JARUS	Joint Authorities for Rulemaking of Unmanned Systems

JARUS guidelines on SORA

Annex E

Integrity and assurance levels for the Operational Safety Objectives (OSO)

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CONTENTS

1. How to use SORA Annex E

The following table provides the basic principles to consider when using SORA Annex E.

	Principle description	Additional information
#1	Annex E provides Low/Medium/High assessment criteria for the integrity (i.e. safety gain) and assurance (i.e. method of proof) of the Operational Safety Objectives (OSOs) proposed by an applicant.	The identification and implementation of OSOs for a given operation is the responsibility of the applicant. The relationships between the SAIL and the Low/Medium/High level of robustness of an OSO can be found in Step #9 of the SORA Main Body.
#2	Annex E does not cover the Level of Involvement (LoI) of the competent authority. LoI is based on the competent authority's assessment of the applicant's ability to perform the given operation.	JARUS may develop additional recommendations in the future for competent authorities on the Level of Involvement needed to assess Operators' abilities.
#3	When more than one criterion exists for a given level of integrity or assurance in an OSO, all the criteria need to be met at the required integrity/assurance level to satisfy the given OSO.	
#4	"Optional" cases defined in SORA Main Body Table 8 do not need to be defined in terms of integrity and assurance levels in Annex E.	No robustness level is required for OSOs for which an "optional" level of robustness is defined in Table 6 "Recommended operational safety objectives (OSO)" of the SORA Main Body.
#5	When criteria to assess the level of integrity or assurance of an OSO rely on "standards" not yet available, the OSO needs to be developed in a manner acceptable to the competent authority.	
#6	Annex E intentionally uses non-prescriptive terms (e.g. suitable, reasonably practicable) to provide flexibility to both the applicant and the competent authorities. This does not constrain the applicant in proposing mitigations, nor the competent authority's ability to determine needs on a case-by-case basis.	
#7	This annex in its entirety also applies to single-person organizations.	
#8	Security is addressed specifically in Annex E for Cyber.	

2. OSOs integrity and assurance criteria

OSO #I - Ensure the Operator is competent and/or proven

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #I Ensure the Operator is competent and/or proven	Criterion	The applicant is knowledgeable of the UAS being used and as a minimum has the following relevant operational procedures: • checklists, • maintenance, training, • responsibilities, and associated duties.	Same as Low. In addition, the applicant has an organization appropriate[1] for the intended operation. Also, the applicant has a method to identify, assess, and mitigate risks associated with flight operations. These should be consistent with the nature and extent of the operations specified.	Same as Medium.
	Comments	*N/A*	*[1] For the purpose of this assessment appropriate should be interpreted as commensurate/proportionate with the size of the organization and the complexity of the operation.*	*N/A*

TECHNICAL ISSUE WITH THE UAS		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #I Ensure the Operator is competent and/or proven	Criterion	The elements delineated in the level of integrity are available.	Prior to the first operation, a competent third party performs an audit of the organization	The applicant holds an Organizational Operating Certificate or is/has a recognized flight test organization. In addition, a competent third party recurrently verifies the Operator's competence.
	Comments	*N/A*	*Audits should be adapted to the size of the operational organization.* *The audit conducted by the competent third party should be focused on items that can be connected to OSOs applicable for SAIL III.*	*Audits should be adapted to the size of the operational organization.* *The audit conducted by the competent authority to issue the certificate should be focused on items that can be connected to applicable OSOs depending on the SAIL of the operation.*

OSO #II - UAS manufactured by competent and/or proven entity

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #II UAS manufactured by competent and/or proven entity	Criterion	As a minimum, manufacturing procedures cover: • specification of materials, • suitability and durability of materials used, • processes necessary to allow for repeatability in manufacturing and conformity within acceptable tolerances, • configuration control, • occurrence analysis procedures for design-related in-service events reported to the designer by the Operator.	Same as Low. In addition, manufacturing procedures also cover: • verification of incoming products, parts, materials, and equipment, • identification and traceability, • in-process and final inspections & testing, • control and calibration of tools, • handling and storage, • non-conforming item control.	Same as Medium. In addition, the manufacturing procedures cover at least: • manufacturing processes, • personnel competence and qualification, • supplier control.
	Comments	*N/A*	*N/A*	*N/A*

TECHNICAL ISSUE WITH THE UAS		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #II UAS manufactured by competent and/or proven entity	Criterion	The declared manufacturing and design-related in-service occurrence reporting procedures are developed to a standard considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.	Same as Low. In addition, evidence is available that the UAS has been manufactured in conformance to its design.	Same as Medium. In addition: • manufacturing procedures, • conformity of the UAS to its design and specification are recurrently verified through process or product audit by a competent third party(ies).
	Comments	*National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*	*N/A*

OSO #III - Remote crew is fit to operate

(a) For the purpose of this assessment, the expression “fit to operate” should be interpreted as physically and mentally fit to perform duties and discharge responsibilities safely.

(b) Fatigue and stress are contributory factors to human error. Therefore, to ensure vigilance is maintained at a satisfactory level of safety, consideration may be given to the following:

- Remote Crew duty times;
- Regular breaks;
- Rest periods;
- Handover/Take Over procedures;
- Personal Protective Equipment (PPE);
- Workplace environment, including ergonomy of the workstation.

HUMAN ERROR		LEVEL of INTEGRITY		
		Low	Medium	High
OSO #III Remote crew is fit to operate	Criterion	The applicant has a policy defining how the remote crew can declare themselves unfit to operate before or during any operation.	Same as Low. In addition: • Duty, flight duty and resting times for the remote crew are defined by the applicant and adequate for the operation. • The Operator defines requirements appropriate for the remote crew to operate the UAS.	Same as Medium. In addition: • The remote crew is medically fit, • A Fatigue Risk Management System (FRMS) is in place to manage any escalation in duty/flight duty times.
	Comments	*N/A*	*N/A*	*N/A*

HUMAN ERROR		LEVEL of ASSURANCE		
		Low	Medium	High
OSO #III Remote crew is fit to operate	Criterion	• The policy to define how the remote crew declares themselves unfit to operate (before or during an operation) is documented. • The remote crew fit-to-operate declaration (before or during an operation) is based on a policy defined by the applicant.	Same as Low. In addition: • Remote crew duty, flight duty and the resting times policy is documented. • Remote crew duty cycles are logged and cover at a minimum: ○ when the remote crew member’s duty day commences, ○ when the remote crew members are free from duties, ○ resting times within the duty cycle.	Same as Medium. In addition: • Medical standards considered adequate by the competent authority and/or means of compliance acceptable to that authority[1] are established and a competent third party verifies the remote crew is medically fit. • A competent third party validates the duty/flight duty times. • The FRMS is validated by a competent third party and internally monitored by the Operator.

	Comments	*N/A*	*N/A*	*[1] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*

OSO #IV - Operational procedures are defined, validated and adhered to address normal, abnormal and emergency situations potentially resulting from technical issues with the UAS or external systems supporting UAS operation, human errors or critical environmental conditions

(a) Standard Operating Procedures are 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 during normal situations.

(b) 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 normal state and allow the return to using standard operating procedures, or allow the safe cessation of the flight.

(c) Emergency Procedures are intended to mitigate the effect of failures that cause or lead to an emergency condition.

(d) The Emergency Response Plan (ERP) deals with the potential hazardous secondary or escalating effects after a loss of control of the operation (e.g., in the case of ground impact, mid-air collision or flyaway) and is decoupled from the Emergency Procedures, as it does not deal with the control of the UA.

<table>
<tr><th colspan="2" rowspan="2">OPERATIONAL PROCEDURES</th><th colspan="3">LEVEL of INTEGRITY</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">OSO #IV</td><td>Criterion #1 (Procedure definition)</td><td colspan="3">• Operational procedures[1] appropriate for the proposed operation are defined and as a minimum cover the following elements:
○ Flight planning,
○ Pre and post-flight inspections,
○ Procedures to evaluate environmental conditions before and during the mission (i.e. real-time evaluation),
○ Procedures to cope with unintended adverse operating conditions (e.g. when ice is encountered during an operation not approved for icing conditions)
○ Normal procedures,
○ Contingency procedures (to cope with abnormal situations),
○ Emergency procedures (to cope with emergency situations), and
○ Occurrence reporting procedures.
• Normal, Contingency and Emergency procedures are compiled in an Operation Manual.
• The limitations of the external systems supporting UAS operation[2] are defined in an Operation Manual.</td></tr>
<tr><td>Comments</td><td colspan="3">[1] In addition to addressing the deterioration of the UAS itself, operational procedures also need to cover the deterioration of any external system supporting UAS operation[3]. The operational procedures should also consider the protection of involved persons that should be briefed of the potential risk and should be aware of the actions to take in case of misbehaviour of the UA.
[2] In the scope of this assessment, external systems supporting UAS operation are defined as systems not already part of the UAS but used to:
• launch / take-off the UAS (e.g. catapult launcher), or
• undertake pre-flight checks (e.g. online checklist software), or
• keep the UA within its operational volume (e.g. GNSS, Satellite Systems, Air Traffic Management, UTM).
External systems activated/used after the loss of control of the operation are <u>excluded</u> from this definition.</td></tr>
</table>

	[3] To properly address the deterioration of external systems supporting UAS operation, it is recommended to: • *identify these "external systems",* • *identify the "external systems" deterioration modes (e.g. complete loss of GNSS, drift of the GNSS, latency issues, …) which would lead to a loss of control of the operation,* • *describe the means to detect these deterioration modes of the external systems/facilities,* • *describe procedure(s) used when deterioration is detected (e.g. activation of the Emergency Recovery Capability, switch to a manual control …).*		
Criterion #2 (Consideration of Potential Human Error)	At a minimum, operational procedures provide: • a clear distribution and assignment of tasks • an internal checklist to ensure staff are adequately performing assigned tasks.	Operational procedures take human error into consideration.	Same as Medium. In addition, the Remote Crew[4] receives Crew Resource Management (CRM)[5] training.
Comments	*N/A*	*N/A*	*[4] In the context of SORA, the term "Remote crew" refers to any person involved in the mission.* *[5] CRM training focuses on the effective use of all remote crew to assure a safe and efficient operation, reducing error, avoiding stress and increasing efficiency.*
Criterion #3 (Emergency Response Plan)	The Emergency Response Plan (ERP): • is suitable for the situation[6]; • effectively mitigates all probable hazardous secondary effects after a loss of control of the operation; • clearly delineates Remote Crew member(s) duties; • is practical to use and trained, so that the Remote Crew can execute the procedures effectively under stress. The ERP contains at minimum: • the list of probable emergency situations with secondary effects; • the procedures for each of the identified probable emergency situation (including criteria to identify each of these situations); • the training syllabus and a corresponding up to date record of trained Remote Crew members		
Comments	*[6] The ERP should always be proportional to the operation's potential secondary effects. In exceptional cases where secondary/escalating effects from a crash are catastrophic and would increase risks from the operation significantly (e.g. large spreading fires) the ERP should be developed to a very high effectiveness. Additional information regarding these exceptional cases can be found in Annex F section…*		

<table>
<tr><th colspan="2" rowspan="2">OPERATIONAL PROCEDURES</th><th colspan="3">LEVEL of ASSURANCE</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="6">OSO #IV</td><td>Criteria #1 and #2</td><td>The adequacy of the operational procedures is declared, except for Emergency Procedures, which are tested.</td><td>● Operational procedures are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority[1].
● Adequacy of the Contingency and Emergency procedures is proven through:
○ Dedicated flight tests, or
○ Simulation provided the simulation is proven valid for the intended purpose with positive results.</td><td>Same as Medium. In addition:
● Flight tests performed to validate the procedures and checklists cover the complete flight envelope or are proven to be conservative.
● The procedures, checklists, flight tests and simulations are validated by a competent third party.</td></tr>
<tr><td>Comments</td><td>Operational procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority.</td><td colspan="2">[1] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.</td></tr>
<tr><td>Alternative Criteria #1 and #2 taking credit for functional test-based methods</td><td colspan="3">FUNCTIONAL TEST-BASED METHODS (for SAILs up to IV included):
If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[2], the assurance that the operational procedures are adequate is fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[3].</td></tr>
<tr><td>Comments</td><td colspan="3">[2] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:
● within the full operational scope/envelope intended by the UAS Operator,
● following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.
[3] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO #IV is fulfilled at High Level.</td></tr>
<tr><td>Criterion #3 (Emergency Response Plan)</td><td colspan="3">The ERP is developed to standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority[4].
The ERP should be practical to use. The ERP is validated through a representative tabletop exercise[5] consistent with the ERP training syllabus.</td></tr>
<tr><td>Comments</td><td colspan="3">[4]National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.
[5] The tabletop exercise may involve the third parties identified in the ERP.</td></tr>
</table>

OSO #V - UAS maintained by competent and/or proven entity

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #V UAS maintained by competent and/or proven entity	Criterion	• The UAS Operator[1] maintenance instructions (i.e. the information establishing how to carry out the needed maintenance/repairs) and requirements (i.e. the needs for maintenance on the UAS) are defined and, when applicable, cover the UAS designer instructions and requirements[2/3]. • The maintenance staff is competent and has received an authorisation to carry out UAS maintenance. • The UAS Operator follows the UAS Operator maintenance requirements (e.g. inspection after hard landing, regular check of lighting system) and the maintenance staff use the UAS maintenance instructions while performing maintenance.	Same as Low. In addition: • Preventative/Scheduled maintenance / inspection of each UAS is organised and in accordance with the UAS Operator maintenance programme on the basis of the UAS designer scheduled maintenance requirements and adapted to the specificities of UAS operations. • Upon completion, the maintenance log system is used to record all maintenance conducted on the UAS including releases. A maintenance release can only be accomplished by a staff member who has received a maintenance release authorisation for that particular UAS model/family.	Same as Medium. In addition, the maintenance staff works in accordance with a maintenance procedure manual that provides information and procedures relevant to the Operator maintenance facility, records, maintenance instructions, release, tools, material, components, defect deferral.
	Comments	*[1] The maintenance may not be directly performed by the Operator (e.g. use of a third party).* *[2] The UAS Operator may just reuse the UAS designer instructions and requirements for maintenance.* *[3] The UAS designer instructions and requirements for maintenance are sometimes referred to as ICA (Instructions for Continued Airworthiness).*		

TECHNICAL ISSUE WITH THE UAS		LEVEL of ASSURANCE – Low	LEVEL of ASSURANCE – Medium	LEVEL of ASSURANCE – High
OSO #V UAS maintained by competent and/or proven entity	Criterion #1 (Procedure)	• The UAS Operator maintenance instructions are documented[1]. • The maintenance conducted on the UAS is recorded in a maintenance log system[2/3]. • A list of maintenance staff authorised to carry out maintenance is established and kept up to date.	Same as Low. In addition: • The UAS Operator maintenance programme layout is in accordance with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority[4]. • A list of maintenance staff with maintenance release authorisation is established and kept up to date.	Same as Medium. In addition, the Operator Maintenance Programme and the maintenance procedures manual are validated by a competent third party.
	Comments	*[1] The UAS Operator may just reuse the UAS designer instructions and requirements for maintenance.* *[2] The objective is to record all the maintenance performed on the aircraft, and why it is performed (defects or malfunctions rectification, modification, scheduled maintenance etc.)* *[3] The maintenance log may be requested for inspection/audit by the approving authority or an authorized representative.*	*[4] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*
	Criterion #2 (Training)	A record of all relevant qualifications, experience and/or trainings completed by the maintenance staff is established and kept up to date.	Same as Low. In addition: • Initial training syllabus and training standard including theoretical/practical elements, duration, etc. is defined and commensurate with the authorisation held by the maintenance staff. • For staff holding a maintenance release authorisation, the initial training is specific to that particular UAS model/family. • All maintenance staff have undergone initial training.	Same as Medium. In addition: • A programme for recurrent training of staff holding a maintenance release authorisation is established; and • This programme is validated by a competent third party.
	Comments	*N/A*	*N/A*	*N/A*

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OSO #VI - Conformity check of the UAS configuration

1) The intent of this OSO is that the Operator assures the configuration of the UAS intended to be used for the operation conforms to the UAS design data considered under the SORA process.
2) This OSO does not describe a pre or post flight inspection as part of normal operations, these are covered under OSO #8.

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #VI Conformity check of the UAS configuration	Criterion	The Operator periodically[1] ensures that the UAS is in a condition for safe operation and conforms to the approved concept of operation, taking into account the life-cycle of the aircraft.[2]		
	Comments	*[1] The periodicity should be defined in the UAS conformity check procedures.* *[2] The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).*		

TECHNICAL ISSUE WITH THE UAS		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #VI Conformity check of the UAS configuration	Criterion #1 (Procedures)	The UAS conformity check is documented and accounts for the UAS designer's recommendations if available.	Same as Low. In addition, the UAS conformity check is documented using checklists.	Same as Medium. In addition, the UAS conformity check procedures are validated by a competent third party.
	Comments	*N/A*	*N/A*	*N/A*
	Criterion #2 (Training)	The remote crew is trained to perform the UAS conformity check. The related training is self-declared (with evidence available).	• A training syllabus including a UAS conformity check procedure is available. • Evidence of competency-based, theoretical and practical training is available.	Same as Medium. In addition, a competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
	Comments	*N/A*	*N/A*	*N/A*

OSO #VII - Environmental conditions for safe operations defined, measurable and adhered to

(a) Environmental conditions include meteorological conditions such as wind, rain, and icing, as well as external factors that may interfere with the performance of systems such as HIRF.

ADVERSE OPERATING CONDITIONS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #VII Environmental conditions for safe operations defined, measurable and adhered to	Criterion #1 (Definition)	Environmental conditions for safe operations are defined and reflected in the flight manual or equivalent document.[1]		
	Comments	*[1]The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).*		
	Criterion #2 (Procedures)	Procedures for evaluating environmental conditions before and during the mission (i.e. real-time evaluation) are available and include assessment of meteorological conditions (METAR, TAFOR, etc.) with a simple recording system.[2]		
	Comments	*[2]The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).*		
	Criterion #3 (Training)	Training covers assessment of meteorological conditions.[3]		
	Comments	*[3]The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).*		

ADVERSE OPERATING CONDITIONS		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #VII Environmental conditions for safe operations defined, measurable and adhered to	Criterion #1 (Definition)	The applicant declares that the required level of integrity has been achieved[1].	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[2], inspection, design review or through operational experience.	A competent third party validates the claimed level of integrity.
	Comments	*[1] Supporting evidence for this declaration may still be requested by the competent authority.*	*[2] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*	*N/A*
	Criterion #2 (Procedures)	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared.	• Procedures are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.	Same as Medium. In addition: • Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative.

		• The adequacy of the procedures is proved through: ○ Dedicated flight tests, or ○ Simulation provided the simulation is proven valid for the intended purpose with positive results.	• The procedures, flight tests and simulations are validated by a competent third party.
Comments	*N/A*	*N/A*	*N/A*
Alternative Criterion #2 taking credit for functional test-based methods	FUNCTIONAL TEST-BASED METHODS: If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[3], the OSO#VII Criteria #2 level of assurance is fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[4].		N/A[5]
Comments	*[3] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:* • *within the full operational scope/envelope intended by the UAS Operator,* • *following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.* *[4] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO#VII Criterion #2 is fulfilled at Medium Level.*		*[5] Functional test-based method are not considered feasible for operations with a SAIL V or VI*
Criterion #3 (Training)	Training is self-declared (with evidence available).	• Training syllabus is available. • Evidence of competency-based, theoretical and practical training is available.	A competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
Comments	*N/A*	*N/A*	*N/A*

OSO #VIII - External services supporting UAS operations are adequate to the operation

For the purpose of the SORA and this specific OSO, the term "External services supporting UAS operations" encompasses any interaction with an external Service Provider critical for the safety of the flight, e.g.

- Communication Service Provider (CSP),
- UTM Service Providers (including surveillance Supplemental Data Service Provider (SDSP), weather SDSP),
- Externally provided electrical power (e.g. in the case where no emergency backup generator is available and the safety of the flight is dependent on continuous power delivery).

The interface between the UAS Operator and the external services <u>may</u> take the form of a Service Level Agreement (SLA).

DETERIORATION OF EXTERNAL SERVICES SUPPORTING UAS OPERATION BEYOND THE CONTROL OF THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #VIII External services supporting UAS operations are adequate to the operation	Criterion	The applicant ensures that the level of performance for any externally provided service critical for the safety of the flight is adequate for the intended operation. If the externally provided service requires communication between the Operator and the Service Provider, the applicant ensures there is effective communication to support the service provisions. Roles and responsibilities between the applicant and the external Service Provider are defined.		
	Comments	*N/A*	*N/A*	*Requirements for contracting services with Service Provider may be derived from ICAO Standards and Recommended Practices - SARPS (currently under development).*

DETERIORATION OF EXTERNAL SERVICES SUPPORTING UAS OPERATION BEYOND THE CONTROL OF THE UAS		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #VIII External services supporting UAS operations are adequate to the operation	Criterion	The applicant declares[1] that the requested level of performance for any externally provided service necessary for the safety of the flight is achieved.	The applicant has supporting evidence that the required level of performance for any externally provided service required for the safety of the flight can be achieved for the full duration of the mission. This may take the form of an SLA or any official commitment that prevails between a Service Provider and the applicant on relevant aspects of the	Same as Medium. In addition: • The evidence of the externally provided service performance is achieved through demonstrations. • A competent third party validates the claimed level of integrity.

			service (including quality, availability, responsibilities). The applicant has means to monitor externally provided services that affect flight-critical systems and take appropriate actions if real-time performance could lead to the loss of control of the operation.	
	Comments	[1] *Supporting evidence for this declaration may still be requested by the competent authority.* *Supporting evidence may take the form of a Service-Level Agreement (SLA) or any official commitment that prevails between a Service Provider and the applicant on relevant aspects of the service (including quality, availability, responsibilities).* *As an exemple, if an applicant uses an external surveillance service they should have evidence available supporting the claim that the service meets performance requirements in Annex D.*	*N/A*	*N/A*

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OSO #IX - Multi crew coordination

(a) This OSO applies only when multiple personnel are directly involved in the flight operation.

HUMAN ERROR		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #IX Multi crew coordination	Criterion #1 (Procedures)	Procedure(s)[1] to ensure coordination between the crew members and robust and effective communication channels is (are) available and at a minimum cover: ● assignment of tasks to the crew, and ● establishment of step-by-step communications.[2]		
	Comments	*[1] The distinction between a Low, a Medium, and a High level of robustness for this criterion is achieved through the level of assurance (see table below).* *[2] This should include the establishment of a proper phraseology between the remote crew members involved in the aerial part of the operation.*		
	Criterion #2 (Training)	Remote Crew training covers multi crew coordination	Same as Low. In addition, the Remote Crew[2] receives Crew Resource Management (CRM)[3] training.	Same as Medium.
	Comments	*N/A*	*[2] In the context of SORA, the term "Remote crew" refers to any person involved in the mission.* *[3] CRM training focuses on the effective use of all remote crew to assure a safe and efficient operation, reducing error, avoiding stress and increasing efficiency.*	*N/A*
	Criterion #3 (Communication devices)	N/A	The applicant determines that the performance of communication devices is adequate to safely conduct the intended operation. The remote crew has the means to continuously monitor the performance of the communication devices and ensure the performance continues to meet the operational requirements.	Same as Medium. In addition: communication devices are redundant[4] and comply with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority[5] .
	Comments	*N/A*		*[4] This implies the provision of an extra device to cope with the failure case of the first device.*

				[5] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.

HUMAN ERROR		**LEVEL of ASSURANCE**		
		Low	**Medium**	**High**
OSO #IX Multi crew coordination	Criterion #1 (Procedures)	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared.	• Procedures are validated against standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority[1]. • Adequacy of the procedures is proven through: ○ Dedicated flight tests, or ○ Simulation, provided the simulation is proven valid for the intended purpose with positive results.	Same as Medium. In addition: • Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative. • The procedures, flight tests and simulations are validated by a competent third party.
	Comments	*N/A*	*[1] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*
	Alternative Criterion #1 taking credit for functional test-based methods	FUNCTIONAL TEST-BASED METHODS: If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[2], the assurance that		N/A[4]

		the multi crew coordination procedures are adequate is fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[3].		
	Comments	*[2] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:* • *within the full operational scope/envelope intended by the UAS Operator,* • *following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.* *[3] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO#IX Criterion #1 is fulfilled at Medium Level.*		*[4] Functional test-based method are not considered feasible for operations with a SAIL V or VI*
	Criterion #2 (Training)	Training is self-declared (with evidence available)	• Training syllabus is available. • Evidence of competency-based, theoretical and practical training is available.	A competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
	Comments	*N/A*	*N/A*	*N/A*
	Criterion #3 (Communication devices)	The applicant declares that the required level of integrity has been achieved[4].	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[5], inspection, design review or through operational experience.	A competent third party validates the claimed level of integrity.
	Comments	*[4] Supporting evidence for this declaration may still be requested by the competent authority.*	*[5] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*	*N/A*

OSO #X - Remote crew trained and current and able to control the normal, abnormal and emergency situations potentially resulting from technical issues with the UAS or external systems supporting UAS operation, human errors or critical environmental conditions

(a) The applicant needs to propose competency-based, theoretical and practical training:
- appropriate for the operation to be approved, and
- including proficiency requirements and training recurrences.

(b) The entire remote crew (i.e. any person involved in the operation) should undergo a competency-based, theoretical and practical training specific to their duties (e.g. pre-flight inspection, ground equipment handling, evaluation of the meteorological conditions, etc.).

REMOTE CREW COMPETENCIES		LEVEL of INTEGRITY		
		Low	Medium	High
OSO #X	Criterion	The competency-based, theoretical and practical training ensures knowledge of: a) UAS regulation b) UAS airspace operating principles c) Airmanship and aviation safety d) Human performance limitations e) Meteorology f) Navigation/Charts g) UA knowledge h) Operating procedures i) Use of external services[3] and is adequate for the operation.[1/2]		
	Comments	*[1] The details of the areas to be covered for the different subjects listed above is provided by JARUS WG1 in "JARUS RECOMMENDATION FOR REMOTE PILOT COMPETENCY (RPC) FOR UAS OPERATIONS IN CATEGORY A (OPEN) AND CATEGORY B (SPECIFIC)" (the aim of this document is to provide recommendations to competent authorities (national authorities or Regional Safety Oversight Organisations) to use their own national legislation, concerning uniform remote pilot competency for operations in Category A (Open) and Category B (Specific).* *[2] The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).* *[3] If external services are used, the Operator is responsible for using the services in the intended manner (e.g. as defined in a Service Level Agreement) and ensuring that the remote crew is trained to use the service as intended.*		

REMOTE CREW COMPETENCIES		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #X	Criterion	Training is self-declared (with evidence available).	• Training syllabus is available. • Evidence of competency-based, theoretical and practical training is available.	A competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
	Comments	*N/A*	*N/A*	*N/A*

(c) If external services are used for which training is critical for the safety of the flight[1], the Service Provider has a responsibility to supply competency-based, theoretical, and/or practical training materials that are appropriate to support operations as defined within limits of the Service Level Agreement (SLA) and recommend any applicable proficiency requirements and training recurrences. Proposed criteria for the 3 Service Levels related to UAS safety services described in Annex H are provided in the tables below:

EXTERNAL SERVICE COMPETENCIES		LEVEL of INTEGRITY		
		Service Level 1 (as described in Annex H)	**Service Level 2 (as described in Annex H)**	**Service Level 3 (as described in Annex H)**
OSO #X	Criterion	Training materials are provided to cover: • The intended use of the service • The limitations of the service, as defined in the SLA • The service operational procedures, including system recovery Recommendations for proficiency requirements and training recurrence[1].		
	Comments	[1] The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).		

EXTERNAL SERVICE COMPETENCIES		LEVEL of ASSURANCE		
		Service Level 1 (as described in Annex H)	**Service Level 2 (as described in Annex H)**	**Service Level 3 (as described in Annex H)**
OSO #X	Criterion	Training is self-declared (with evidence available).	• Training syllabus is available. • Evidence of competency-based, theoretical and practical training is available.	A competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
	Comments	*N/A*	*N/A*	*N/A*

[1] Typically, this criterion is not expected to be applicable to GNSS service providers

OSO #XI - Safe recovery from Human Error

(a) This OSO addresses the risk of human errors that may affect the safety of the operation if they are not prevented or are not detected and recovered in a timely fashion.

i) Any person involved in the operation is at risk of human errors

ii) An example could be the flight crew incorrectly loading the payload onto the UAS, causing the payload to fall off the UA during the operation.

iii) Another example could be the flight crew incorrectly extending or deploying an antenna mast, reducing the C2 link coverage.

Note: the flight envelope protection is excluded from this OSO since it is specifically covered by OSO #18.

(b) This OSO covers:

i) Procedures and lists,

ii) Training, and

iii) UAS design, i.e. systems detecting and/or recovering from human errors (e.g. functional tests, safety pins, use of acknowledgment features, fuel or energy consumption monitoring functions)

HUMAN ERROR		**LEVEL of INTEGRITY**		
		Low	**Medium**	**High**
OSO #XI Safe recovery from Human Error	Criterion #1 (Procedures and checklists)	Procedures and checklists that mitigate the risk of potential human errors from any person involved with the mission are defined and used. Procedures provide at a minimum: ● a clear distribution and assignment of tasks, ● an internal checklist to ensure staff are adequately performing assigned tasks.		
	Comments	*N/A*	*N/A*	*N/A*
	Criterion #2 (Training)	● The Remote Crew[1] is trained to procedures and checklists. ● The Remote Crew[1] receives Crew Resource Management (CRM)[2] training.[3]		
	Comments	*[1] In the context of SORA, the term "Remote crew" refers to any person involved in the mission.* *[2] CRM training focuses on the effective use of all remote crew to assure a safe and efficient operation, reducing human errors by bringing awareness on factors that foster errors and ways to detect them, avoiding stress and increasing efficiency.* *[3]The distinction between a Low, a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).*		
	Criterion #3 (UAS design)	Systems detecting and/or recovering from human errors are developed to industry best practices.	Systems detecting and/or recovering from human errors are developed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.	Same as Medium.
	Comments	*N/A*	*National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*

HUMAN ERROR		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #XI Safe recovery from Human Error	Criterion #1 (Procedures and checklists)	• Procedures and checklists do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared.	• Procedures and checklists are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority[1]. • Adequacy of the procedures and checklists is proven through: ○ Dedicated flight tests, or ○ Simulation provided the simulation is proven valid for the intended purpose with positive results.	Same as Medium. In addition: • Flight tests performed to validate the procedures and checklists cover the complete flight envelope or are proven to be conservative. • The procedures, checklists, flight tests and simulations are validated by a competent third party.
	Comments	*N/A*	*[1] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*
	Criterion #2 (Training)	Use the criteria defined for level of assurance of the remote crew training OSO #X corresponding to the SAIL of the operation		
	Comments	*N/A*	*N/A*	*N/A*
	Criterion #3 (UAS design)	*The applicant declares that the required level of integrity has been achieved[2].*	*The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[3], inspection, design review or through operational experience.*	*A competent third party validates the claimed level of integrity.*
	Comments	*[2] Supporting evidence for this declaration may still be requested by the competent authority.*	*[3] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*	*N/A*

	Alternative Criteria #1 and #3 taking credit for functional test-based methods	FUNCTIONAL TEST-BASED METHODS (for SAILs up to IV included): If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[4], theOSO#XI Criteria #1 and #3 levels of assurance are fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[5].	N/A[6]
	Comments	*[4] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:* • *within the full operational scope/envelope intended by the UAS Operator,* • *following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.* *[5] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO#XI Criteria #1 and #3 is fulfilled at Low Level.*	*[6] Functional test-based method are not considered feasible for operations with a SAIL VI*

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OSO #XII - UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)

(a) Starting at SAIL IV, it is considered that the safety objective associated to the SAIL of one operation (e.g. probability of loss of control of the operation below 10-4/FH for a SAIL IV operation) can not be achieved without a complete demonstration of compliance to Airworthiness Design Standard (ADS) (unless an FTB-approach is chosen by the UAS designer), where the term Airworthiness Design Standard (ADS) refers to the "applicable regulations" (e.g. 14 C.F.R. § 21.17(1)) or "airworthiness code" (e.g. EASA 21.A.16A and 21.A.17).

(b) The list of Airworthiness Design Standard (ADS) to be complied with through OSO#XII are not intended to duplicate requirements already covered by other design-related OSOs:

- OSOs #XIII/#XVIII (System Safety Related)
- OSO #XVI (C3)
- OSO #VI (conformity check)
- OSO #VIII (external systems)
- OSO #XIV (automatic protection of envelope)
- OSO #XV (HMI)
- OSO #VII/#XVII (adverse environment).

(c) For SAIL IV, the applicant may take credit for a Functional Test-Based (FTB) design appraisal gained by a UAS designer (refer to section 3 for more information on FTB approach).

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #XII UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)	Criterion	The UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)[1] considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority to contribute to the overall safety objective of 10-4/FH for the loss of control of the operation.	The UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)[1] considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority to contribute to the overall safety objective of 10-5/FH for the loss of control of the operation.	The UAS components essential to safe operations are designed to an Airworthiness Design Standard (ADS)[1] considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority to contribute to the overall safety objective of 10-6/FH for the loss of control of the operation.
	Comments	[1] *Example of Airworthiness Design Standards (ADS) are:* • *the EASA Special Condition Light-UAS, or* • *the JARUS Certification Specification for Light Unmanned Rotorcraft Systems (LURS), or* • *the JARUS Certification Specification for Light Unmanned Aeroplane Systems (LUAS).*		

	Alternative criterion taking credit for functional test-based methods	A Functional Test-Based (FTB) design appraisal gained by a UAS designer is available and meets the conditions described in section 3(c)(ii), in particular: • 30,000 hours in order to achieve a 95% confidence (assuming a binomial/Poisson distribution for the operational level hazard rate and no failures during the test). • The functional tests supporting the FTB design appraisal gained by a UAS designer have been executed: ○ within the full scope/envelope intended by the UAS Operator. ○ following the maintenance and operational procedures and the remote crew training referred to in the operational authorization.	N/A[2]
	Comments	*N/A*	*[2] Functional test-based method are not considered feasible for operations with a SAIL V or VI*

TECHNICAL ISSUE WITH THE UAS		LEVEL of ASSURANCE		
		Low	Medium	High
OSO #XII UAS components essential to safe operations are designed to an Airworthiness Design Standard	Criterion	The applicant declares that the required level of integrity has been achieved[1].	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[2], inspection, design review or through operational experience.	A competent third party validates the claimed level of integrity.

(ADS)	*Comments*	*[1] Supporting evidence for this declaration may still be requested by the competent authority.*	*[2] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*	*N/A*
	Alternative criterion taking credit for functional test-based methods	The Operator declares[3] that the FTB design appraisal gained by a UAS designer have been executed according to principles/standards[2] considered adequate by the competent authority in charge of granting the Operational Authorization.	N/A[4]	
	Comments	*[3] For example ASTM F3478-20: "Standard Practice for Development of a Durability and Reliability Flight Demonstration Program for Low Risk Unmanned Aircraft Systems (UAS) under FAA Oversight."*	*[4] Functional test-based method are not considered feasible for operations with a SAIL V or VI*	

OSO #XIII - UAS is designed considering system safety and reliability

(a) This OSO complements:

- The safety requirements for containment defined in the main Body
- OSO #XVIII which is only addressing the risk of a fatality while operating over populous areas or gatherings of people.

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	Medium	High
OSO #XIII UAS is designed considerin g system safety and reliability	Criterion	The equipment, systems, and installations are designed to minimize hazards[1] in the event of a probable[2] malfunction or failure of the UAS[3].	Same as Low. In addition, the strategy for detection, alerting and management of any malfunction, failure or combination thereof, which would lead to a hazard is available.	Same as Medium. In addition: • Major Failure Conditions are not more frequent than Remote[4]; • Hazardous Failure Conditions are not more frequent than Extremely Remote[4]; • Catastrophic Failure Conditions are not more frequent than Extremely Improbable[4]; • Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) may cause or contribute to hazardous or catastrophic failure conditions are developed to an industry-standard or a methodology considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority[5].
	Comments	*[1] For the purpose of this assessment, the term "hazard" should be interpreted as a failure condition that relates to major, hazardous, or catastrophic.* *[2] For the purpose of this assessment, the term "probable" should be*	*N/A*	*[4] Safety objectives may be derived from JARUS AMC RPAS.1309 Issue 2 Table 3 depending on the UAS class or an equivalent risk-based methodology acceptable to the competent authority.* *[5] Development Assurance Levels (DALs) for SW/AEH*

		interpreted in a qualitative way as, "Anticipated to occur one or more times during the entire system/operational life of a UAS". [3] *Eurocae ED-280 "Guidelines for UAS safety analysis for the specific category (low and medium levels of robustness)" may be considered acceptable by the competent authority to support compliance with this criterion.*		*may be derived from JARUS AMC RPAS.1309 Issue 2 Table 3 depending on the UAS class or an equivalent risk-based methodology acceptable to the competent authority.*

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TECHNICAL ISSUE WITH THE UAS		**LEVEL of ASSURANCE**		
		Low	**Medium**	**High**
OSO #XIII UAS is designed considering system safety and reliability	Criterion	A Functional Hazard Assessment[1] and a design and installation appraisal that shows hazards are minimized are available.	Same as Low. In addition: ● Safety analyses are conducted in line with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. ● A strategy for the detection of single failures of concern includes pre-flight checks.	Same as Medium. In addition, safety analyses and development assurance activities are validated by a competent third party.
	Comments	[1] *Severity of failure conditions (No Safety Effect, Minor, Major, Hazardous and Catastrophic) should be determined according to the definitions provided in JARUS AMC RPAS.1309 Issue 2.*	*N/A*	*N/A*

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OSO #XIV - Automatic protection of the flight envelope from human errors

(a) Unmanned Aircraft (UA) are designed with a flight envelope that describes its safe performance limits with regard to minimum and maximum operating speeds, and operating structural strength.

(b) Automatic protection of the flight envelope is intended to prevent the remote pilot from operating the UA outside its flight envelope. If the applicant demonstrates that the remote pilot is not in the loop, this OSO is not applicable.

(c) UAS implementing such automatic protection function will ensure the UA is operated within an acceptable flight envelope margin even in the case of incorrect remote-pilot control input (human error).

(d) UAS without automatic protection function are susceptible to incorrect remote-pilot control inputs (human errors) which can result in loss of the UA if the performance limits of the aircraft are exceeded.

(e) Failures or development errors of the flight envelope protection are addressed in OSOs #XIII and #XVIII.

<table>
<tr><th colspan="2" rowspan="2">HUMAN ERROR</th><th colspan="3">LEVEL of INTEGRITY</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">OSO #XIV Automatic protection of the flight envelope from human errors</td><td>Criterion</td><td>The UAS incorporates automatic protection of the flight envelope to prevent the remote pilot from making any <u>single</u> input under <u>normal operating conditions</u> that would cause the UA to exceed its flight envelope or prevent it from recovering in a timely fashion.</td><td colspan="2">The UAS incorporates automatic protection of the flight envelope to ensure the UA remains within the flight envelope or ensures a timely recovery to the designed operational flight envelope <u>following remote pilot error(s)</u>.[1]</td></tr>
<tr><td>Comments</td><td>N/A</td><td colspan="2">[1] The distinction between a Medium and a High level of robustness for this criterion is achieved through the level of assurance (see table below).</td></tr>
</table>

<table>
<tr><th colspan="2" rowspan="2">HUMAN ERROR</th><th colspan="3">LEVEL of ASSURANCE</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">OSO #XIV Automatic protection of the flight envelope from human errors</td><td>Criterion</td><td>The automatic protection of the flight envelope has been developed in-house or out of the box (e.g. using Commercial Off The Shelf elements), without following specific standards.</td><td>The automatic protection of the flight envelope has been developed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.</td><td>Same as Medium. In addition, evidence is validated by a competent third party.</td></tr>
<tr><td>Comments</td><td>N/A</td><td>National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.</td><td>N/A</td></tr>
</table>

OSO #XV - A Human Factors evaluation has been performed and the Human-Machine Interface (HMI) found appropriate for the mission

<table>
<tr><th colspan="2" rowspan="2">HUMAN ERROR</th><th colspan="3">LEVEL of INTEGRITY</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="3">OSO #XV

A Human Factors evaluation has been performed and the HMI found appropriate for the mission</td><td>Criterion</td><td colspan="3">The UAS information and control interfaces are clearly and succinctly presented and do not confuse, cause unreasonable fatigue, or contribute to remote crew error that could adversely affect the safety of the operation.</td></tr>
<tr><td rowspan="2">Comments</td><td colspan="3">If an electronic means is used to support the remote crew members in their role to maintain awareness of the position of the unmanned aircraft, its HMI:
- is sufficient to allow the remote crew members to determine the position of the UA during operation;
- does not degrade the remote crew members' ability to:
○ scan the airspace visually where the unmanned aircraft is operating for any potential collision hazard; and
○ maintain effective communication with the remote pilot at all times.</td></tr>
<tr><td colspan="2">N/A</td><td>For a high level of integrity, the Human Factors evaluation is expected to cover:
● an appraisal to check that the remote crew workload remain acceptable in both normal and emergency situations;
● an appraisal of the efficiency of the emergency procedures (efficacy of the actions, expected potential latencies);
● analyses to check if prioritization of alarms and emergency procedures should be put in place to organize emergency procedures in such a way that they remain adapted to the criticality of the situation.</td></tr>
</table>

HUMAN ERROR		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #XV A Human Factors evaluation has been performed and the HMI found appropriate for the mission	Criterion	The applicant conducts a human factors evaluation of the UAS to determine if the HMI is appropriate for the mission. The HMI evaluation is based on inspection or analyses.	Same as Low but the HMI evaluation is based on demonstrations or simulations.[1]	Same as Medium. In addition, a competent third party witnesses the HMI evaluation.
	Comments	*N/A*	*[1] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*	*N/A*
	Alternative Criterion taking credit for functional test-based methods	FUNCTIONAL TEST-BASED METHODS (for SAILs up to IV included): If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[2], the assurance that the HMI evaluation is adequate is fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[3].		N/A[4]
	Comments	*[2] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:* • *within the full operational scope/envelope intended by the UAS Operator,* • *following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.* *[3] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO#XVII is fulfilled at Low Level.*		*[4] Functional test-based method are not considered feasible for operations with a SAIL VI*

OSO #XVI - C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation

(a) For the purpose of the SORA and this specific OSO, the term “C3 link” encompasses:

- the Command and Control (C2) link, and
- any communication link required for the safety of the flight.

(b) To correctly assess the integrity of this OSO, the applicant should identify:

3) The C3 links performance requirements necessary for the intended operation.
4) All C3 links, together with their actual performance and Radio Frequency (RF) spectrum usage.
   Note: The specification of performance and RF spectrum for a C2 Link is typically documented by the UAS designer in the UAS manual.
   Note: Main parameters associated with C2 link performance (RLP) and the performance parameters for other communication links (e.g. RCP for communication with ATC) include, but are not limited to the following:
   - Transaction expiration time
   - Availability
   - Continuity
   - Integrity

   Refer to ICAO references for definitions, and to JARUS RPAS “Required C2 Performance”(RLP) concept.
5) The RF spectrum usage requirements for the intended operation (including the need for authorization if required).
   Note: Usually, countries publish the allocation of RF spectrum bands applicable in their territory. These allocations stem primarily from the International Telecommunication Union (ITU) Radio Regulations (RR). However, the applicant should check their State requirements and request authorization when needed since there may be national differences to spectrum allocations (e.g. national sub-division of ITU allocations). Some aeronautical bands (e.g. AM(R)S, AMS(R)S 5030-5091MHz) are allocated for potential use in UAS operations under classified as cat. C (“certified”), however their use may still be authorized for operations under the specific category. The use of other licensed bands (e.g. those allocated to mobile networks) may also be authorized under the specific category. Some un-licensed bands (e.g. ISM (Industrial, Scientific, Medical) or SRD (Short Range Devices)) may be acceptable under the specific category, for instance for operations with lower integrity requirements.
6) Environmental conditions that might affect the C3 links performance.

TECHNICAL ISSUE WITH THE UAS		LEVEL of INTEGRITY		
		Low	Medium	High
OSO #06 C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation	Criterion	• The applicant determines that performance, RF spectrum usage[1] and environmental conditions for C3 links are adequate to safely conduct the intended operation. • The UAS remote pilot has the means to continuously monitor the C3 performance and ensures the performance continues to meet the operational requirements[2].	Same as Low[3].	Same as Low. In addition, the use of licensed[4] frequency bands for C2 Link is required.

	Comments	*[1] For a low level of integrity, unlicensed frequency bands might be acceptable under certain conditions, e.g.:* • *the applicant demonstrates compliance with other RF spectrum usage requirements (e.g. for EU: Directive 2014/53/EU, for the US: CFR Title 47 Part 15 Federal Communication Commission (FCC) rules), by showing the UAS equipment is compliant with these requirements (e.g. FCC marking), and* • *the use of mechanisms to protect against interference (e.g. FHSS, frequency deconfliction by procedure).* *[2] The remote pilot has continual and timely access to the relevant C3 information that could affect the safety of flight. For operations requesting only a low level of integrity for this OSO, this could be achieved by monitoring the C2 link signal strength and receiving an alert from the UAS HMI if the signal becomes too low.*	*[3] Depending on the operation, the use of licensed frequency bands might be necessary. In some cases, the use of non-aeronautical bands (e.g. licensed bands for cellular network) may be acceptable.*	*[4] This ensures a minimum level of performance and is not limited to aeronautical licensed frequency bands (e.g. licensed bands for cellular network). Nevertheless, some operations may require the use of bands allocated to the aeronautical mobile service for the use of C2 Link (e.g. 5030 – 5091 MHz).* *In any case, the use of licensed frequency bands needs authorization.*

TECHNICAL ISSUE WITH THE UAS		**LEVEL of ASSURANCE**		
		Low	**Medium**	**High**
OSO #XVI C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation	Criterion	The applicant declares that the required level of integrity has been achieved[1].	Demonstration of the C3 link performance is in accordance with standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority.	Same as Medium. In addition, evidence is validated by a competent third party.
	Comments	*[1] Supporting evidence for this declaration may still be requested by the competent authority*	*National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	*N/A*

OSO #XVII - UAS designed and qualified for adverse environmental conditions (e.g. adequate sensors, DO-160 qualification)

(a) To assess the integrity of this OSO, the applicant determines:

- If credit can be taken for the equipment environmental qualification tests / declarations, e.g. by answering the following questions:
    i. *Is there a Declaration of Design and Performance (DDP) available to the applicant stating the environmental qualification levels to which the equipment was tested?*
    ii. *Did the environmental qualification tests follow a standard considered adequate by the competent authority (e.g. RTCA DO-160 "Environmental Conditions and Test Procedures for Airborne Equipment")?*
    iii. *Are the environmental qualification tests appropriate and sufficient to cover all environmental conditions intended by the UAS Operator?*
    iv. *If the tests were not performed following a recognized standard, were the tests performed by an organisation/entity being qualified or having experience in performing DO-160 like tests?*
- Can the suitability of the equipment for the intended/expected UAS environmental conditions be determined from either in-service experience or relevant test results?
- Any limitations which would affect the suitability of the equipment for the intended/expected UAS environment conditions.

(b) The lowest integrity level should be considered for those cases where a UAS equipment has only a partial environmental qualification and/or a partial demonstration by similarity and/or parts with no qualification at all.

ADVERSE OPERATING CONDITIONS		**LEVEL of INTEGRITY**		
		N/A	**Medium**	**High**
OSO #XVII UAS designed and qualified for adverse environmental conditions	Criterion	N/A	The UAS is designed to perform as intended in the environmental conditions defined and reflected in the flight manual.	The UAS is designed using environmental standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.
	Comments	*N/A*	*As an example, if a UAS is proposed to be operated in raining conditions, it is not necessarily proposed to comply with DO-160G waterproof conditions; rain conditions can be limited as long as representative of the environmental conditions*	*National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*

<table>
<tr><th colspan="2" rowspan="2">ADVERSE OPERATING CONDITIONS</th><th colspan="3">LEVEL of ASSURANCE</th></tr>
<tr><th>N/A</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="4">OSO #XVII UAS designed and qualified for adverse environmental conditions</td><td>Criterion</td><td>N/A</td><td>The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[1], inspection, design review or through operational experience.</td><td>A competent third party validates the claimed level of integrity.</td></tr>
<tr><td>Comments</td><td>N/A</td><td>[1] When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.</td><td>N/A</td></tr>
<tr><td>Alternative Criterion taking credit for functional test-based methods</td><td>N/A</td><td colspan="2">FUNCTIONAL TEST-BASED METHODS (for SAILs up to SAIL IV included):

If a Functional Test-Based (FTB) design appraisal gained by a UAS designer meets the conditions described in section 3(c)(ii)[2], the assurance that the UAS is designed to limit the effect of environmental conditions exercised throughout the test cycle is fulfilled at the level corresponding to the SAIL being demonstrated by the functional test-based approach[3].</td></tr>
<tr><td>Comments</td><td>N/A</td><td colspan="2">[2] In particular, the functional tests supporting the FTB design appraisal gained by the UAS designer have been executed:
• within the full operational scope/envelope intended by the UAS Operator,
• following the maintenance, operational procedures and the remote crew training referred to in the operational authorization.

[3] As an example, if the number of test cycles supporting the FTB design appraisal gained by the UAS designer is proportionate to the risk of a SAIL III operation, the assurance level for OSO#XVII is fulfilled at Medium Level.</td></tr>
</table>

OSO #XVIII - Safe recovery from technical issue with the UAS or external systems supporting UAS operation

(a) The objective of OSO#XVIII is to complement the safety requirements for containment defined in the Main Body Step #08 by addressing the risk of a fatality within the operational volume, when operating over population density above 2,500 ppl/km2.

(b) It ensures that the effect of failures to the external systems supporting the UAS operation are adequately mitigated by the UAS; as such, external systems are defined as systems not already part of the UAS but used to:

- launch / take-off the UAS, and/or
- undertake pre-flight checks, and/or
- support operations of the UA within the operational volume (e.g. GNSS, Satellite Systems, Air Traffic Management, UTM).

External systems may be supported by an external service for which a service level agreement is established in line with OSO #VIII.

OSOS RELATED TO SAFE DESIGN		LEVEL of INTEGRITY		
		Low	**Medium**	**High**
OSO #XVIII	Criterion	When operating over population density above 2,500 ppl/km^2, no probable[1] failure[2] of the UAS or any external system supporting the operation will lead to a fatality(ies).	When operating over population density above 2,500 ppl/km^2: • no single failure[3] of the UAS or any external system supporting the operation will lead to a fatality(ies). • Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) could directly lead to a failure affecting the operation in such a way that it can be reasonably expected that a fatality will occur are developed to a standard considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority[4].	Same as Medium
	Comments	*[1] For the purpose of this assessment, the term "probable" should be interpreted in a qualitative way as, "Anticipated to occur one or more times during the entire system/operational life of a UAS".*	*[3] Some structural or mechanical failures may be excluded from the no-single failure criterion if it can be shown that these mechanical parts were designed to a standard considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority*	

		[2] Some structural or mechanical failures may be excluded from the criterion if it can be shown that these mechanical parts were designed to aviation industry best practices.	*[4] National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*	

		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #XVIII	Criterion	A design and installation appraisal is available. In particular, this appraisal shows that: ● the design and installation features (independence, separation and redundancy) satisfy the low integrity criterion; ● particular risks relevant to the intended operation (e.g. hail, ice, snow, electro-magnetic interference…) do not violate the independence claims, if any.	Same as Low. In addition, the level of integrity claimed is substantiated by analysis and/or test data with supporting evidence.	Same as Medium. In addition, a competent third party validates the level of integrity claimed.
	Comments	*N/A*	*N/A*	*N/A*

3. Functional Test-Based (FTB) Approach

a. The objective of this section is to give some insight into the Functional Test-Based (FTB) approach referenced throughout Annex E. This is articulated around three different but complementary perspectives:

i. FTB as a Means of Compliance (MoC) to support **UAS designers** in demonstrating UAS operational reliability;

ii. FTB design appraisal gained by UAS designers taken credit for by **UAS operators** when showing compliance with some of Annex E OSOs;

iii. FTB as a means for **UAS operators** to take credit for safe and successful operations over time to expand their operational approval (based on the concept of "reliability growth model").

These three approaches are detailed in the following sections b), c) and d).

b. FTB as a Means of Compliance (MoC) to support **UAS designers** in demonstrating UAS operational reliability:

i. Several major competent authorities around the world are adopting functional test-based approaches as a MoC to support UAS designers in demonstrating the UAS operational, i.e. demonstrating an acceptable operational hazard rate across all likely operational states and environments, as well as help expose unacceptable infant mortality and wear out failures across an acceptable sample size of unmanned aircraft[2].

ii. Depending on the principles agreed with the competent authority, a test-based approach may cover both functional tests and induced failure tests, which are defined as follows:

- 'functional tests' are operational test cycles fully representative of end-state operations with test points to verify safe operation at the operational limits and corners of the UA envelope;
- 'induced failure tests' are specific tests where operationally-representative cycles alone may not provide sufficient detail, e.g. to cover likely failures. These tests typically address demand-based systems (i.e. systems that are not continuously active and could be triggered only under certain [failure] conditions) which need to be assessed separately to demonstrate adequate reliability.

iii. While it is not the objective of this section to prescribe Means of Compliance for a Functional test-based approach, competent authorities may want to consider the principles laid down in ASTM F3478-20: "Standard Practice for Development of a Durability and Reliability Flight Demonstration Program for Low Risk Unmanned Aircraft Systems (UAS) under FAA Oversight.", some of its concepts being highlighted below:

- An adequate functional test-based campaign will include mostly operational flight tests; it may include as well specific (ground) testing to verify underlying system parameters statistically (e.g. component Mean Time Between Failures (MTBF), UA MTBF, operational hazard rates, parachute reliability). Both the UAS designer and the competent authority need to understand the assumptions made when attributing a distribution type to a system parameter (e.g. exponential, normal, Weibull, gamma distributions).

[2] The sample size will need to be defined and agreed with the competent authority to ensure that an individual system under test operates throughout a not insignificant portion of its intended design life, and to ensure that there is appropriate consistency of operational reliability & performance across multiple systems during testing.

- Any infringement or loss of control occurring during the test campaign will require a root cause analysis and may trigger design modifications, or extended testing, to meet the required reliability rates.
- UAS designers and competent authorities should also be cognisant of systems, such as software- or airborne electronic hardware-based systems, that do not allow accurate analysis under operational time or demand-based testing. These systems should use system-specific analyses (e.g. multiple condition/decision coverage, model checking, development assurance, design and analysis) appropriate to the SAIL level.

iv. The competent authority may grant a specific flight test authorisation to enable such functional and induced failure tests needed to complete an FTB method.

c. FTB design appraisal gained by UAS designers taken credit for by **UAS operators** when showing compliance with some of Annex E OSOs:

i. An FTB design appraisal gained by a UAS designer presents several benefits both for the UAS Operator going through the Operational Authorization (OA) process and the Competent Authority issuing such OA, in particular when the UAS Operator does not have a full relationship with the designer or does not have all the design details.

ii. In order for a UAS Operator to take credit for a FTB design appraisal gained by a UAS designer, the following conditions need to be met at a minimum:

- The functional tests supporting the FTB design appraisal gained by a UAS designer have been executed within the full operational scope/envelope intended by the UAS Operator; this means that the test cycles are fully representative of the operators' intended operations with test points to verify safe operation at the operational limits and corners of the vehicle envelope.
- The functional tests supporting the FTB design appraisal gained by a UAS designer have been executed following the operational procedures and the remote crew training referred to in the operational authorization (and meeting the integrity assurance of the associated OSOs).
- The UAS operator maintenance instructions are established based on the UAS designer's instructions and requirements which were used for maintenance, repair, or replacement of UAS sub-systems during the functional tests supporting the FTB design appraisal gained by the UAS designer.
- Any UAS configuration differences compared to the initial configuration used by the UAS designer to gain the FTB design appraisal are confirmed by the UAS designer not to impair the validity of the design appraisal.
- The minimum number of test cycles are proportionate to the risk of the operation, with at least:
  - 30 hours for SAIL I;
  - 300 hours for SAIL II;
  - 3,000 hours for SAIL III; and
  - 30,000 hours for SAIL IV

  in order to achieve a 95% confidence (assuming a binomial/Poisson distribution for the operational level hazard rate and no failures during the test)[3].

[3] See the Rule of Three: https://en.wikipedia.org/wiki/Rule_of_three_(statistics)

Note that FTB methods are not considered feasible for UAS operations with a SAIL above or equal to V.

- The functional tests supporting the FTB design appraisal gained by a UAS designer have been executed by the UAS designer according to principles/standards considered adequate by the competent authority in charge of granting the Operational Authorization, including at a minimum the following principles:
  - The functional tests supporting the FTB design appraisal gained by a UAS designer have been executed using an acceptable sample size of unmanned aircraft.
  - Safe life limits for UAS subsystems sensitive to wear-out conditions based on the maximum cycles and hours demonstrated by one or more fleet leader UAS (i.e. the UAS with the longest time and/or cycles compared to other UAS used during the FTB testing) have been derived by the UAS designer and captured in the FTB design appraisal limitations.

iii. Under the conditions listed in the previous paragraph, FTB design appraisals gained by UAS designers may support the assurance claims for the OSOs listed below (all these options are addressed in this version of Annex E for the OSOs listed above):

- FTB design appraisals gained by UAS designers may support the assurance claims of the procedures and training elements of the following OSOs, when they are exercised throughout the tests:
  - OSO#IV and OSO#VII (criterion #2): operational procedures; and
  - OSO#IX (criterion #1), OSO#XI (criterion #1 & #3), and OSO#XV: human errors.
- FTB design appraisals gained by UAS designers may also support the assurance claims of OSO#XVII related to operations in (adverse) environmental conditions.
- FTB design appraisals gained by UAS designers for a SAIL IV operation could as well be taken credit for OSO#XII in lieu of a standard-based approach.

iv. Additionally, induced failure tests may help demonstrate compliance with the following OSOs and Step #08:

- OSO#XIII, #XVIII and Step #08: safety and reliability / safe design (e.g., induced failure tests with no loss of control or containment as pass-fail criteria);
- OSO#XVI: C3 link performance appropriate for the operation (e.g., if the distance from a C2 radio transmitter/receiver is a critical factor, then the demonstration of the maximum allowable range from the transmitter/receiver in the most likely worst-case conditions is needed);
- OSO#XIV: Automatic protection of the flight envelope from human errors;

However, this kind of test is not addressed in this version of Annex E (v2.5) since competent authorities are still in the process of defining the modalities of test-based approaches. In the meantime, credit for induced failure testing may be proposed on a case-by-case basis by a UAS Operator depending on the scope of the FTB design appraisal gained by the UAS designer.

d. FTB as a means **<u>for UAS operators</u>** to take credit for safe and successful operations over time to expand their operational approvals (based on the concept of "reliability growth model"):

i. In a second step, an FTB approach should allow UAS Operators to take credit for safe and successful operations over time to expand their operational approvals based on the concept of "reliability growth".

ii. UAS Operators should be able to operate through a low SAIL approval and then, through operational experience, gather sufficient operational data to justify an increase in the SAIL, based upon the increase in operational reliability demonstrated by the operators. This is only valid <u>under representative operating conditions</u>.

Note that this option does not cover expanded operating conditions which would require additional testing and/or analysis to be performed by the UAS designer.

iii. For example, a UAS Operator may start with a SAIL II operation with approval to fly over 100 people/km^2 and, if they demonstrate the flight hours needed for a SAIL III operation (i.e. 3,000 hours with no loss of control), graduate to the next SAIL level and corresponding higher population band.

iv. To be relevant, the UAS Operator would need to show that:

- the next population band does not introduce new or unique hazards, and if so, they are properly mitigated through test or analysis;
- the reliability demonstrated through operational testing demonstrates the required operational reliability at the higher SAIL level desired;
- any UAS configuration differences compared to the initial configuration used by the UAS designer to gain the FTB design appraisal are confirmed by the UAS designer not to impair the validity of the design appraisal.

4. Containment requirements

a. In SORA Main Body, Step #8: Determination of containment requirements addresses the risk posed by an operational loss of control that could infringe on areas adjacent to the operational volume and buffers. The ground risk (in the adjacent area) and air risk in the adjacent airspace dictate the level of safety requirements to be met by containment design features and operational procedures.

b. The following section provided the detailed containment requirements for the following 3 levels of containment: Low, Medium and High.

Containment	**LEVEL of INTEGRITY**		
	Low	**Medium**	**High**[2]
Criterion #1 - Operational Volume Containment	(Qualitative) No **probable**[1] failure of the UAS or any external system supporting the operation shall lead to operation outside of the operation volume. OR (Quantitative) The probability of the failure condition "UA leaving the operational volume" considering all failure modes of interest shall be less than 10-3/Flight Hour (FH).		(Qualitative) No **remote**[3] failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume. OR (Quantitative) The probability of the failure condition "UA leaving the operational volume" considering all failure modes of interest shall be less than 10-4/FH[4].
Comments	*[1] Failures anticipated to occur one or more times during the entire system/operational life of an item.*		*[2] This may be achieved by a tether that prevents the drone from exiting the operational volume.* *[3] Failures unlikely to occur with each UA during its total life but that may occur several times when considering the total operational life of a number of UA of this type.* *[4] This means a reduction by a factor of 10 of the likelihood of exiting the operational volume compared to low robustness containment.*
Criterion #2 - End of Flight upon exit of the operational volume	When the UA leaves the operational volume, an immediate end of the flight must be initiated through a combination of procedures/processes alongside technical means.		
Comments	*N/A*		
Criterion #3 - Definition of the GRC buffer	The Ground Risk Buffer must at least adhere to the 1:1 principle[4]. A smaller ground risk buffer value may be proven by the applicant	Ground risk buffer must consider the following points below: • **<u>Improbable</u>**[5] single malfunctions or failures (including the projection of high energy parts such as rotors and propellers) which would lead to an operation outside of the operational volume, • Meteorological conditions (e.g. wind),	

	for a rotary wing UA using a ballistic methodology approach acceptable to the competent authority.	• UAS latencies (e.g. latencies that affect the timely maneuverability of the UA), • UA behaviour when activating a technical containment measure, UA performance.
Comments	*[4]The 1:1 principle refers to applying a ground risk buffer that is as wide as the maximum height of the operational volume*	*[5] For the purpose of this assessment, the term "improbable" should be interpreted in a qualitative way as, "Unlikely to occur in each UAS during its total life but which may occur several times when considering the total operational life of a number of UAS of this type".*
Criterion #4 - GRC buffer containment	N/A	**No single failure**[6] of the UAS or any external system supporting the operation shall lead to operation **outside of the ground risk buffer**. Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) could **directly lead to operations outside of the ground risk buffer** shall be developed to an industry standard or methodology recognized as adequate by the competent authority.
Comments	*N/A*	*[6] Example methods of achieving this may include:* • *an independent Flight Termination Systems (FTS), that will initiate the end of the flight, when exiting the operational volume; or* • *a secondary independent emergency flight control system, that ends the flight in a controlled manner; or* • *a tether that prevents the drone from exiting the ground risk buffer;* • *a fail safe health monitoring system that triggers in the event of a critical feature failure (such a navigation).*

Containment	**LEVEL of ASSURANCE**		
	Low	**Medium**	**High**
For all criteria	The applicant declares that the required level of integrity has been achieved[1]. In addition: For criterion #1, compliance is to be substantiated by a design and installation appraisal and includes as a minimum: • design and installation features (independence, separation and redundancy); • any relevant particular risk (e.g. hail, ice, snow, electro-magnetic interference…) associated with the operation.	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[2], inspection, design review or through operational experience. In addition: For criterion #1: Same as low. For criterion #2: Adequacy of the Emergency Procedures to terminate flight are proven through: • dedicated flight tests, or • simulation provided the simulation is proven valid for the intended purpose with positive results.	Same as Medium. In addition, a competent third party validates the claimed level of integrity.

	For criterion #2, the adequacy of Emergency Procedures to terminate flight are tested.		
Comments	[1] *Supporting evidence for this declaration may still be requested by the competent authority.*	[2] *When simulation is used, the suitability of the targeted environment used in the simulation needs to be justified.*	*N/A*