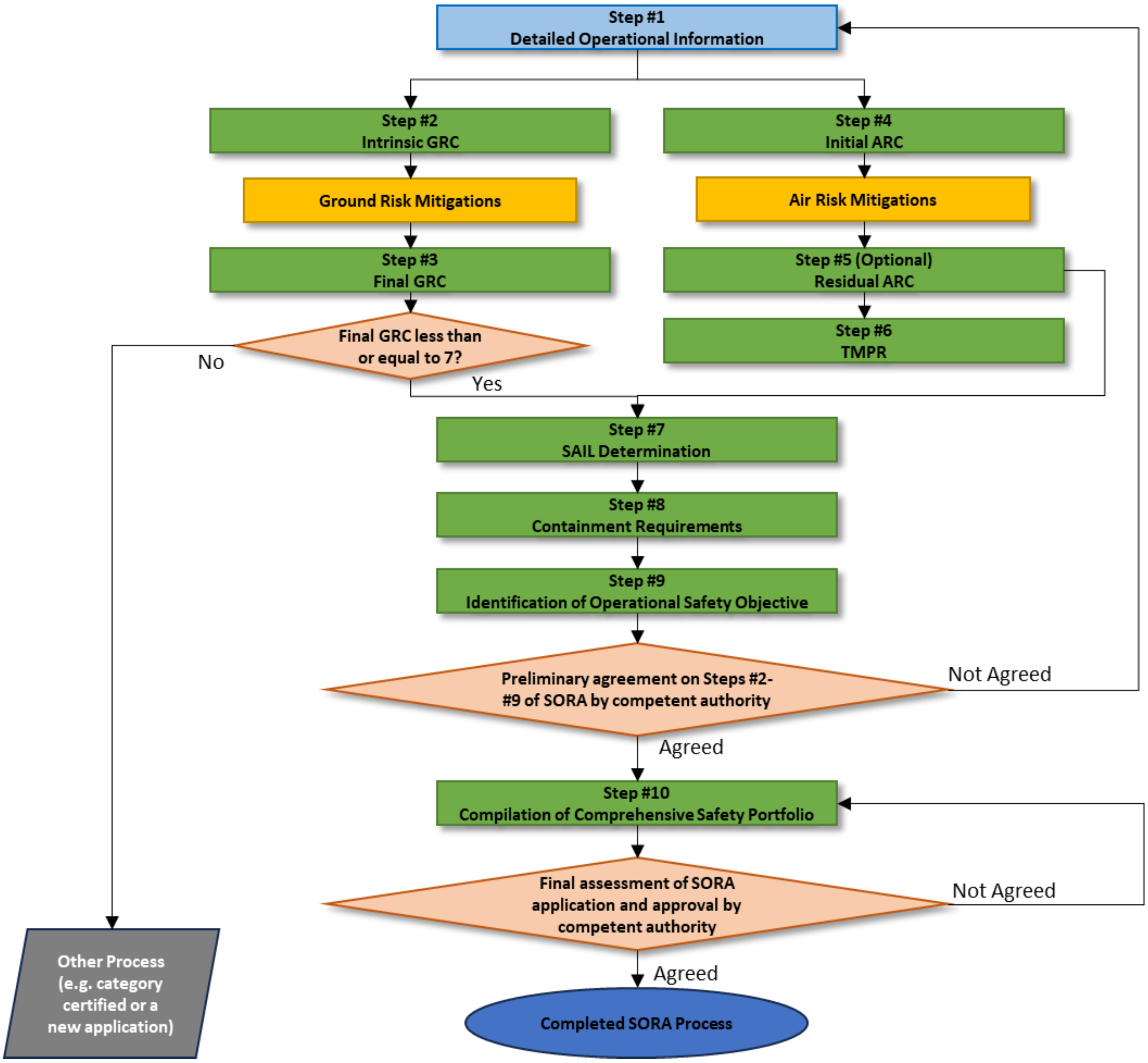

Figure 1 - The SORA process

Note: If operations are conducted across different environments, some steps may need to be repeated for each particular environment.

The SORA methodology consists of ten systematic steps:

Step #1: Documentation of the proposed operation(s)

This is a preparatory step which is intended to ensure the applicant has sufficient information to complete Steps #2 to #9 of the SORA process. This information should enable the subsequent steps of the SORA process to be completed successfully.

Step #2: Determination of the intrinsic Ground Risk Class (iGRC)

The intrinsic Ground Risk Class (scaled from 1 to 10) is determined by the UA characteristics (maximum characteristic dimension and maximum speed) as well as the at-risk population density in the operational volume and ground risk buffer.

Step #3: Final Ground Risk Class determination

The Final Ground Risk Class is determined based on any mitigation measures put in place, as described in Annex B, which may have a significant effect on the likelihood of a fatality after loss of control of the operation, including:

i. Strategic mitigations intended to reduce the risk before flight,
ii. Tactical mitigations intended to reduce the risk during flight,
iii. Mitigations intended to reduce the effect of a ground impact.

A final GRC higher than 7 is out of the scope of SORA and should be handled in the certified category.

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

The determination of Air Risk Class is done in Steps #4 & #5. In Step #4, the initial ARC is assessed based on an expected generalised encounter rate in the airspace identified in Step #1. The parameters that define the four categories of ARC (a, b, c, d) are: if the airspace is atypical (e.g., segregated), altitude, controlled by air traffic versus uncontrolled, airport versus non-airport environment, and airspace over urban versus rural environments.

Step #5: Application of strategic mitigations to determine residual Air Risk Class

The residual ARC is obtained after applying any relevant strategic mitigation measures in order to lower the initial Air Risk Class. Two types of strategic mitigation measures, as described in Annex C, exist in the SORA. Air risk mitigations are either operational restrictions (e.g., boundaries, time of operation) which are controlled by the UAS operators, or by the structure and associated rules of the airspace which are controlled by the relevant authorities (e.g. UTM, U-space).

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

Tactical mitigation requirements on the operation are then applied in Step #6 to mitigate any remaining unacceptable residual risk of a mid-air collision with manned air traffic 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 Residual Air Risk Class.

Step #7: Specific Assurance and Integrity Level (SAIL) determination

A SAIL (scaled from I to VI) is then assigned to the operation described Step #1 based on the final GRC and residual ARC.

Step #8: Determination of Containment requirements

The containment requirements ensure that the target level of safety can be met for both ground and air risk in the adjacent area.

There are three possible levels of robustness for containment: Low, Medium and High; each with a set of safety requirements described in Annex E as a function of UA characteristics, SAIL, average population density in the defined adjacent area and the presence of outdoor assemblies within 1 km of the outer limit of the operational volume.

Step #9: Identification of Operational Safety Objectives (OSO)

The SAIL identifies levels of Integrity and Assurance (Low, Medium, High) to be met for each Operational Safety Objective (OSO) according to criteria provided in Annex E and in the Cyber Safety Extension.

For the assigned SAIL, the operator is required to show compliance with each of the 17 OSOs, at the defined robustness level (for lower SAILs, some OSOs may not be required to show compliance to the competent authority). The OSOs cover, but are not limited to, areas pertaining to: the UAS designer, UAS operator or other organisations involved in maintenance, related services and training, UAS technical aspects, deterioration of external systems supporting UAS operations, human machine interface, human error and adverse operating conditions.

Step #10: Comprehensive Safety Portfolio

The Comprehensive Safety Portfolio (CSP) is a suite of documents showing compliance with the requirements resulting from the SORA steps for the proposed operation. If the Comprehensive Safety Portfolio does not provide appropriate evidence as determined by the SORA process at the given SAIL, changes to the proposed operation (e.g., reduction of the intrinsic risk of the operation), additional mitigation measures, possible UAS design changes, or further analysis/evidence may be needed.

Annex A provides guidance and templates on how to provide relevant information to the competent authority as part of the SORA process.

1. Introduction

1.1 Preface

This Specific Operation Risk Assessment (SORA) is the JARUS Working Group – Safety Risk Management (WG-SRM) consensus vision on how to safely evaluate an Unmanned Aircraft System (UAS) operation. The SORA provides a methodology to guide both the applicant and the competent authority in determining whether an operation can be conducted in a safe manner. The document shall not be used as a checklist, nor be expected to provide answers to all the potential challenges related to the UAS operation. The SORA is a guide that allows an operator to identify the risk and, if needed, reduce it to an acceptable level by tailoring their mitigations to the operation. This involves meeting or exceeding the Target Level of Safety (TLOS) regardless of the complexity of the operation, UA size, or the area of operation. The TLOS of operations under the "specific" category covered by SORA is equivalent to that of the category A "open" and C "certified" categories. For this reason, it does not contain prescriptive requirements but rather safety objectives to be met at various levels of robustness commensurate with risk.

1.2 Purpose of the document

(a) The purpose of the SORA is to propose a methodology of risk assessment to support an application for authorization to operate a UAS within the specific[1] category.

(b) Due to the operational differences and expected increase in level of risk of the operating environment, the "specific" category cannot automatically take credit for the safety and performance data demonstrated with the large number of UAS operating in the "open" category. Therefore, the SORA provides a consistent approach to assess the additional risks associated with the expanded operations not covered by the "open" category.

(c) This methodology is proposed as an acceptable means to evaluate the safety risks and determine the acceptability of a proposed UAS operation within the "specific" category.

(d) This methodology may be applied where the traditional approach to aircraft certification (approving the design, issuing an airworthiness approval and type certificate) may not be appropriate and proportionate to the safety risk presented by the operation. This methodology may also support activities necessary to determine associated airworthiness requirements.

(e) The methodology is based on the principle of a holistic system safety risk-based assessment model used to evaluate the risks of a given operation. The model considers the most common safety threats associated with a specified hazard, the relevant design, and the proposed operational mitigations for a specific UAS operation(s). The SORA then helps to evaluate the risks systematically and determine any needed limitations required for safe operation. This method allows the applicant to determine acceptable risk levels and to validate that those levels are complied with by the proposed operations. The competent authority may also apply this methodology to gain confidence that the UAS operator can conduct the operation safely.

1 This category of operations is further defined in JARUS "UAS Operational Categorization" (Edition 1.0., June 2019)

(f) The competent authority may adapt the existent methodology or request additional measures or requirements to what the SORA stipulates for UAS operations.

(g) The methodology, related processes, and values proposed in this document are intended to guide an applicant when performing a risk assessment of an intended operation to obtain operational approval by the competent authority. For that purpose, the competent authority could decide to adapt any section of this document into their regulatory framework.

1.3 Applicability

(a) The methodology presented in this document is aimed at evaluating the safety risks involved with the operation of one or multiple UAS of any class and size. In the case of multiple simultaneous UA operating relative to each other, such as displays for entertainment, it is recommended to examine common mode failures and adapt the application of the SORA as needed in consultation with the competent authority.

(b) The methodology is particularly suited, but not limited to UAS operations for which a hazard and risk assessment is required.

(c) The methodology is designed to be applicable to all levels of automation.

(d) Safety risks associated with collisions between UA and manned aircraft are in the scope of the methodology. The risk of collision between two UA or between a UA and a UA carrying people will be addressed in future revisions of the document. It is expected that multiple simultaneous operations and concurrent high-volume operators have a deconfliction strategy for their own UA.

(e) The carriage of people is not within the scope of the SORA. The carriage of dangerous goods on board the UAS (e.g., weapons, munitions of war, explosives, hazardous medical samples) that present additional hazards are excluded from the scope of this methodology and might require additional safety considerations (e.g., demonstration of the ability to contain a dangerous good). A separate approval for the carriage of dangerous goods is required to be made by the applicant as part of an overall application for an operational approval to the competent authority.

(f) Cyber security aspects are covered in the supplemental Cyber Safety Extension for Annexes B & E and are not limited to those confined by the airworthiness of the systems (e.g., aspects relevant to the protection from unlawful electromagnetic interference).

(g) Privacy, environmental and financial aspects are excluded from the applicability of this methodology.

(h) In addition to performing the SORA process, the operator must also ensure compliance to all other regulatory requirements applicable to the operation that are not necessarily addressed by the SORA, i.e., the SORA does not preclude any additional regulatory requirements implemented by the competent authority.

(i) The SORA may be used to support waiving regulatory requirements applicable to the operation in some states, if allowed.

(j) The SORA can be used to get operational approval for UAS operations conducted in multiple locations. In that situation, the UAS operator needs to provide a SORA that is applicable to all these areas to show that the SORA requirements will be met for all flights performed under the operational approval. If an applicant can demonstrate to have sufficient procedures in place to correctly allocate operational volumes, buffers, adjacent areas and airspaces, a generic location authorisation should be considered by the competent authority.

1.4 SORA documents

At the time of publication, SORA is currently comprised of the following documents:

i. Main Body: Describes the SORA risk assessment process;
ii. Annex A: Guidelines on collecting and presenting system and operation information for a specific UAS operation;
iii. Annex B: Integrity and assurance levels for the mitigations used to reduce the intrinsic Ground Risk Class;
iv. Annex C: Strategic Mitigation Collision Risk Assessment;
v. Annex D: Tactical Mitigation Collision Risk Assessment;
vi. Annex E: Integrity and assurance levels for the Operational Safety Objectives (OSO);
vii. Annex F: Theoretical basis for ground risk classification and mitigation;
viii. Annex I: Glossary of Terms;
ix. Cyber Safety Extension for Annex B & E.

SORA Edition 2.5 will be extended by Annex H in the near future.

Annexes G, and J will be added to SORA as part of a future edition.

2. Key concepts and definitions

2.1 Risk in the context of SORA

(a) The definition of “risk” as provided in the SAE ARP 4754A / EUROCAE ED-79A: “the combination of the frequency (probability) of an occurrence and its associated level of severity” is used.

(b) The consequence of an occurrence will be designated as a harm of some type.

(c) Many different categories of harm can arise from any given occurrence. Various authors on this topic have collated these categories of harm as supported by literature. This document will focus on occurrences of harm (e.g., an UAS crash) that are short-lived and usually give rise to potential loss of life. Chronic events (e.g., toxic emissions over a period of time), are explicitly excluded from this assessment. The categories of harm in this document are the potential for:

    i. Fatal injuries to third parties on the ground[2];
    ii. Fatal injuries to third parties in the air.

(d) As the SORA only addresses safety risk, it is acknowledged that the competent authorities, when appropriate, may consider additional categories of harm (e.g., privacy, disruption of a community, environmental damage, financial loss, etc.).

(e) Fatal injury is a well-defined condition and, in most countries, known by the authorities. Therefore, the risk of under-reporting fatalities is almost non-existent. The quantification of the associated risk of fatality is straightforward. The usual means to measure fatalities are by the number of deaths within a particular operating time interval (e.g., fatal accident per million flying hours), or the number of deaths for a specified circumstance (e.g., fatal accident rate per number of take-offs).

(f) Damage to critical infrastructure is a more complex condition and different countries may have differing sensitivities to this harm. Therefore, the quantification of the associated risks may be difficult and subject to national specificities, thus it is not addressed within the SORA and should be subject to a separate risk assessment. This should be done in cooperation with the organization responsible for the infrastructure, as they are most knowledgeable of the threats.

2.2 Semantic model in the context of SORA

(a) The semantic model is a key aspect to understanding the SORA and introduces concepts and common terms for all users of the SORA.

(b) To facilitate effective communication of all aspects of the SORA, the methodology requires standardized use of terminology for phases of operation[3], procedures, and operational volumes. The semantic model shown in Figure 2, provides a consistent use of terms for all SORA users. Figure 3 provides a graphical representation of the model and a visual reference to further aid the reader in understanding the SORA terminology.

[2] Risk to involved persons is not included and should be mitigated appropriately. Involved persons should accept the risk of the UAS operation by informed consent.

[3] An operation may be a single flight or, multiple sequential and/or simultaneous flights, that are assessed under a single SORA process.

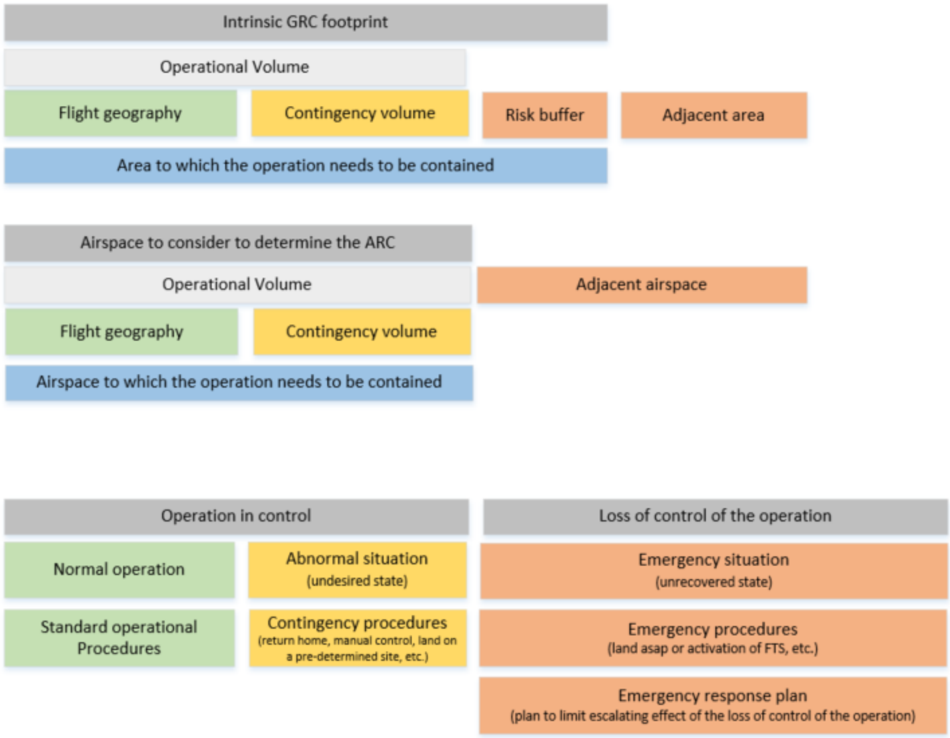

Figure 2 - SORA Semantic Model

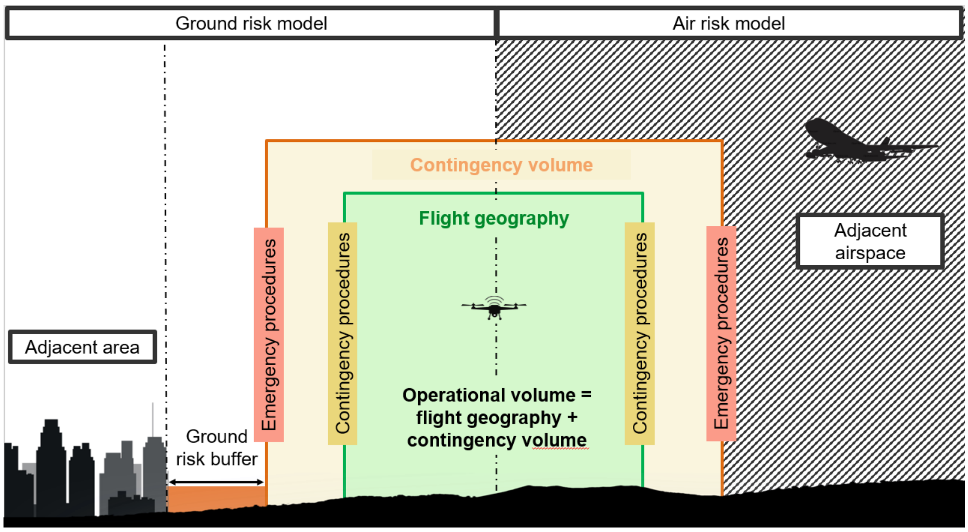

Figure 3 - Graphical Representation of SORA Semantic Model

(c) The SORA considers two states of the operation – in control and loss of control. The SAIL score of the operation is inversely proportional to the acceptable loss of control rate of the operation to meet the safety objectives. The higher the SAIL score, the higher the level of integrity and assurance of the operational safety objectives becomes, which should result in a decreased loss of control rate for the operation.

2.2.1 The operational volume

(a) The operational volume is defined as the volume in which the operation is intended to take place safely.

(b) It is made up of the flight geography and the contingency volume.

(c) The operational volume is the basis to determine the Air Risk Class (ARC) of the operation.

(d) The main SORA process is applied to the operational volume and ground risk buffer. To protect the adjacent area and airspace the UAS operation should be contained within the operational volume.

2.2.2 The flight geography

(a) For normal operations, the UA shall only operate inside the flight geography.

(b) Depending on the type of the operation, the flight geography can be defined as a flight corridor for each planned trajectory, a larger volume to allow for a multitude of similar flights with changing flight paths or a set of different flight volumes fulfilling some specific conditions.

(c) Whenever a particular flight requires the UA to traverse or loiter/hold at a specific point of interest, this point shall be included inside the flight geography. The outer boundary of the flight geography should include sufficient margins for system and operational errors (e.g., deviation from planned trajectory, map error and latency).

2.2.3 The contingency volume

(a) The contingency volume surrounds the flight geography. The outer limit of the contingency volume is equivalent to the outer limit of the operational volume.

(b) Entry into this volume is always considered an abnormal situation and requires the execution of appropriate contingency procedures to return the UA to the flight geography.

(c) It should be noted that an abnormal situation may also occur inside the flight geography.

2.2.4 The ground risk buffer

(a) The ground risk buffer is an area on the ground that surrounds the footprint of the contingency volume.

(b) If the UA exits the contingency volume during a loss of control of the operation, it is expected to end its flight within the ground risk buffer.

(c) The appropriate size of the ground risk buffer is based on the individual risk of an operation and is driven by the flight characteristics of the UA and the identified containment requirements of the SORA.

(d) The footprint of the operational volume plus the ground risk buffer is the area used to determine the Ground Risk Class (GRC).

2.2.5 The adjacent area

(a) The adjacent area represents the ground area adjacent to the ground risk buffer where it is reasonably expected a UA may crash after a loss of control situation resulting in a flyaway.

(b) While the adjacent area inner limit starts at the outer limit of the ground risk buffer, the outer limit of the adjacent area is calculated starting from the inner limit of the ground risk buffer.

(c) The size of the adjacent area depends on the UA performance. Authorities should notice and prevent cases where an applicant tries to include in the operational volume areas which are not intended for use but are only there for manipulation of the composition of the adjacent area.

2.2.6 The adjacent airspace

(a) The adjacent airspace corresponds to the airspace where it is reasonably expected that an unmanned aircraft may fly after a loss of control situation resulting in a flyaway.

(b) The adjacent airspace is the airspace adjacent to the operational volume.

2.3 States of the Operation

2.3.1 Operation in control

(a) An operation is considered in control, when the remote crew is able to continue the management of the current flight situation, such that no persons on the ground or in the air onboard manned aircraft are put in immediate danger.

(b) This holds true for both normal and abnormal situations, however the safety margins in the abnormal situation are reduced. In the abnormal state, it is the remote crews' duty to try to return the operation back into the controlled state by executing contingency procedures as soon as practical.

(c) Normal operation

i. Utilises **standard operating procedures** – a set of instructions covering policies, procedures and responsibilities set out by the applicant that supports operational personnel in ground and flight operations of the UA safely and consistently.

(d) Abnormal situation

i. An abnormal situation is an undesired state where it is no longer possible to continue the flight using standard operating procedures, but the safety of the aircraft, persons on the ground or in the air is not in immediate danger. In this case contingency procedures should be applied.

ii. **Contingency procedures** are designed to potentially prevent a significant future event (e.g., loss of control of the operation) that has an increased likelihood to occur due to the current abnormal state of the operation. These procedures should return the operation to a controlled state and allow the return to using standard operating procedures or allow the safe cessation of the flight.

2.3.2 Loss of control of the operation

(a) Loss of control of the operation is a state that corresponds to situations:

i. Where the outcome of the situation highly relies on providence, or

ii. Which could not be handled by a contingency procedure.

(b) In the context of the semantic model, this includes situations where a UA has exited the operational volume and is potentially operating over or in an area of higher ground or air risk for which it is not approved.

(c) The “loss of control” state is also entered, if a UA does not follow the predefined route and the remote pilot is unable to control it, it crashes or if an unplanned flight termination sequence is executed, even if this happens inside the operational volume.

(d) **Emergency procedures** are executed in case of loss of control of the operation. They are executed by the remote crew and may be supported by automated features of the UAS (or vice versa) and are intended to mitigate the effect of failures that cause or lead to an emergency condition (e.g. flight termination system). Emergency procedures should be activated as soon as the UA reaches the boundary of the operational volume. However, as soon as the remote crew identifies a failure condition where the UA cannot be recovered through contingency procedures (e.g., loss of propulsion), the remote crew may initiate the emergency procedures when the UAS is in the operation volume. Emergency procedures deal with affecting the UA to either:

i. Return to a state where the operation is “in control”, or

ii. Minimize hazards until the flight has ended.

(e) **Emergency Response Plan (ERP)**

i. The ERP deals with the potential hazardous secondary or escalating effects after a loss of control of the operation (e.g., timely intervention of emergency services).

ii. It is different from the emergency procedures, as it does not deal with the control of the UA.

iii. The ERP is used for coordinating all activities needed to respond to incidents and accidents.

(f) **Containment** is a function consisting of technical and operational mitigations that are meant to contain the flight of the UA within the defined operational volume and ground risk buffer and reduce the likelihood of a loss of control of the operation resulting in a flyaway.

2.4 Robustness

(a) To properly understand the SORA process, it is important to introduce the key concept of robustness.

(b) **Robustness** is the term used to describe the combination of two key characteristics of a risk mitigation or operational safety objective: the **level of integrity** (i.e., how good the mitigation/objective is at reducing risk), and the **level of assurance** (i.e., the degree of certainty with which the level of integrity is ensured).

(c) The activities used to substantiate the level of integrity and assurance are detailed in the Annexes B, C, D and E. These annexes provide either guidance material or reference industry standards and practices where applicable.

(d) Table 1 provides guidance to determine the level of robustness based on the level of integrity and the level of assurance.

	Low Assurance	Medium Assurance	High Assurance
Low Integrity	Low robustness	Low robustness	Low robustness
Medium Integrity	Low robustness	Medium robustness	Medium robustness
High Integrity	Low robustness	Medium robustness	High robustness

Table 1 - Robustness, Integrity and Assurance matrix

(e) For example, if an applicant demonstrates a medium level of integrity with a low level of assurance the overall robustness will be considered as low as the robustness is equal to the lowest level of either integrity or assurance.

(f) Any given risk mitigation or operational safety objective will have different requirements for the different levels of robustness. The SORA contains three levels of robustness: low, medium and high, commensurate with risk.

(g) Guidance for the level of assurance is provided below:

i. A **low** level of assurance is where the applicant declares that the required level of integrity has been achieved, after having performed, produced or obtained any necessary evidence required. The competent authority will validate the compliance statement and may request evidence in support of this declaration. The evidence should not be provided unless requested.

ii. A **medium** level of assurance is one where the applicant provides supporting evidence that the required level of integrity has been achieved. This is typically achieved by means of testing or operational data. The competent authority will validate the compliance statement and the existence of the evidence.

iii. A **high** level of assurance is where the achieved integrity has been verified to be acceptable by a competent third party. The competent authority will consider the compliance report provided by the competent third party. The competent third party may be the competent authority receiving and assessing the application.

(h) The specific criteria defined in the SORA Annexes take precedence over the criteria defined in paragraph (g) above.

(i) To accommodate national specificities that cannot and should not be standardised, the competent authorities might require different activities to substantiate the level of robustness. National specificities could include nationally sensitive infrastructure, protection of environmental areas, etc.

2.5 Roles and responsibilities

(a) While performing an assessment using the SORA process several key actors might be required to interact in different phases of the process. The main actors applicable to the SORA are described in this section.

(b) Applicant – The applicant is the party seeking an operational approval. The applicant must substantiate the safety of the operation by performing the SORA. Supporting material for the assessment may be provided by third parties (e.g., the designer of the UAS or equipment, UTM service providers, etc.).

(c) Operator – The operator is an applicant that has obtained an operational approval from the competent authority. The approval allows the operator to perform a series of flights, provided that they are performed in accordance with the scope and limitations of the operational approval, based on the SORA compliance demonstration. The operator is responsible for the safe operation of the UAS. Hence the compliant execution of the procedures, training and other applicable programs as well as the observation of the limits and other requirements of the applicable concept of operations are the UAS operator's obligation.

(d) UAS design and production organisation – For the purposes of the SORA, the UAS design and production organisation is the party that designs and produces the UAS. In some cases, a UAS may be equipped with one or more components (e.g., parachute) designed and produced by an entity other than the UAS manufacturer and installed by a UAS component integrator (that may be also the same entity designing the component or a different one or the UAS operator itself). It may be expected that sometimes the design and production of the UAS or components are carried out by two different organisations. The design and production organisation has unique design evidence (e.g., system performance, system architecture, software/hardware development documentation, test/analysis documentation, etc.) that they may choose to make available to one or many UAS operator(s) or the competent authority to help substantiate the operator's SORA safety case. Alternatively, a design and production organisation may utilise the SORA to target design objectives for specific or generalised operations, tailored to the relevant SAIL. To obtain airworthiness approval(s), these design objectives could be complemented by use of JARUS Certification Specifications (CS) or industry consensus standards if they are found acceptable by the competent authority.

(e) Competent authority – The competent authority is the recognized authority for approving the SORA safety case of the UAS operation(s). The competent authority may accept an applicant's submission of an operational manual with an associated SORA based risk assessment. Through the SORA process, the applicant may need to consult with the competent authority to ensure consistent application or interpretation of individual steps. The competent authority may also have oversight of the UAS designer-and/or component designer and may approve the design and/or the manufacture of each. The competent authority provides the operational approval to the operator.

(f) Competent third party – A competent third party is responsible for reviewing supporting evidence for mitigations and operational safety objectives of an application when required. The competent authority may designate or recognise organizations[4] that perform this task for all or a selection of review items. The competent authority may also decide to perform this task by themselves, thus becoming the competent third party.

(g) Air navigation service provider (ANSP) – The ANSP is the designated provider of air traffic service in a specific area of operation (airspace). The ANSP assesses and/or should be consulted whether the proposed operation can be safely conducted in the particular airspace that they cover. Whether an ANSP approval would be required may depend on whether the particular operation may be considered as being compliant with the rules of the air or should be managed as a contained hazard. Annex J, when published, will have additional information on ANSP roles, responsibilities, and interactions with applicants[5].

(h) UTM/U-space service provider – UTM/U-space service providers are entities that provide services to support safe and efficient use of airspace. These services may support an operator's compliance with their safety obligation and risk analysis described in Annex H.

(i) Remote pilot in command – The remote pilot that is designated by the operator as being in command and charged with the safe conduct of the flight(s). Some UAS operations may require employing more than one remote pilot with different tasks, however in this case only one is responsible as remote pilot in command.

(j) Remote crew – The remote crew includes all operator personnel involved in the operation of the UAS, with duties essential to the safe operation of the UAS. The remote pilot in command is part of the remote crew.

(k) Maintenance staff – Ground personnel in charge of maintaining the UAS before and after flight in accordance with UAS maintenance instructions.

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[4] In some regions designated organisations means that the competent authority delegates some of their tasks (e.g. issue a certificate or the operational authorisation) while recognised organisations are those that review the supporting evidence and provide a recommendation to the competent authority. In the latter last case, the competent authority keeps the responsibility to issue the certificate or the operational authorisation.

[5] The role of ANSP as a function is distinct from that of the aviation regulator or the function of safety oversight.

3. The SORA walkthrough

3.1 Introduction to the SORA walkthrough

(a) This section describes how the SORA process is detailed in the document. The intent is to provide both an applicant and a competent authority with clear guidance in terms of what is expected from the SORA process.

(b) The following headers are applied:

i. **Task Description:** is a recommendation to be followed by the applicants completing the SORA process.

ii. **Outcome:** is what is achieved when the task description has been completed.

iii. **Guidance:** is material provided to applicants to better identify and understand the steps contained in the task description.

(c) Recommendations[6] are marked as 'R' and generally use the terms 'describe' / 'detail' / 'explain' / 'declare'.

(d) Guidance is marked as 'G' and is intended to help the applicant to provide the information in the recommendations.

(e) 'Should' indicates a strong obligation.

(f) 'May' indicates that discretion can be used when assessing what information to provide.

3.2 Before starting the SORA process

3.2.1 Outcome

G

Determine whether the operator should carry out the SORA process.

3.2.2 Task description

R

(a) Before starting the SORA process, the following aspects should be verified:

i. If the operation falls under the "open" category or if the competent authority has determined that the UAS is "harmless" (the worst credible case is negligible or minor in consequence) in terms of the risk presented by the operation;

ii. If the operation is covered by a "standard scenario" recognized by the competent authority[7];

iii. If the operation falls under the "certified" category;

iv. If the operation is subject to specific no-go criteria from the competent authority.

(b) If none of the above cases apply, the SORA process should be applied.

[6] In some regions these may be called means of compliance.

[7] In some regions, standard scenarios may be published by the competent authority to enable UAS operators to conduct UAS operations after complying with a pre-defined set of requirements.

3.3 The SORA process phases

G

(a) As part of the SORA, it is critical to review the steps and to validate the assumptions and derivations made throughout this process. The SORA process has a natural break point after Step #9 (see Figure 4), from which the SORA process can be split into two phases:

i. Phase 1 focuses on the derivation of safety requirements and proposed means of compliance, and

ii. Phase 2 focuses on compliance with the derived safety requirements from Phase 1.

(b) The phases ensure there is a review of the first phase outputs for the applicant to determine if any adjustments to the proposed operation are required before undertaking the second phase. This approach should minimise unnecessary iterations in the operational procedures, remote crew requirements, and system(s) design in the proposed operations and mitigations.

(c) An additional benefit of the phases is that it provides an engagement point with the competent authority. This is intended to support reaching a preliminary agreement that Phase 1 has been undertaken correctly, and that the derived requirements and proposed means of compliance for Phase 2 are appropriate.

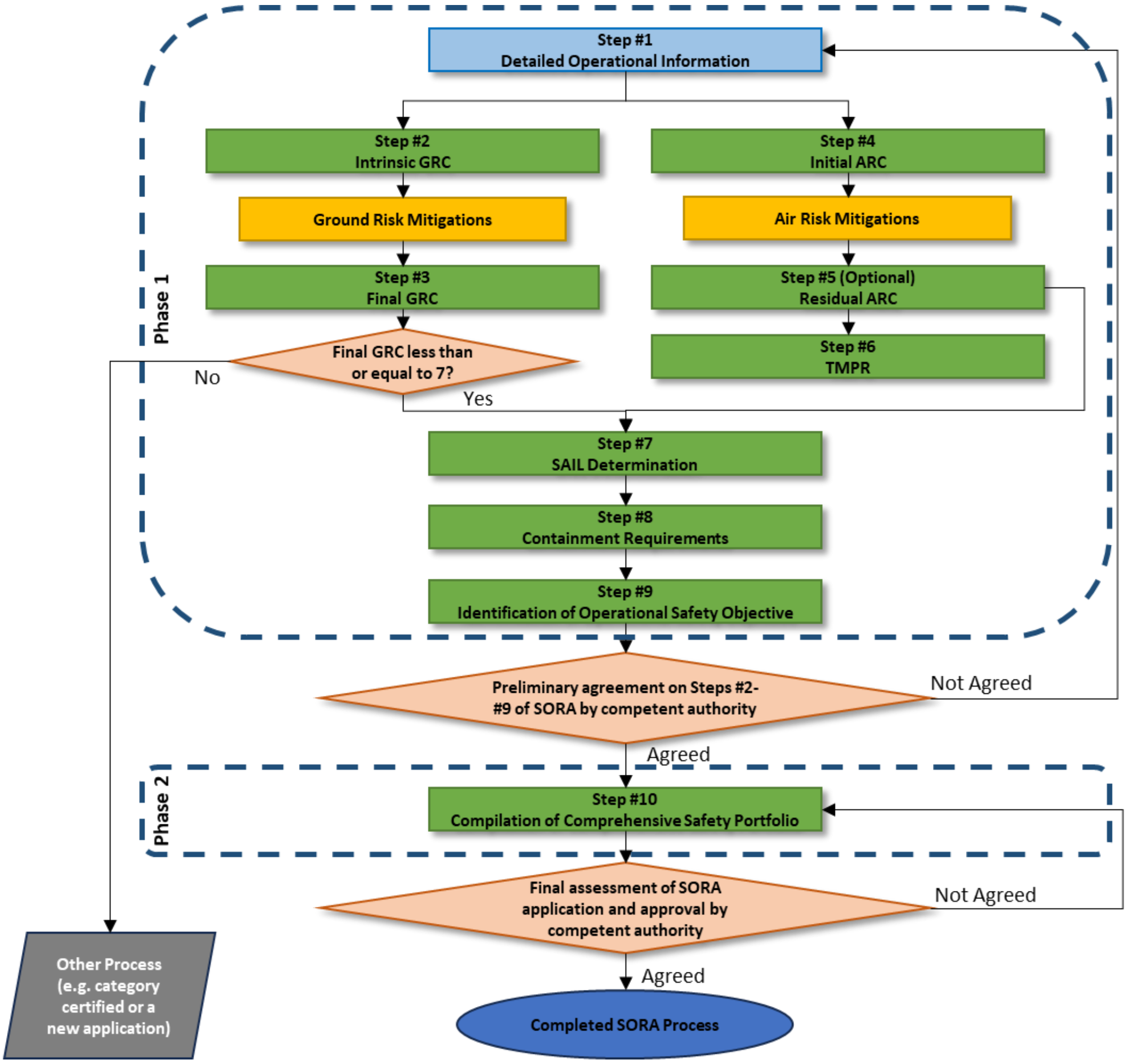

Figure 4 – The SORA process phases

3.3.1 Phase 1 (Requirements derivation)

G

(a) The purpose of Phase 1 is to derive all relevant safety requirements based on the proposed operation which should result in a document suite that sufficiently describes the proposed operation(s). This should include the relevant information, safety claims and derived requirements of Step #1 to Step #9. The applicant should collect explanations, but not the entire justification, of the means by which the applicant will demonstrate compliance with any safety claims and requirements derived in Phase 1. This can assist both the applicant and competent authority in ensuring any means of compliance proposed is valid and will result in satisfying the safety claims or requirements. This may take the form of an initial compliance matrix (an example is provided in Annex A, Section A.4).

(b) The results of this phase may be the basis for a pre-application evaluation by the competent authority. The competent authority may or may not be able to provide a formal agreement until the submission and review of final compliance evidence (covered in Phase 2).

(c) It is recommended that the applicant contacts the competent authority as early as possible in order to present the available information and reach a common initial understanding and in-principle agreement on the safety claims, in particular the final GRC, residual ARC, and SAIL.

3.3.2 Phase 2 (Compliance with requirements)

G

(a) Phase 2 occurs after the completion of Step #9. This phase is a final set of iterations to complete the SORA process. This should result in a SORA Comprehensive Safety Portfolio (CSP), which collects the work done in all previous steps of the SORA into a comprehensive, justified document suite showing compliance with the SORA requirements.

(b) If completed correctly, the CSP should provide all the necessary claims, arguments and evidence to support the assessment and approval of the proposed operation.

4. The SORA process

4.1 Step #1 – Documentation of the proposed operation(s)

4.1.1 Introduction

G

Step #1 provides an opportunity for the applicant to collect and present contextual information on the proposed operation and the intended safety claims made during Phase 1 of the SORA process.

4.1.2 Outcome

G

A sufficiently detailed operational concept, that allows the applicant to continue through the SORA process.

4.1.3 Task description

R

(a) Compile operational, technical, and organisational information. This may include:

   i. Various maps, figures, diagrams and other information detailing the operational volume, ground risk buffers, adjacent area, and adjacent airspace to facilitate the determination of:

      A. The intrinsic Ground Risk Class (i.e., population density maps, land use information),

      B. The initial Air Risk Class (i.e., airspace use information, aerodromes, and airspace charts), and

      C. The adjacent areas.

   ii. Information on the operational, technical, and organisational elements of:

      A. The operation and functions during flight, including intended flight profiles, states, and modes that provide safety throughout the nominal, contingency, and emergency phases of flight,

      B. Any ground and air risk mitigations (strategic and tactical) used to reduce the intrinsic ground risk or initial air risk.

(b) A description of the contingency volume and ground risk buffers, and how they were determined.

(c) The applicant may use Annex A, Section A.3 to assist in understanding the type of data that needs to be presented and any other information that supports the risk assessment to the authority.

4.2 Step #2 – Determination of the intrinsic Ground Risk Class (iGRC)

4.2.1 Introduction

G

(a) In this step the UAS operator is required to assess the intrinsic ground risk of the operational volume and ground risk buffer.

(b) No ground risk mitigations will be applied at this step, this may be completed in Step #3.

4.2.2 Outcome

G

Calculation and documentation of the intrinsic ground risk class.

4.2.3 Task description

R

iGRC Footprint

(a) Identify the maximum characteristic dimension and the maximum speed of the UA.

(b) Identify the iGRC footprint:

   i. Identify the flight geography;

   ii. Calculate the contingency volume;

   iii. Calculate the initial ground risk buffer (the final ground risk buffer calculation will be completed in Step #8);

(c) Identify the highest population density within the iGRC footprint.

(d) Identify the iGRC of the footprint using Table 2 for fixed wing, single and multi-rotor aircraft.

<table>
<tr><th colspan="7">Intrinsic UAS Ground Risk Class</th></tr>
<tr><td colspan="2">Maximum UA characteristic dimension</td><td>1m / approx. 3 ft</td><td>3 m / approx. 10 ft</td><td>8 m / approx. 25 ft</td><td>20 m / approx. 65 ft</td><td>40 m / approx. 130 ft</td></tr>
<tr><td colspan="2">Maximum speed</td><td>25 m/s</td><td>35 m/s</td><td>75 m/s</td><td>120 m/s</td><td>200 m/s</td></tr>
<tr><td rowspan="7">Maximum iGRC population density (people/km^2)</td><td>Controlled Ground Area</td><td>1</td><td>1</td><td>2</td><td>3</td><td>3</td></tr>
<tr><td>< 5</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>< 50</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>< 500</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>< 5,000</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>< 50,000</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>> 50,000</td><td>7</td><td>8</td><td colspan="3">Not part of SORA</td></tr>
</table>

- A UA weighing less than or equal to 250 g and having a maximum speed less than or equal to 25 m/s is considered to have an iGRC of 1 regardless of population density.
- A UA expected to not penetrate a standard dwelling will get a -1 GRC reduction in Step 3 from the M1(A) sheltering mitigation when not overflying large open assemblies of people, see Annex B for additional details.

Table 2 - Intrinsic Ground Risk Class (iGRC) determination

(e) For UA with a maximum characteristic dimension greater than 40 m the iGRC should be calculated following the guidance in Appendices A and B in Annex F.

4.2.4 Guidance

G

Intrinsic UA Characteristics

(a) Maximum UA characteristic dimension examples:

i. Wingspan for fixed wing,

ii. Blade diameter for rotorcraft,

iii. Maximum distance between blade tips for multi-copters.

(b) Maximum speed:

i. The maximum speed is conservatively defined as the maximum possible commanded airspeed of the UA, as defined by the designer,

ii. This is not the mission specific maximum commanded airspeed of the UA as reducing the mission airspeed may not necessarily reduce the impact area. Mitigations that limit airspeed below the maximum speed value during an impact can be accounted for in Annex B, part of Step #3.

iGRC Footprint

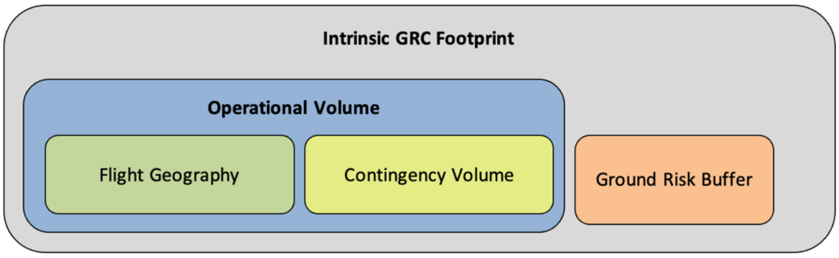

Figure 5 - Visualisation of the intrinsic GRC Footprint

(a) The applicant needs to have defined the area at risk when conducting the operation, which is defined as the intrinsic GRC footprint. This is composed of the operational volume plus the ground risk buffer as shown in Figure 5.

(b) The operational volume is composed of the flight geography and the contingency volume (refer respectively to points 2.2.1, 2.2.2 and 2.2.3 for additional information). To determine the operational volume the applicant should consider the position keeping capabilities of the UAS in 4D space (latitude, longitude, height and time). In particular, the accuracy of the navigation solution, the flight technical error of the UAS, the path definition error (e.g., map error) and latencies should be accounted for in this determination.

The iGRC Footprint is used to determine the population density. It is expected that for many flight operations, the iGRC footprint may cover segments with different population densities. The segment with the highest population density should be used when determining the iGRC.

Identification of the iGRC

(a) The iGRC is found at the intersection of the applicable maximum population density and the left most column matching both criteria, the maximum UA characteristic dimension and the maximum speed in Table 2.

(b) The applicant can provide substantiation to the competent authority for a different iGRC. See Annex F, Appendix A for further guidance.

(c) Operations that do not have a corresponding iGRC (i.e., grey cells on the table) are outside the scope of the SORA methodology. Applicants falling in these categories should consider the certified category.

(d) In the event that population density values are not available, not accurate or an authority would rather use qualitative descriptors for the iGRC table, the following approximations can be used as guidance:

Quantitative Population Value (people/km^2)	Qualitative Descriptors	Area Description
Controlled Ground Area	Controlled ground / Extremely remote	Areas that are controlled where unauthorized people are not allowed to enter. Hard to reach areas (mountains, remote deserts, etc), large bodies of water away from expected boat traffic, where it is reasonably expected that people will rarely be present.
< 5	Remote	Areas where people may be, such as forests, deserts, large farm parcels, etc. Areas where there is approximately 1 small building every km^2.
< 50	Lightly populated	Areas of small farms. Residential areas with very large lots (~ 4 acres or 16,000 m^2).
< 500	Sparsely populated / Residential lightly populated	Areas comprised of homes and small businesses with large lot sizes (~1 acre or 4,000 m^2).
< 5,000	Suburban / Low density metropolitan	Areas of single-family homes on small lots, apartment complexes, commercial buildings, etc. Can contain multistory buildings, but generally most should be below 3-4 stories.
< 50,000	High density metropolitan	Areas of mostly large multistory buildings. The downtown area of most cities. Areas of dense skyscrapers.
> 50,000	Assemblies of people	The densest areas in the largest cities. Large gatherings of people such as professional sporting events, large concerts, etc.

Table 3 – Qualitative descriptors for population density estimation.

Ground risk buffer

(a) An appropriate initial ground risk buffer could be defined:

i. With a 1-to-1 principle, or

ii. A different ground risk buffer value may be proposed by the applicant using the principles outlined in Annex E, Section E.4, Criteria 3.

(b) Cases where the final ground risk buffer may be different than the initial one could include:

i. Medium and high level of containment,

ii. Use of ground risk mitigations, such as a parachute.

Controlled Ground Areas

(a) A controlled ground area is defined as the intended UAS operational area where only involved persons (if any) are present.

(b) Controlled ground areas are a way to strategically mitigate the ground risk; the assurance that there will be no uninvolved persons in the area of operation is under the full responsibility of the operator. The authority may request evidence on how the operator will ensure control of the area during operation.

Non-typical cases

(a) There are certain cases, for example aircraft whose maximum characteristic dimension and maximum speed differ significantly from the selected column, which may have a large effect on the iGRC. This may not be well represented in the iGRC table and lead to an increase or decrease in iGRC. See Annex F Section 1.8 for further guidance.

(b) The applicant may consider that the iGRC is too conservative for their UA. Therefore, an applicant may decide to calculate the iGRC by applying the mathematical model defined in Annex F Section 1.8. The operator should choose the column that matches their risk as identified in Annex F Table 33.

Population density information

(a) Determining the population density to calculate the iGRC in Step #2 should be done using maps with appropriate grid size based on the operation. Competent authorities should designate specific maps to be used for determining population densities.

(b) If there are no acceptable population density maps available, or if designated by the authority, the qualitative population density descriptors (see Table 3) may be used to estimate the population density band in the operational volume and ground risk buffer. Alternatively, the authority may require or permit applicants to provide appropriate population density maps. Table 4 below presents the suggested optimal grid size for different maximum operating heights:

Max. Height (AGL)		Suggested Optimal Grid Size (meter x meter)
Feet	Meters	
500	152	>200 x 200
1,000	305	>400 x 400
2,500	762	>1,000 x 1,000
5,000	1,524	> 2,000 x 2,000
10,000	3,048	>4,000 x 4,000
20,000	6,096	>5,000 x 5,000
60,000	18,288	>10,000 x 10,000

Table 4 - Suggested grid size for authoritative maps

(c) The authority designated map should be at the suggested optimal grid size. If mapping products do not exist at the suggested optimal grid size, the authority should use the closest grid size available. If the closest grid size available is smaller than the suggested optimal grid size, then the map should be smoothed to the suggested optimal grid size.

(d) If the applicant identifies errors in the designated static population density map, they can provide alternative data that demonstrates the correction in the estimated average population density of the area (i.e., using other mapping products, satellite imagery, on-site inspections, local knowledge of the area, etc.). If accepted by the competent authority, the applicant can use the alternative data to determine the iGRC. Use of time-based restriction arguments (e.g., flying at night) for reduction of people at risk on the ground are addressed in Step #3.

(e) Additional information can be found in Annex F Section 3.2.

4.3 Step #3 – Final Ground Risk Class (GRC) determination (optional)

4.3.1 Introduction

G

(a) The intrinsic risk of a person being struck by the UA during a loss of control of the operation can be reduced by means of acceptable mitigations.

(b) In this step, the UAS operator may identify ground risk mitigations and reduce the GRC of the operation.

4.3.2 Outcome

G

(a) Identification of the mitigations applied to reduce the iGRC for the iGRC footprint.

(b) Identification of the applicable mitigation requirements.

(c) Determination of the final GRC by subtracting the credit derived by the mitigations from the iGRC.

(d) Collection of information and references used to substantiate the application of the ground risk mitigation(s).

4.3.3 Task description

R

(a) Identify the applicable mitigations listed in Table 5 that could lower the iGRC of the iGRC footprint. All mitigations must be applied in numerical sequence:

	Level of Robustness		
Mitigations for ground risk	**Low**	**Medium**	**High**
M1(A) - Strategic mitigations - Sheltering	**-1**	**-2**	**N/A**
M1(B) - Strategic mitigations - Operational restrictions	**N/A**	**-1**	**-2**
M1(C) - Tactical mitigations - Ground observation	**-1**	**N/A**	**N/A**
M2 - Effects of UA impact dynamics are reduced	**N/A**	**-1**	**-2**

Table 5 - Mitigations for Final GRC determination

(b) Identify in Annex B the requirements needed to comply with in order to receive appropriate credit for the mitigation.

(c) In case a mitigation that affects the UA descent behaviour is used, assess if the size of the ground risk buffer defined in Step #2 is still valid.

(d) Determine the final GRC by applying the appropriate correction to the iGRC.

4.3.4 Guidance

G

Ground risk mitigations

(a) Step #3 is an optional step.

(b) The mitigations used to modify the iGRC have a direct effect on the safety objectives associated with an operation, and therefore it is important to ensure their robustness. This has particular relevance for technical mitigations (e.g., parachute).

(c) The Final GRC determination is based on the availability and correct application of the mitigations to the operation. Table 5 provides a list of potential mitigations and the associated relative correction factor. All mitigations must be applied in numeric sequence to perform the assessment. Annex B provides additional details on the robustness of each mitigation. Competent authorities may define or accept additional mitigations and the relative correction factors.

(d) A quantitative approach to mitigations allows a reduction in the iGRC by 1 point if the mitigation reduces the at-risk population to the next lowest iGRC population band. This is in most cases approximately a factor of 10 (90% reduction) compared to the risk that is assessed before the mitigation means are applied. Such quantitative criteria may be used to validate the risk reduction that is claimed when applying Annex B to SORA.

(e) In rare situations, iGRC reductions larger than the ones shown in Table 5 may be possible. Refer to Annex B for further guidance.

(f) When applying all the M1 mitigations, the final GRC cannot be reduced to a value lower than the lowest value in the applicable column in Table 2. This is because it is not possible to reduce the number of people at risk below that of a controlled ground area.

(g) In case the mitigation influences the descent behaviour of the UA, for example by using a parachute, the ground risk buffer size should be redefined using the updated assumptions including the effects of the mitigation means.

(h) Additional information can be found in Annex A, Section A.3 for guidance on presenting the data supplementing the risk assessment to the competent authority.

Multiple partial mitigations

For situations where multiple partial mitigations do not meet the criteria within Annex B individually but when taken together achieve cumulative order(s) of magnitude reductions, the competent authority may accept a reduction of the final GRC score.

What if the final GRC is greater than 7?

If the final GRC is greater than 7, the operation is considered to have more risk than the SORA is designed to support. The applicant may discuss options available with the competent authority, such as using the certified category or a new application (as stated in Figure 1).

4.4 Step #4 – Determination of the initial Air Risk Class (ARC)

4.4.1 Introduction

G

(a) The SORA uses the operational airspace defined in Step 1 as the baseline to evaluate the intrinsic risk of mid-air collision with manned aircraft and for determining the air risk class (ARC). The ARC may be modified/lowered by applying strategic and tactical mitigation means. An example of strategic mitigations to reduce collision risk may be by operating during certain times or within certain boundaries. After applying strategic mitigations any residual risk of mid-air collision is addressed by means of tactical mitigations.

(b) Tactical mitigations take the form of detect and avoid systems or alternate collaborative means, such as ADS-B, systems transmitting on SRD 860 frequency band, UTM/U-Space services[8] or operational procedures. Depending on the residual risk of mid-air collision, the Tactical Mitigation Performance Requirement(s) may vary.

(c) As part of the SORA process, the Operator should cooperate with the relevant service provider for the airspace (e.g., ANSP or UTM/U-Space service provider) and obtain the necessary authorisations. Additionally, generic local authorisations or local procedures allowing access to a certain portion of airspace may be used if available (e.g., Low Altitude Authorization and Notification Capability – LAANC – system used in the United States). The competent authority or ANSP may impose additional strategic or tactical mitigations on airspace authorisations, taking into account uncertainties related to UA reliability, conspicuity, and other factors.

(d) The SORA recommends that, irrespective of the results of the risk assessment, the operator pay particular attention to all features that may increase the detectability of the UA in the airspace. Therefore, technical solutions that improve the electronic conspicuousness or detectability of the UAS are recommended.

4.4.2 Outcome

G

(a) Identification of the risk of collision between the UA and a manned aircraft.

(b) Documentation of information and references used to determine the initial ARC of the operational volume.

[8] Some UTM/U-Space services could also be used as strategic mitigations.

4.4.3 Task description

R

Operational volume

(a) Identify the vertical limit of the operational volume:

i. Identify the vertical limit of the flight geography;

ii. Identify and document the contingency procedures in case the UA will exceed the height of the flight geography;

iii. Evaluate the maximum height the UA will travel above the limit of the flight geography when applying the contingency procedures before it enters again in the flight geography.

(b) Check if there are official airspace collision risk maps available. The competent authority, ANSP, or UTM/U-space service provider, may elect to directly map the airspace collision risks using airspace characterization studies. These maps would directly show the initial/residual Air Risk Class (ARC) for a particular airspace. If the competent authority, ANSP, or UTM/U-space service provides an air collision risk map (static or dynamic), the applicant should use that service to determine the initial/residual ARC and go directly to section 4.5 “Application of Strategic Mitigations” to reduce the initial ARC, provided that a further reduction is still possible.

(c) If subsection (b) is not applicable, identify the initial ARC of the operational volume using the decision tree found in Figure 6.

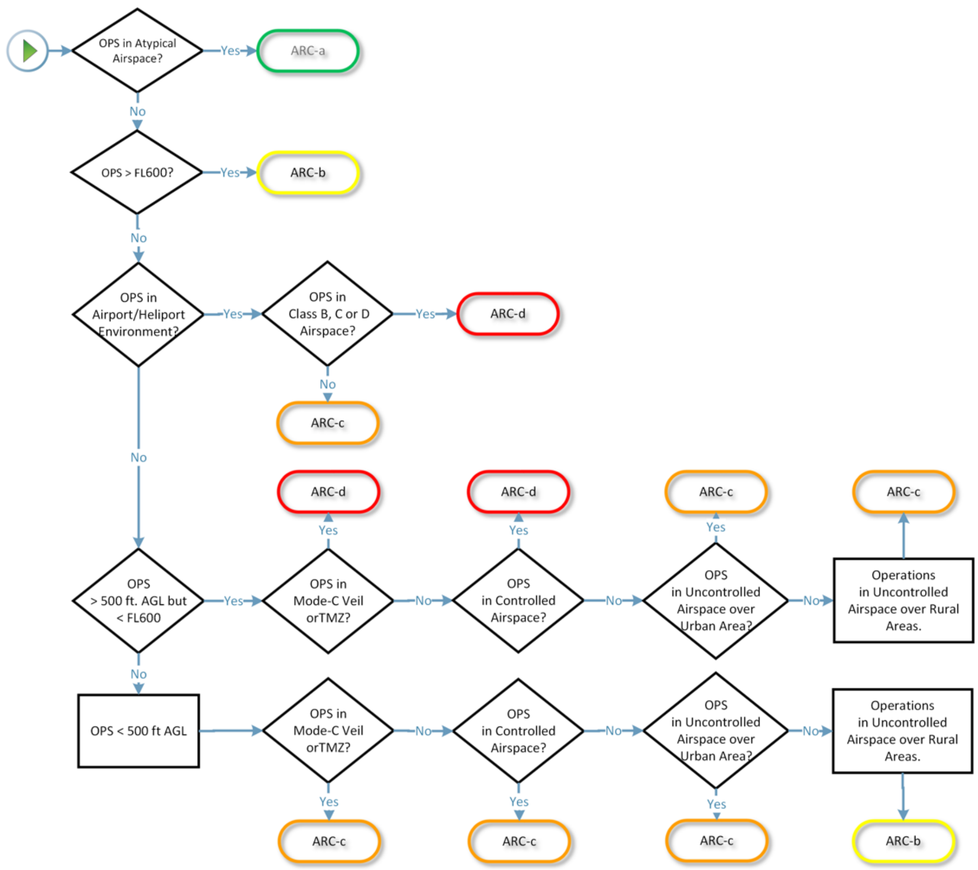

Figure 6 - ARC assignment process

4.4.4 Guidance

G

Identification of the initial ARC

(a) As seen in Figure 6, the airspace is categorized into 12 aggregated collision risk categories. These categories were characterized by altitude, controlled versus uncontrolled airspace, airport/heliport versus non-airport/non-heliport environments, airspace over urban versus rural areas, and lastly atypical (e.g., segregated) versus typical airspace. The categories correspond to the Airspace Encounter Classes (AECs), which provide a further qualitative delineation of unmitigated collision risk that is elaborated in Annex C.

(b) During the UAS operation, the UAS operational volume may span many different airspace environments. The applicant needs to do an air risk assessment for the entire range of the operational volume. An example scenario of operations in multiple airspace environments is provided at the end of Annex C.

(c) The ARC is a qualitative classification of the rate at which a UAS would typically encounter a manned aircraft within that volume of airspace. The ARC is an initial assignment of the aggregated collision risk for the airspace, before mitigations are applied. Actual collision risk of a specific local operational volume could be much different and can be addressed in Step #5.

(d) Although the unmitigated risk captured by the ARC is conservative, there may be situations where that conservative assessment may not suffice. It is important that both the competent authority and operator take great care to understand the operational volume and under what circumstances the definitions in Figure 6 could be invalidated. In some situations, the competent authority may raise the operational volume ARC to a level which is higher than that indicated by Figure 6. The ANSP should be consulted to assure that the assumptions related to the operational volume are accurate.

(e) A competent authority may designate parts of their airspace as atypical. ARC-b, ARC-c, ARC-d are generally defining airspace with increasing risk of collision between a UAS and manned aircraft.

Identification of the vertical limit of the operational volume

(a) The vertical limit of the flight geography is the maximum height where the UA can operate in normal conditions.

(b) On top of the flight geography the UAS operator should identify the extent of the contingency volume as the maximum height the UA will travel when applying the contingency procedures.

Atypical air environment

(a) An atypical air environment (leading to ARC-a classification) is defined as airspace where the risk of collision between a UAS and manned aircraft is acceptably low without the addition of any tactical mitigation. This is usually the case, when it can be generally expected that no manned aircraft use the airspace volume intended for the operation.

(b) Examples may include operation in reserved or restricted airspaces, or operation at very low altitudes (including in close proximity to obstacles) in those areas where manned aircraft generally do not operate.

4.5 Step #5 – Application of strategic mitigations to determine residual ARC (optional)

4.5.1 Introduction

G

(a) As stated before, the ARC is a qualitative classification of the rate at which a UAS would encounter a manned aircraft in a given airspace environment. However, it is recognized that the UAS operational volume may have a collision risk that differs from the initial ARC assigned.

(b) If an applicant considers that the initial ARC assigned is too high for the condition in the local operational volume, then refer to Annex C for the ARC reduction process.

(c) If the applicant considers that the initial ARC assignment is correct for the condition in the local operational volume, then that ARC becomes the residual ARC.

4.5.2 Outcome

G

(a) Identification of the strategic mitigations applied to reduce the initial ARC of the operational volume.

(b) Identification of the residual ARC.

(c) Documentation of information and references used to support the application of strategic mitigations.

4.5.3 Task description

R

(a) Identify the applicable strategic mitigations listed in Annex C, Section 5.

(b) Identify the residual ARC of the operational volume following the process listed in Annex C, Section 6.

(c) Utilise Annex A, Section A.3 for further guidance on presenting the data supplementing the risk assessment to the authority.

(d) If flying in VLOS, consider the additional guidance below.

4.5.4 Guidance

G

Application of the strategic mitigations

For VLOS operations or operations where the remote pilot is supported by an airspace observer situated alongside the pilot for instantaneous communication, the initial air risk class can be reduced by one class. In these conditions, the crew is assumed to have the ability to assess the other aircraft activity in the airspace and therefore is able to lower the encounter rate, applying this mitigation both before and during the operation. The mitigation cannot be used to reduce the ARC to an ARC-a. In ARC-d environments, an additional agreement with ATC might be required.[9]

4.6 Step #6 – Tactical Mitigation Performance Requirement (TMPR) and robustness levels

4.6.1 Introduction

G

Tactical Mitigations are applied to mitigate any residual risk of a mid-air collision needed to achieve the applicable airspace safety objective.

4.6.2 Outcome

G

(a) Identification of the applicable TMPR and corresponding level of robustness.

(b) Collection of information and references to be used to support the compliance with the TMPR.

4.6.3 Task description

R

Identify if flying in VLOS, EVLOS or BVLOS.

VLOS/EVLOS Operations

(a) Develop and document a VLOS de-confliction scheme, in which it is explained which methods will be used for detection, and

(b) Define the associated criteria applied for the decision to avoid incoming traffic. In case the remote pilot relies on detection by observers, the use of phraseology will have to be described as well.

BVLOS Operations

(a) Identify the applicable TMPR level deriving it from the Residual ARC using Table 6.

(b) Identify the applicable TMPR according to Annex D – Section 5.

(c) Utilise Annex A, Section A.3 for further guidance on presenting the data supplementing the risk assessment to the authority.

[9] This information will be reflected in a future version of Annex C.

Residual ARC	Tactical Mitigation Performance Requirements (TMPR)	TMPR Level of Robustness
ARC-d	High	High
ARC-c	Medium	Medium
ARC-b	Low	Low
ARC-a	No requirement	No requirement

Table 6 - Tactical Mitigation Performance Requirement (TMPR) and TMPR Level of Robustness Assignment

4.6.4 Guidance

G

Applications of tactical mitigations

Tactical mitigations will take the form of either "See and Avoid" (i.e., operations under VLOS) or may require a system which provides an alternate means of achieving the applicable airspace safety objective (operation using a Detect and Avoid (DAA) system, or multiple DAA systems). Annex D provides the method for applying tactical mitigations.

VLOS/EVLOS operations

(a) VLOS is considered an acceptable Tactical Mitigation for collision risk for all ARC levels.

(b) Notwithstanding the above, the operator is advised to consider additional means to increase situational awareness with regard to air traffic operating in the vicinity of the operational volume.

(c) In the case of multiple segments of the flight, those segments done under VLOS do not have to meet the TMPR nor the TMPR robustness requirements, whereas those done BVLOS do need to meet the TMPR and the TMPR robustness requirements.

(d) In general, all VLOS requirements are applicable to Extended Visual Line of Sight (EVLOS). EVLOS may have additional requirements over and above VLOS. EVLOS verification and communication latency between remote pilot and observers should be less than 15 seconds.

(e) For VLOS operations, it is assumed that an observer is not able to detect traffic beyond 2 NM. (Note that the 2 NM range is not a fixed value and may largely depend on atmospheric conditions, aircraft size, geometry, closing rate, etc.). Therefore, the operator may have to adjust the operation and /or procedures accordingly.

Tactical Mitigation Performance Requirement (TMPR) levels

(a) High TMPR (ARC-d): This is airspace where either the manned aircraft encounter rate is high, and/or the available strategic mitigations are Low. Therefore, the resulting residual collision risk is high, and the TMPR is also high. In this airspace, the UAS may be operating in integrated airspace and will have to comply with the operating rules and procedures applicable to that airspace, without reducing existing capacity, decreasing safety, negatively impacting current operations with manned aircraft, or increasing the risk to airspace users or persons and property on the ground. This is no different than the requirements for the integration of comparable new and novel technologies in manned aviation. The performance level(s) of those tactical mitigations and/or the required variety of tactical mitigations is generally higher than for the other ARCs. If operations in this airspace are conducted more routinely, the competent authority is expected to require the operator to comply with the recognised DAA system standards (e.g., those developed by RTCA SC-228 and/or EUROCAE WG-105).

(b) Medium TMPR (ARC-c): A medium TMPR will be required for operations in airspace with a moderate likelihood of encounter with manned aircraft, and/or where the strategic mitigations available are medium robustness. Operations with a medium TMPR will likely be supported by systems currently used in aviation to aid the remote pilot with detection of other manned aircraft, or on systems designed to support aviation that are built to a corresponding level of robustness. Traffic avoidance manoeuvres could be more advanced than for a low TMPR.

(c) Low TMPR (ARC-b): A low TMPR will be required for operations in airspace where the likelihood of encountering another manned aircraft is low but not negligible and/or where strategic mitigations address most of the risk and the resulting residual collision risk is low. Operations with a low TMPR are supported by technology that is designed to aid the remote pilot in detecting other traffic, but which may be built to lesser standards. For example, for operations below 500 feet AGL, the traffic avoidance manoeuvres are expected to mostly be based on a rapid descent to an altitude where manned aircraft are not expected to ever operate.

(d) No TMPR (ARC-a): This is airspace where the manned aircraft encounter rate is expected to be extremely low, and therefore there is no need for a TMPR. It is defined as airspace where the risk of collision between a UAS and manned aircraft is acceptable without the addition of any tactical mitigation. An example of this may be UAS flight operations in some parts of Alaska or northern Sweden where the manned aircraft density is so low that the airspace safety threshold could be met without any tactical mitigation.

(e) Annex D provides information on how to satisfy the TMPR based on the available tactical mitigations and the TMPR Level of Robustness.

Guidance on airspace / operation requirements

(a) Modifications to the initial and subsequent approvals may be required by the competent authority or ANSP as safety and operational issues arise.

(b) The operator and competent authority need to be cognizant that the ARCs are a generalized qualitative classification of collision risk. Local circumstances could invalidate the aircraft density assumptions of the SORA, for example with special events. It is important that both the competent authority and operator fully understand the airspace and air-traffic flows and develop a system which can alert operators to changes to the airspace on a local level. This will allow the operator to safely address the increased risks associated with these events.

(c) There are many airspaces, operational and equipage requirements which have a direct impact on the collision risk of all aircraft in the airspace. Some of these requirements are general and apply to all airspaces, while some are local and are required only for a particular airspace. The SORA cannot possibly cover all the possible requirements required by the competent authority for all conditions in which the operator may wish to operate. The applicant and the competent authority need to work closely together to define and address these additional requirements.

(d) The SORA process should not be used to support operations of a UAS in a given airspace without the UAS being equipped with the required equipment for operations in that airspace (e.g. equipment required to ensure interoperability with other airspace users). In these cases, specific exemptions may be granted by the competent authority. Those exemptions are outside the scope of the SORA.

(e) Operations in controlled airspace, an airport/heliport environment or a Mode-C Veil/Transponder Mandatory Zone (TMZ) will likely require prior approval from the ANSP. The applicant should ensure that they coordinate with the relevant ANSP/authority prior to commencing operations in these environments.

4.7 Step #7 – Specific Assurance and Integrity Levels (SAIL) determination

4.7.1 Introduction

G

(a) The SAIL parameter consolidates the ground and air risk analyses and drives the required activities.

(b) The SAIL represents the level of confidence that the UAS operation will stay under control.

4.7.2 Outcome

G

Identification of the SAIL.

4.7.3 Task description

R

Identify the SAIL associated with the proposed operation deriving it from the final GRC and residual ARC using Table 7.

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 (Certified) operation[10]			

Table 7 - SAIL determination

[10] This category of operations is further defined in JARUS "UAS Operational Categorization" (Edition 1.0., June 2019)

4.7.4 Guidance

G

(a) The level of confidence that the operation will remain in control is represented by the SAIL.

(b) The SAIL is not quantitative but instead corresponds to:

i. The level of OSO robustness to be complied with (see Table 14),

ii. Description of activities that might support compliance with those objectives, and

iii. The evidence that indicates the objectives have been satisfied.

4.8 Step #8 – Determination of Containment requirements

4.8.1 Introduction

G

(a) The containment requirements ensure that the target level of safety can be met for both ground and air risk in the adjacent area.

(b) The containment requirements are derived from the difference between the final ground risk level in the operational volume plus ground risk buffer, and the final ground risk level in the adjacent area.

(c) There are three possible levels of robustness for containment: Low, Medium and High; each with a set of safety requirement described in Annex E.

4.8.2 Outcome

G

(a) A set of operational limits for population in the adjacent area,

(b) A derived level of robustness for containment,

4.8.3 Task description

R

(a) If the UA is less than 250 g, apply Low containment with no required operational limits for the population in the adjacent area and go to Step #9.

Otherwise:

(b) Determine the size and population characteristics of the adjacent area:

i. Calculate the size of the adjacent area for the operation. The lateral outer limit of the adjacent area is calculated from the operational volume as the distance flown in 3 minutes at maximum speed of the UA:

A. If the distance is less than 5 km, use 5 km,

B. If the distance is between 5 km and 35 km, use the distance calculated,

C. If the distance is more than 35 km, use 35 km.

ii. Calculate the average population density between the outer limit of the ground risk buffer and the outer limit of the adjacent area.

iii. Assess the presence of outdoor assemblies of people within 1 km of the outer limit of the operational volume.

(c) Determine a set of operational limits appropriate for intended operation using the columns in Tables 8-13

i. Choose an operational limit for the acceptable average population density in the established adjacent area.

ii. Choose an operational limit for the acceptable size of assemblies of people within 1 km surrounding the operational volume.

(d) Use Tables 8-13 to identify the required containment robustness level for the chosen operational limits, the characteristic dimension of the UA and the SAIL of the operation.

1 m UA (< 25 m/s) Sheltering assumed applicable for the UA in the adjacent area			
Average Population density allowed	No Upper Limit		< 50,000 ppl/km²
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k
SAIL			
I & II	High	Medium	Low
III	Medium	Low	Low
IV - VI	Low	Low	Low
V-VI	Low	Low	Low

Table 8 - Containment requirements 1 m UA

3 m UA (< 35 m/s) Shelter applicable for the UA in the adjacent area				
Average Population density allowed	No Upper Limit		< 50,000 ppl/km²	< 5,000 ppl/km²
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k people	
SAIL				
I & II	Out of scope	High	Medium	Low
III	Out of scope	Medium	Low	Low
IV	Medium	Low	Low	Low
V & VI	Low	Low	Low	Low

Table 9 - Containment requirements 3 m UA with shelter assumption

3 m UA (< 35 m/s) Shelter not applicable for the UA in the adjacent area				
Average Population density allowed	No Upper Limit	< 50,000 ppl/km^2	< 5,000 ppl/km^2	< 500 ppl/km^2
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k people	
SAIL				
I & II	Out of scope	High	Medium	Low
III	Out of scope	Medium	Low	Low
IV	Medium	Low	Low	Low
V & VI	Low	Low	Low	Low

Table 10 - Containment requirements 3 m UA without shelter assumption

8 m UA (< 75 m/s) Sheltering assumed not applicable for the UA in the adjacent area					
Average Population density allowed	No Upper Limit	< 50,000 ppl/km^2	< 5,000 ppl/km^2	< 500 ppl/km^2	< 50 ppl/km^2
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k		
SAIL					
I & II	Out of scope	Out of scope	High	Medium	Low
III	Out of scope	Out of scope	Medium	Low	Low
IV	Out of scope	Medium	Low	Low	Low
V	Medium	Low	Low	Low	Low
VI	Low	Low	Low	Low	Low

Table 11 - Containment requirements 8 m UA

20 m UA (< 125 m/s) Sheltering assumed not applicable for the UA in the adjacent area					
Average Population density allowed	No Upper Limit	< 50,000 ppl/km^2	< 5,000 ppl/km^2	< 500 ppl/km^2	< 50 ppl/km^2
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k		
SAIL					
I & II	Out of scope	Out of scope	Out of scope	High	Medium
III	Out of scope	Out of scope	Out of scope	Medium	Low
IV	Out of scope	Out of scope	Medium	Low	Low
V	Out of scope	Medium	Low	Low	Low
VI	Medium	Low	Low	Low	Low

Table 12 - Containment requirements 20 m UA

< 40 m UA (< 200 m/s) Sheltering assumed not applicable for the UA in the adjacent area					
Average Population density allowed	No Upper Limit	< 50,000 ppl/km^2	< 5,000 ppl/km^2	< 500 ppl/km^2	< 50 ppl/km^2
Outdoor Assemblies allowed within 1km of the OPS volume	> 400k	Assemblies of 40k to 400k	Assemblies < 40k		
SAIL					
I & II	Out of scope	Out of scope	Out of scope	Out of scope	High
III	Out of scope	Out of scope	Out of scope	Out of scope	Medium
IV	Out of scope	Out of scope	Out of scope	Medium	Low
V	Out of scope	Out of scope	Medium	Low	Low
VI	Out of scope	Medium	Low	Low	Low

Table 13 - Containment requirements 40 m UA

b) Ensure the operation complies with the containment requirements listed in Annex E – Section E.4.

4.8.4 Guidance

G

Utilise Annex A, Section A.3, for further guidance on presenting the data supplementing the risk assessment to the authority.

Adjacent Area

(a) The adjacent area represents the ground area adjacent to the ground risk buffer where it is reasonably expected a UA may crash after a loss of control situation resulting in a flyaway.

(b) The operator is not approved to plan flights in this area and it should only be overflown unintentionally in the event of a loss of control that results in a fly away.

(c) In the above situation, the direction and duration of the fly away is assumed to be random, thus the average population density of the adjacent area is used, instead of the maximum as is done in Step #2.

(d) Conservative simplifications for calculating the average population density may be used by the operator when compliance with the operational limit can be assured.

Calculating the Size of the Adjacent Area

The diagram below in Figure 7 depicts how to determine the adjacent area size.

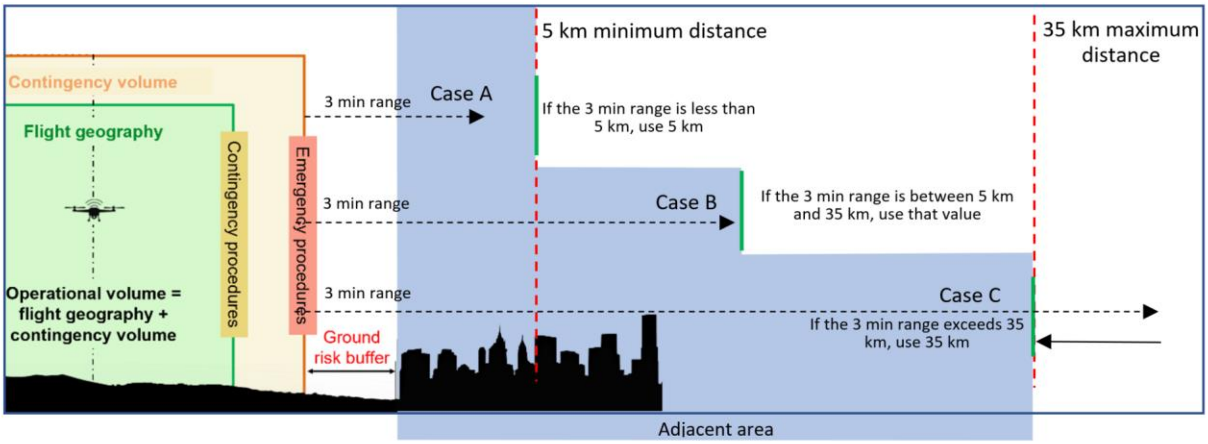

Figure 7 - Lateral limits - Adjacent area

If the ground risk buffer is larger than the adjacent area then the assessment of adjacent area is not required.

Adjacent Area Containment Requirements

(a) When using Tables 8-13 to identify the required containment robustness level of the operation:

   i. Select the correct table based on the maximum characteristic dimension of the UA used in Step 2.

      A. For a 3m UA determine whether sheltering can be applied in the adjacent area

      B. If sheltering applies for a UA greater than 3m, the operator can use Annex F to apply the credit and determine the appropriate containment requirements;

   ii. Identify the correct row based on the SAIL found in Step 7;

   iii. Identify the appropriate column to derive the containment level of robustness based on the adjacent area average population density.

   iv. If the results are "out of scope", the operation cannot be conducted in the specific category. In this case, adjusting the location of the operation or an increase of the SAIL of the operation could be considered.

(b) Example: An operation uses a SAIL III 2.5 m drone with a maximum speed of 30 m/s, sheltering is applicable, the outer limit of the adjacent area is 5.4 km from the boundary of the operational volume. An assessment of the adjacent area shows no large assemblies of people within 1 km and the area is mostly over rural and suburban areas, expecting an average population density between 1k-4k people/km^2. This results in low containment requirements. If the operator decides to use a UA with low containment, the operator should document operational limitations for the low containment SAIL III UA:

   i. No assemblies of people > 40k people within 1 km of the operational volume

   ii. The adjacent area (5.4 km from the operational volume) average population density should not exceed 50,000 people/km^2

Adjacent Area Operational Limitations

(a) The operator defined operational limitations have to be adhered to when planning the operational volume for a flight operation.

(b) The operator should have a procedure to identify and take into account scheduled open air assemblies of people in excess of the operational limitations within 1 km of the operational volume. The values for the sizes of assemblies of people are to be understood as rough order of magnitude guidelines as measuring the actual values is not practical.

(c) If the ground risk buffer size exceeds 1 km, the adjacent area consideration for all assemblies of people is not applicable.

Containment feedback into ground risk buffer and operational volume definitions

(a) If the operator determines they require medium or high robustness containment for their operational objective, there might be a recursive effect, as these containment requirements have higher requirements on the fidelity of the ground risk buffer size calculation. It is possible, that this results in a bigger ground risk buffer size compared to the one defined by the operator in Step #1.

(b) If this is the case, the applicant needs to go back to Step #2 and re-evaluate the GRC.

(c) Alternatively, the operator might choose to reduce the size of their operational volume described in Step #1 to allow for a larger ground risk buffer.

Containment requirements for adjacent airspace

By containing flight to the operational volume and assuring the immediate cessation of the flight in case of an unlikely breach of the operational volume, low robustness containment is generally considered sufficient to allow operations adjacent to all airspaces.

Notes on using an alternative method for ground risk containment

The methodology proposed in Step #8 may overestimate the adjacent area risk in certain cases. Applicants may therefore employ an alternative method to compute the ground risk containment requirements, as described in Annex F, Section 5.3. Due to the increased workload of this method for applicants and authorities, its application should be limited to cases where effective mitigations might be applied in the adjacent area. This method also allows the possibility of “No Containment” requirements for the adjacent ground risk. Nevertheless, the adjacent airspace must also be considered, and thus the competent authority needs to confirm that the adjacent airspace can be sufficiently protected without containment.

4.9 Step #9 – Identification of Operational Safety Objectives (OSO)

4.9.1 Introduction

G

This step of the SORA process is to map the operation’s SAIL score to required levels of robustness of the Operational Safety Objectives (OSO).

4.9.2 Outcome

G

(a) Identification of the required robustness levels of the individual OSOs.

(b) Collection of information and references to be used to show compliance with the OSO requirements.

4.9.3 Task description

R

(a) Identify the level of robustness of each OSO, deriving it from the SAIL of the proposed operation using Table 14.

OSO ID	Operational Safety Objective	SAIL						Dependencies (Crit. references as per Annex E)		
		I	II	III	IV	V	VI	Operator	Training org	Designer
OSO#01	Ensure the Operator is competent and/or proven	NR	L	M	H	H	H	x		
OSO#02	UAS manufactured by competent and/or proven entity	NR	NR	L	M	H	H			x
OSO#03	UAS maintained by competent and/or proven entity	L	L	M	M	H	H	Crit. 1 Crit. 2		Crit. 1
OSO#04	UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)	NR	NR	NR	L	M	H			x
OSO#05	UAS is designed considering system safety and reliability	NR	NR(c)	L	M	H	H			x
OSO#06	C3 link characteristics are appropriate for the operation	NR	L	L	M	H	H	x		x
OSO#07	Conformity check of the UAS configuration	L	L	M	M	H	H	Crit. 1 Crit. 2		Crit. 1
OSO#08	Operational procedures are defined, validated and adhered to	L	M	H	H	H	H	x		Crit. 1
OSO#09	Remote crew trained and current	L	L	M	M	H	H	x	x	
OSO#13	External services supporting UAS operations are adequate to the operation	L	L	M	H	H	H	x		
OSO#16	Multi crew coordination	L	L	M	M	H	H	Crit. 1 Crit. 3	Crit. 2	
OSO#17	Remote crew is fit to operate	L	L	M	M	H	H	x		
OSO#18	Automatic protection of the flight envelope from human errors	NR	NR	L	M	H	H			x
OSO#19	Safe recovery from human error	NR	NR	L	M	M	H			x
OSO#20	A Human Factors evaluation has been performed and the HMI found appropriate for the mission	NR	L	L	M	M	H	x		x
OSO#23	Environmental conditions for safe operations defined, measurable and adhered to	L	L	M	M	H	H	x		x
OSO#24	UAS designed and qualified for adverse environmental conditions	NR	NR	M	H	H	H			x

Table 14 - Recommended operational safety objectives (OSO)

(b) Refer to Annex E for the integrity and assurance requirements of each OSO based on its level of robustness:

   i. Identify the requirements for procedures and document them accordingly,

   ii. Identify the technical requirements for the UAS and document them accordingly.

(c) Identify the training requirements for the personnel essential for the safety of the operation and document them accordingly. See further guidance in Annex E regarding UAS designs that employ novel or complex features which have very limited operational experience and intend to be operated in SAIL II.

4.9.4 Guidance

G

(a) Table 14 is a consolidated list of common OSOs that historically have been used to ensure safe UAS operations. It represents the collected experience of many experts and is therefore a solid starting point to determine the required safety objectives for a specific operation.

(b) While the operator is the organisation responsible for showing compliance for all OSOs, some of the evidence may be developed by other organisations such as designer or training organisations as identified in Table 14.

(c) Table 14 indicates the corresponding OSOs. In this table:

   i. NR stands for “not required” to show compliance to the competent authority, however, the applicant is encouraged to consider the operational safety objective at a low integrity level,

   ii. L is recommended with low robustness,

   iii. M is recommended with medium robustness,

   iv. H is recommended with high robustness.

4.10 Step #10 – Comprehensive Safety Portfolio (CSP)

4.10.1 Introduction

G

(a) The final step of the SORA involves the compilation of the CSP.

(b) The CSP is a structured argument using the SORA process, that is supported by a body of evidence which provides a robust safety case. This demonstrates that the proposed operation has been assessed correctly and meets its SORA objectives.

4.10.2 Outcome

G

(a) A completed Comprehensive Safety Portfolio to be provided to the competent authority for the application for the operational authorisation.

(b) By documenting all elements of the SORA, the competent authority can assess a standardised document suite that provides assurance that the SORA process has been completed correctly and the operation can be conducted safely.

4.10.3 Task description

R

(a) Finalise and present all the documentation that needs to be included in the CSP. This should include:

   i. The finalized **detailed operational description** from Step #1 that details the proposed operation(s), providing the air and ground risk information necessary to validate the safety claims within the proposed operational context,

   ii. All **safety claims** and their robustness made through Steps #2 (iGRC), #3 (M1(A), M1(B), M1(C), M2), #4 (initial ARC), #5 (Strategic Mitigations for Air Risk), updated (if required) from Phase 1 to reflect the finalised operation,

   iii. All **derived requirements** based on the safety claims; the final GRC, the residual ARC, TMPR, the OSOs associated with the SAIL, and the containment requirements,

   iv. **Compliance evidence**, which is the data, facts, and information that provide the necessary justification for each of the safety claims and derived requirements made through the SORA process at the robustness level required. The CSP covers operational, technical, personnel, and organisational compliance evidence,

   v. The necessary linkages and references between documents, that ensures the CSP makes a **justified safety case** that demonstrates the operation has satisfied all required SORA safety claims and derived requirements,

   vi. It is expected that a finalised **compliance matrix** (based on the initial compliance matrix if developed in Phase 1) will be used to map the safety claims and derived requirements to the compliance evidence.

(b) Refer to Annex A for more guidance on structuring documentation as part of the CSP.

4.10.4 Guidance

G

(a) The applicant should only put information into the CSP as required by the items mentioned above. If a requirement has a low robustness (ref. Section 2.4), it is mostly sufficient to self-declare the compliance by a statement in the CSP. SORA requirements for self-declaration in no way prevents the competent authority from requesting further documents to validate the declaration, if considered necessary for the given operation.

(b) The CSP is expected to be a collection of documents specific to the operation(s). It can be modularized and consist of multiple sub-documents and sub-sections to accommodate the need to perform the intended operation(s).

(c) Appropriate references and version/configuration control apply to all documents in the CSP, including subsections and sub-documents. Annex A, Section A.4 to the SORA provides a template that could be used for developing the CSP that is in line with the requirements of the Main Body to SORA. Any changes may require a separate process from the competent authority. The management of any changes should follow the relevant competent authority’s requirements.

(d) A completed and valid CSP forms the basis for the issue of an operational approval.

(e) In the case the operator uses external service(s), reference(s) to Service Level Agreement(s) (SLA) providing a delineation of responsibilities between the Service Provider(s) and the operator should be included as part of the CSP. It should also detail the functionality, limitations and performance of the service.