Annex I to ED Decision 2020/022/R

‘Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Commission Implementing Regulation (EU) 2019/947 — Issue 1, Amendment 1’

Annex I to ED Decision 2019/021/R is amended as follows:

The text of the amendment is arranged to show deleted text, new or amended text as shown below:

(a) deleted text is marked with ~~strikethrough~~;

(b) new or amended text is highlighted in blue;

(c) an ellipsis ‘(…)’ indicates that the remaining text is unchanged.

LIST OF ABBREVIATIONS

AEC	airspace encounter category
AEH	airborne electronic hardware
ANSP	air navigation service provider
ARC	air risk class
AGL	above ground level
AMC	acceptable means of compliance
AO	airspace observer
ATC	air traffic control
BVLOS	beyond visual line of sight
C2	command and control
C3	command, control and communication
ConOps	concept of operations
DAA	detect and avoid
EASA	European Union Aviation Safety Agency
ERP	emergency response plan
EU	European Union
FHSS	frequency-hopping spread spectrum
GRC	ground risk class
GM	guidance material
GNSS	Global Navigation Satellite System
HMI	human machine interface
ISM	industrial, scientific and medical
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
METAR	aviation routine weather report (in (aeronautical) meteorological code)
MCC	multi-crew cooperation
MTOM	maximum take-off mass
NAA	national aviation authority
OM	operations manual
OSO	operational safety objective
PDRA	predefined risk assessment
RBO	risk-based oversight
RCP	required communication performance
RF	radio frequency
RLP	required C2 link performance
RP	remote pilot
RPS	remote pilot station
SAIL	specific assurance and integrity level
SMM	safety management manual
SORA	specific operations risk assessment
SPECI	aviation selected special weather code in (aeronautical) meteorological code
STS	standard scenario
SW	software
TAF	terminal area forecast
TCAS	traffic collision avoidance system
TMPR	tactical mitigation performance requirement
UA	unmanned aircraft
UAS	unmanned aircraft system

UAS Regulation	Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft
VLL	very low level
VLOS	visual line of sight
VO	visual observer

AMC1 Article 11 Rules for conducting an operational risk assessment

SPECIFIC OPERATIONS RISK ASSESSMENT (SOURCE JARUS SORA V2.0)

EDITION ~~September 2019~~December 2020

[…]

1.5 Roles and responsibilities

[…]

(d) UAS manufacturer — For the purposes of the SORA, the UAS manufacturer is the party that designs and/or produces the UAS. The UAS manufacturer has unique design evidence (e.g. for the system performance, the system architecture, software/hardware development documentation, test/analysis documentation, etc.) that they may choose to make available to one or many UAS operator(s) or to the competent authority to help to substantiate the UAS operator's safety case. Alternatively, a potential UAS manufacturer may utilise the SORA to target design objectives for specific or generalised operations. To obtain airworthiness approval(s), these design objectives could be complemented by the use of certification specifications (CS) or industry consensus standards if they are found to be acceptable by EASA~~the competent authority~~.

[…]

(f) Competent authority — The competent authority that is referred to throughout this AMC is the ~~recognised national~~ authority designated by the Member State in accordance with Article 17 of the UAS regulation to assess ~~for approving~~ the safety case of UAS operations and to issue the operational authorisation~~, according to~~ in accordance with Article 12 of the UAS Regulation. The competent authority may accept an applicant's SORA submission in whole or in part. Through the SORA process, the applicant may need to consult with the competent authority to ensure the consistent application or interpretation of individual steps. The competent authority must perform oversight of the UAS operator ~~according to~~in accordance with paragraphs (i) and (j) of Article 18 of the UAS Regulation. According to Regulation (EU) 2018/1139[3] (the EASA 'Basic Regulation'), EASA is the authority competent in the European Union to verify compliance of the UAS design and its components with the applicable rules, while the authority that is designated by the Member State is competent to verify compliance with the operational requirements and compliance of the personnel's competency with those rules. The following elements are related to the UAS design:

— OSOs #02, #04, #05, #06, #10, #12, #18, #19 (limited to criterion #3), #20, and #24;

— M1 mitigation (tethered operations): criterion #1 and M2 mitigation: criterion #1;

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[3] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R1139).

— verification of the system to contain the UAS within the operational volume in accordance with Step #9 of the SORA process.

When according to the SAIL or to the claimed mitigation means, the level of assurance of the above OSOs and/or mitigation means is 'high' (i.e. SAIL V and VI), a verification by EASA is required according to Article 40(1)(d) of Regulation (EU) 2019/945[4]. For the other OSOs and mitigation means, the competent authority defines which third party is able to verify compliance with them.

If the level of robustness of the design-related OSOs and/or mitigation means is lower than 'high', the competent authority may still require a verification by EASA of the compliance of the UAS and/or its components with the design-related OSOs and/or mitigation means according to point Article 40(1)(d) of Regulation (EU) 2019/945. Similarly, also for UAS operators to which the competent authority granted a light UAS operator certificate (LUC), the terms of the approval may require to use a UAS that is verified by EASA when conducting operations for which the level of robustness of the design-related OSOs and/or mitigation means is lower than 'high'. In those cases, EASA will verify that the achievement of the design integrity level is appropriate to the related SAIL and to the mitigation means, when those means are applicable, and will issue a type certificate (TC) (or a restricted type certificate (RTC)) to the UAS manufacturer, which will cover all design-related OSOs, the design-related mitigation means, and the enhanced containment verification in accordance with Step #9, if that verification is applicable. Alternatively, the competent authority that issues the operational authorisation may accept a declaration by the UAS operator, who is responsible for compliance of the UAS with the design-related OSOs.~~EASA may perform oversight of the UAS design and/or production organisation, and, when considered necessary, of the component design and/or production organisation, and may approve the design and/or the production of each. The competent authority also provides the operational approval to the UAS operator.~~

[…]

2. The SORA process

[…]

2.2 SORA process outline

[…]

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[4] Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems (OJ L 152, 11.6.2019, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R0945).

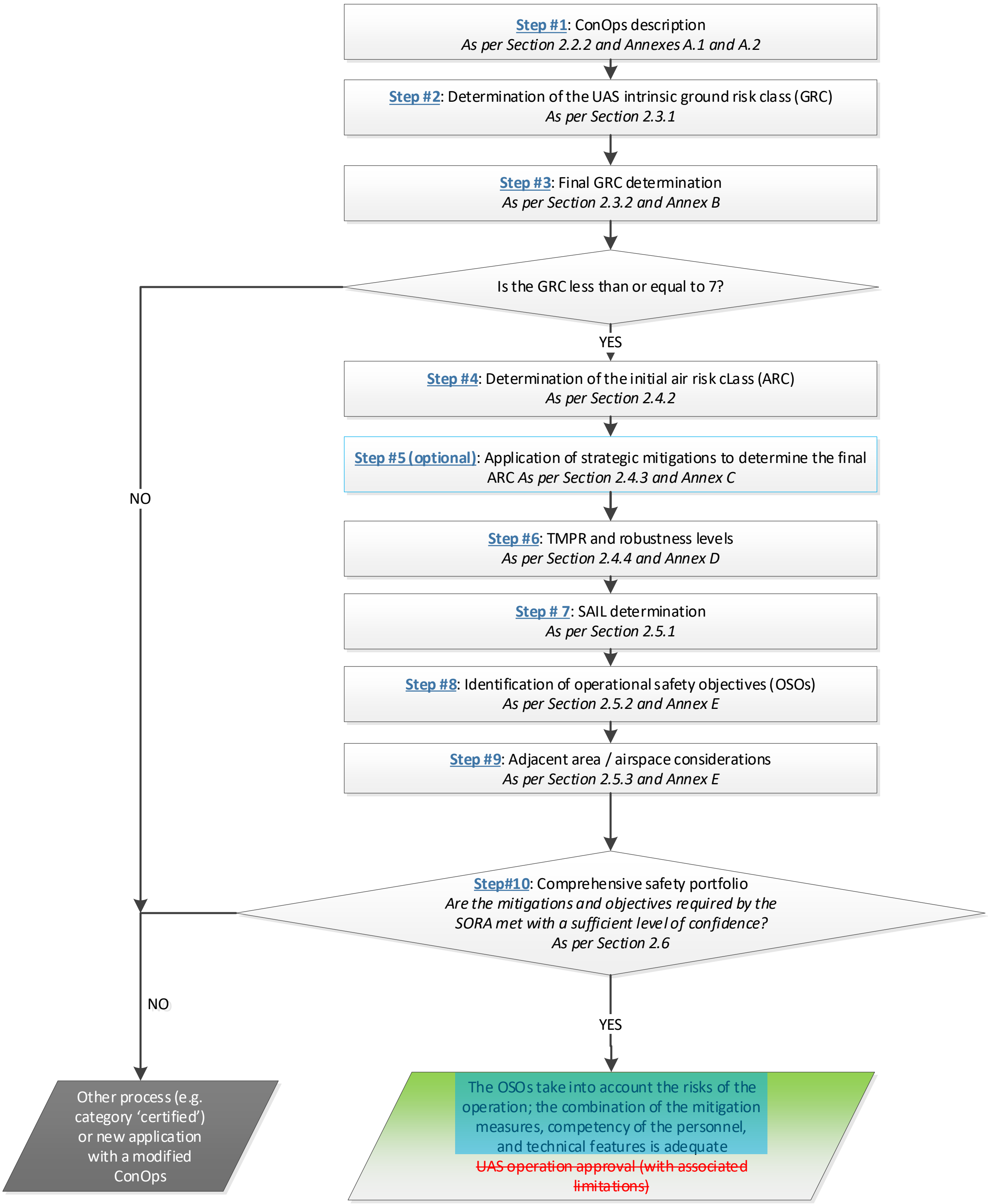

Figure 3 — The SORA process

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

[…]

2.3 The ground risk process

2.3.1 Step #2 — Determination of the intrinsic UAS ground risk class (GRC)

[…]

(c) The applicant needs to have defined the area at risk when conducting the operation (also called the 'area of operation') including:

[…]

(d) Table 2 illustrates how to determine the intrinsic ground risk class (GRC). The intrinsic GRC is found at the intersection of the applicable operational scenario and the maximum UA characteristic dimension that drives the UAS lethal area. ~~In case of~~If there is a mismatch between the maximum UAS characteristic dimension and the typical kinetic energy expected, the applicant should provide substantiation for the chosen column.

Intrinsic UAS ground risk class				
Max UAS characteristics dimension	1 m / approx. 3 ft	3 m / approx. 10 ft	8 m / approx. 25 ft	> 8 m / approx. 25 ft
Typical kinetic energy expected	< 700 J (approx. 529 ft lb)	< 34 kJ (approx. 25 000 ft lb)	< 1 084 kJ (approx. 800 000 ft lb)	> 1 084 kJ (approx. 800 000 ft lb)
Operational scenarios				
VLOS/BVLOS over a controlled ground area[6]	1	2	3	4
VLOS ~~in~~over a sparsely populated ~~environment~~area	2	3	4	5
BVLOS ~~in~~over a sparsely populated ~~environment~~area	3	4	5	6
VLOS ~~in~~over a populated ~~environment~~area	4	5	6	8
BVLOS ~~in~~over a populated ~~environment~~area	TBD4[5]5	~~TBD~~[4]6	~~TBD~~[4]8	~~TBD~~[4]10
VLOS over an assembly of people	7			
BVLOS over an assembly of people	~~TBD~~[4]8			

Table 1 — Determination of the intrinsic GRC

(e) The operational scenarios describe~~d~~ an attempt to provide discrete categorisations of operations with increasing numbers of **people at risk**. In principle, it is possible to use either qualitative criteria (please refer to next point (f)) or quantitative criteria, or consider both criteria, to assess if an operation takes place over sparsely populated areas, populated areas, or assemblies of people.

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[6] In line with Figure 1 and ~~paragraph~~point 2.3.1~~.~~(c), the controlled area should encompass the flight geography, the contingency volume, and the ground risk buffer.

~~[5] The intrinsic ground risk class for BVLOS operations in populated environment or over gathering of people will be developed in a future edition of the SORA.~~

(f) ~~Reserved.~~Qualitative assessment: the volume to be used by the operator to classify the operation includes the operational volume and the ground risk buffer (as defined by a semantic model), which determine the intrinsic GRC.

GM1 Article 2(3) 'Definitions I DEFINITION OF 'ASSEMBLIES OF PEOPLE'' provides guidance on when an operation is classified as taking place over assemblies of people.

An operation should be classified as taking place over a populated area if the volume that is used to determine the intrinsic GRC:

— does not include assemblies of people, and

— includes areas that are substantially used for residential, commercial or recreational purposes.

[…]

(h) Controlled ground areas[9] are a way to strategically mitigate the risk on ground (similar to flying in segregated airspace); the UAS operator should ensure, through appropriate procedures, that~~assurance that there will be~~ no uninvolved person~~s~~ is in the area of operation, as defined in Section 2.3.1(c)~~is under the full responsibility of by the UAS operator~~.

[…]

2.3.2 Step #3 – Final GRC determination

[…]

(h) In general, a quantitative approach to mitigation means allows to reduce the intrinsic GRC by 1 point if the mitigation means reduce the risk of the operation by a factor of approximately 10 (90 % reduction) compared to the risk that is assessed before the mitigation means are applied. Such quantitative criteria should be used to validate the risk reduction that is claimed when applying Annex B to AMC1 to Article 11.

[…]

2.5.2 Step #8 — Identification of the operational safety objectives (OSOs)

(a) The last step of the SORA process is to use the SAIL to evaluate the defences within the operation in the form of OSOs, and to determine the associated level of robustness. Table 6 provides a qualitative methodology to make this determination. In this table, O is optional, L is recommended with low robustness, M is recommended with medium robustness, and H is recommended with high robustness. The various OSOs are grouped based on the threat they help to mitigate; hence, some OSOs may be repeated in the table.

(b) Table 6 is a consolidated list of the common OSOs that historically have been used to ensure safe UAS operations. It represents the collected experience of many experts, and is therefore a solid starting point to determine the required safety objectives for a specific

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[9] See the definition in Article 2(21) of the UAS Regulation.

operation. The competent authorities that issue the operational authorisation may define additional OSOs for a given SAIL and the associated level of robustness.

OSO number (in line with Annex E)		SAIL					
		I	II	III	IV	V	VI
	Technical issue with the UAS						
OSO#01	Ensure the UAS operator is competent and/or proven	O	L	M	H	H	H
OSO#02	UAS manufactured by competent and/or proven entity	O	O	L	M	H	H
OSO#03	UAS maintained by competent and/or proven entity	L	L	M	M	H	H
OSO#04	UAS developed to authority recognised design standards[6]	O	O	~~O~~L	L	M	H
OSO#05	UAS is designed considering system safety and reliability	O	O	L	M	H	H
OSO#06	C3 link performance is appropriate for the operation	O	L	L	M	H	H
OSO#07	Inspection of the UAS (product inspection) to ensure consistency with the ConOps	L	L	M	M	H	H
OSO#08	Operational procedures are defined, validated and adhered to	L	M	H	H	H	H
OSO#09	Remote crew trained and current and able to control the abnormal situation	L	L	M	M	H	H
OSO#10	Safe recovery from a technical issue	L	L	M	M	H	H
	Deterioration of external systems supporting UAS operations						
OSO#11	Procedures are in-place to handle the deterioration of external systems supporting UAS operations	L	M	H	H	H	H
OSO#12	The UAS is designed to manage the deterioration of external systems supporting UAS operations	L	L	M	M	H	H
OSO#13	External services supporting UAS operations are adequate for the operation	L	L	M	H	H	H
	Human error						
OSO#14	Operational procedures are defined, validated and adhered to	L	M	H	H	H	H

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[6] ~~The robustness level does not apply to mitigations for which credit has been taken to derive the risk classes. This is further detailed in para. 3.2.11(a).~~In case of experimental flights that investigate new technical solutions, the competent authority may accept that recognised standard are not met.

OSO number (in line with Annex E)		SAIL					
		I	II	III	IV	V	VI
OSO#15	Remote crew trained and current and able to control the abnormal situation	L	L	M	M	H	H
OSO#16	Multi-crew coordination	L	L	M	M	H	H
OSO#17	Remote crew is fit to operate	L	L	M	M	H	H
OSO#18	Automatic protection of the flight envelope from human error	O	O	L	M	H	H
OSO#19	Safe recovery from human error	O	O	L	M	M	H
OSO#20	A human factors evaluation has been performed and the human machine interface (HMI) found appropriate for the mission	O	L	L	M	M	H
	Adverse operating conditions						
OSO#21	Operational procedures are defined, validated and adhered to	L	M	H	H	H	H
OSO#22	The remote crew is trained to identify critical environmental conditions and to avoid them	L	L	M	M	M	H
OSO#23	Environmental conditions for safe operations are defined, measurable and adhered to	L	L	M	M	H	H
OSO#24	UAS is designed and qualified for adverse environmental conditions	O	O	M	H	H	H

Table 6 — Recommended OSOs

2.5.3 Step #9 – Adjacent area/airspace considerations

[…]

(c) The enhanced containment, which consists in the following three safety requirements, applies~~y~~ ~~for~~to operations conducted:

[…]

(2) Or where the operational volume is in a populated area~~environments~~ where:

(i) M1 mitigation has been applied to lower the GRC; or

(ii) operating in a controlled ground area.

(a) The UAS is designed to standards that are considered adequate by the competent authority and/or in accordance with a means of compliance that is acceptable to that authority such that:

~~1.~~(1) ~~T~~the probability of the UA leaving the operational volume should be less than 10^{-4}/FH; and~~.~~

~~2.~~(2) ~~N~~no single failure~~[12]~~[*] of the UAS or any external system supporting the operation should lead to its operation outside the ground risk buffer.

Compliance with the requirements above should be substantiated by analysis and/or test data with supporting evidence.

~~3.~~(b) Software (SW) and airborne electronic hardware (AEH) whose development error(s) could **directly** (refer to Note 2) lead to operations outside the ground risk buffer should be developed to an industry standard or methodology that is recognised as being adequate by the competent authority.

[…]

ANNEX C TO AMC1 TO ARTICLE 11

STRATEGIC MITIGATION — COLLISION RISK ASSESSMENT

[…]

C.4 General air-SORA mitigation overview

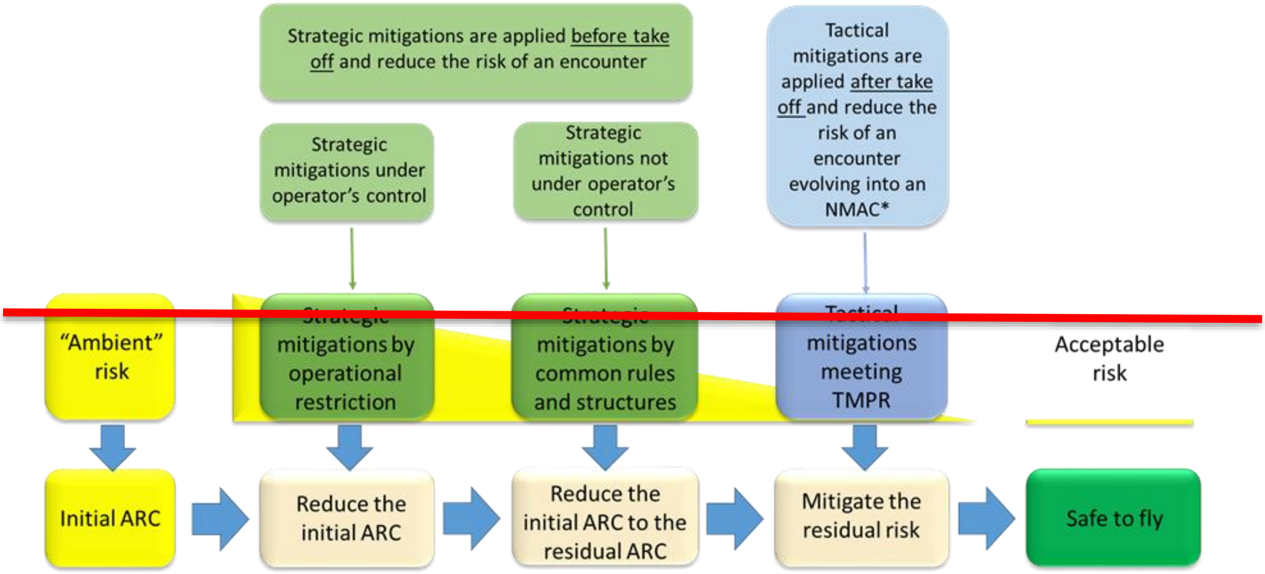
SORA classification of mitigations

The SORA classifies mitigations to suit the operational needs of a UAS in the ‘specific’ class. These mitigations are classified as:

(a) strategic mitigations by the application of operational restrictions;

(b) strategic mitigations by the application of common structures and rules; and

(c) tactical mitigations.



* NMAC: near mid-air collision

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[*] The term ‘failure’ needs to be understood as an occurrence that affects the operation of a component, part, or element such that it can no longer function as intended. Errors may cause failures, but are not considered to be failures. Some structural or mechanical failures may be excluded from the criterion if it can be shown that these mechanical parts were designed according to aviation industry best practices.

~~Figure C.5 shows the alignment of the mitigation definitions between ICAO and the SORA.~~

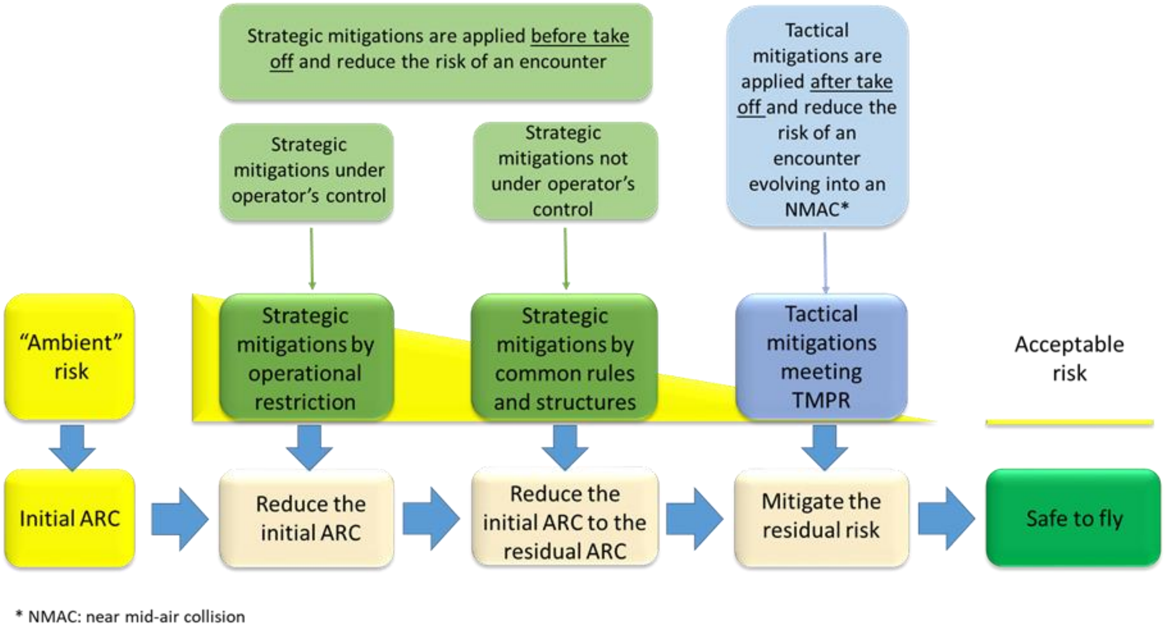


Figure C.5 — SORA air conflict mitigation process

[…]

ANNEX E TO APPENDIX A TO AMC1 TO ARTICLE 11

INTEGRITY AND ASSURANCE LEVELS FOR THE OPERATIONAL SAFETY OBJECTIVES (OSOs)

E.2 OSOs related to technical issues with the UAS

[…]

OSO #02 — UAS manufactured by a competent and/or proven entity

TECHNICAL ISSUE WITH THE UAS		**Level of integrity**		
		Low	**Medium**	**High**
OSO #02 UAS manufactured by competent and/or proven entity	Criteria	As a minimum, manufacturing procedures cover: (a) the specification of materials; (b) the suitability and durability of materials used; and (c) the processes necessary to allow for repeatability in manufacturing, and conformity within acceptable tolerances.	Same as low. In addition, manufacturing procedures also cover: (a) configuration control; (b) the verification of incoming products, parts, materials, and equipment; (c) identification and traceability; (d) in-process and final inspections & testing; (e) the control and calibration of tools; (f) handling and storage; and (g) the control of non-conforming items.	~~Same as medium. In addition, the manufacturing procedures cover at least:~~ ~~(a) manufacturing processes;~~ ~~(b) personnel competence and qualifications; and~~ ~~(c) supplier control.~~ The manufacturer complies with the organisational requirements that are defined in Annex I (Part 21) to Regulation (EU) No 748/2012.
	Comments	*N/A*	*N/A*	*N/A*

TECHNICAL ISSUE WITH THE UAS		**Level of assurance**		
		Low	**Medium**	**High**
OSO #02 UAS manufactured by competent and/or proven entity	Criteria	The declared manufacturing 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. The competent authority may request EASA to validate the claimed integrity.	Same as low. In addition, evidence is available that the UAS has been manufactured in conformance to its design. The competent authority may request EASA to validate the claimed integrity.	~~Same as medium. In addition:~~ ~~(a) manufacturing procedures; and~~ ~~(b) the conformity of the UAS to its design and specification~~ ~~are recurrently verified through process or product audits by a competent third party (or competent third parties).~~ Same as medium. In addition:

				EASA validates compliance with the organisational requirements that are defined in Annex I (Part 21) to Regulation (EU) No 748/2012.

[…]

OSO #04 — UAS developed to authority recognised design standards

TECHNICAL ISSUE WITH THE UAS		**Level of integrity**		
		Low	**Medium**	**High**
OSO #04 UAS developed to authority recognised design standards	Criteria	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a low level of integrity and the intended operation.	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a medium level of integrity and the intended operation.	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a high level of integrity and the intended operation.
	Comments	*~~NAAs may define the standards and/or the means of compliance they consider adequate.~~* *In case of experimental flights that investigate new technical solutions, the competent authority may accept that recognised standards are not met.*		

TECHNICAL ISSUE WITH THE UAS		**Level of assurance**		
		Low	**Medium**	**High**
OSO #04 UAS developed to authority recognised design standards	Criteria	Consider the criteria defined in Section 9		
	Comments	*~~N/A~~The competent authority may request EASA to validate the claimed integrity.*	*~~N/A~~If the operation is classified as SAIL V, EASA validates the claimed integrity. In all other cases, the competent authority may request EASA to validate the claimed integrity.*	*N/A*

OSO #05 — UAS is designed considering system safety and reliability

[…]

TECHNICAL ISSUE WITH THE UAS		**Level of integrity**		
		Low	**Medium**	**High**
OSO #05 **UAS is designed considering system safety and reliability**	Criteria	The equipment, systems, and installations are designed to minimise hazards[1] in the event of a probable[2] malfunction or failure of the UAS.	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: (a) Major failure conditions are not more frequent than remote[3]; (b) Hazardous failure conditions are not more frequent than extremely remote[3]; (c) Catastrophic failure conditions are not more frequent than extremely improbable[3]; and (d) SW and 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 EASA~~the competent authority~~ and/or in accordance with means of compliance acceptable to EASA~~that authority~~[4].
	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 consequences.* *[2] 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'.*	*N/A*	*[3] Safety objectives may be derived from JARUS AMC RPAS.1309 Issue 2 Table 3 depending on the kinetic energy assessment made in accordance with Section 6 of EASA policy E.Y013-01.* *[4] Development assurance levels (DALs) for SW/AEH may be derived from JARUS AMC RPAS.1309 Issue 2 Table 3 depending on the kinetic energy assessment made in accordance with Section 6 of EASA policy E.Y013-01.*

TECHNICAL ISSUE WITH THE UAS		**Level of assurance**		
		Low	**Medium**	**High**
OSO #05 **UAS is designed considering system safety and reliability**	Criteria	A functional hazard assessment[1] and a design and installation appraisal that shows hazards are minimised, are available. The competent authority may request EASA to validate the claimed integrity.	Same as low. In addition: (a) 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. (b) A strategy for the detection of single failures of concern includes pre-flight checks. The competent authority may request EASA to validate the claimed integrity.	Same as medium. In addition, safety analyses and development assurance activities are validated by EASA~~, according to Article 40 of Regulation (EU) 2019/945~~.
	Comments	*[1] The 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*

OSO #06 — C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation

[…]

TECHNICAL ISSUE WITH THE UAS		**Level of assurance**		
		Low	**Medium**	**High**
OSO #06 **C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation**	Criteria	Consider the assurance criteria defined in Section 9 (low level of assurance). The competent authority may request EASA to validate the claimed integrity.	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. The competent authority may request EASA to validate the claimed integrity.	Same as medium. In addition, evidence is validated by EASA~~a competent third party~~.
	Comments	*N/A*	*N/A*	*N/A*

[…]

E.5 OSOs related to safe design

[…]

		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #10 & OSO #12	Criteria	A design and installation appraisal is available. In particular, this appraisal shows that: (a) the design and installation features (independence, separation and redundancy) satisfy the low integrity criterion; and (b) particular risks relevant to the ConOps (e.g. hail, ice, snow, electromagnetic interference, etc.) 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. The competent authority may request EASA to validate the claimed integrity.	Same as medium. In addition, ~~a competent third party~~EASA validates the level of integrity claimed
	Comments	*N/A*	*N/A*	*N/A*

[…]

E.7 OSOs related to Human Error

[…]

HUMAN ERROR		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #18 Automatic protection of the flight envelope from human errors	Criteria	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. The competent authority may request EASA to validate the claimed integrity.	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. The competent authority may request EASA to validate the claimed integrity.	Same as Medium. In addition, evidence is validated by EASA.
	Comments	*N/A*	*N/A*	*N/A*

OSO #19 — Safe recovery from human errors

[…]

HUMAN ERROR		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
OSO #19 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. — 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*	*N/A*	*N/A*
	Criterion #2 (Training)	Consider the criteria defined for the level of assurance of the generic remote crew training OSO (i.e. OSO #09, OSO #15 and OSO #22) corresponding to the SAIL of the operation		
	Comments	*N/A*	*N/A*	*N/A*
	Criterion #3 (UAS design)	~~Consider the criteria defined in Section 9~~The applicant declares that the required level of integrity has been achieved[1]. The competent authority may request EASA to validate the claimed integrity.	The applicant has supporting evidence that the required level of integrity is achieved. That evidence is provided through testing, analysis, simulation[2], inspection, design review or operational experience. If the operation is classified as SAIL V, EASA validates the claimed integrity. In all other cases, the competent authority may request EASA to validate the claimed integrity.	EASA validates the claimed level of integrity.
	Comments	*~~N/A~~[1] Supporting evidence may or may not be available.*	*~~N/A~~[2] When simulation is performed, the validity of the targeted environment that is used in the simulation needs to be justified.*	*N/A*

OSO #20 — A Human Factors evaluation has been performed and the HMI found appropriate for the mission

[…]

HUMAN ERROR		**LEVEL of ASSURANCE**		
		Low	**Medium**	**High**
OSO #20 A Human Factors evaluation has been performed and the HMI found appropriate for the mission	Criteria	The applicant conducts a human factors evaluation of the UAS to determine whether the HMI is appropriate for the mission. The HMI evaluation is based on inspection or analyses. The competent authority may request EASA to witness the HMI evaluation of the UAS.	Same as Low but the HMI evaluation is based on demonstrations or simulations.[1] If the operation is classified as SAIL V, EASA witnesses the HMI evaluation of the UAS. In all other cases, the competent authority may request EASA to witness the HMI evaluation of the UAS.	Same as Medium. In addition, EASA witnesses the HMI evaluation of the UAS and a competent third party witnesses the HMI evaluation of the possible electronic means used by the VO.
	Comments	*N/A*	*[1] When simulation is ~~used~~performed, the validity of the targeted environment that is used in the simulation needs to be justified.*	*N/A*

[…]

E.9 Assurance level criteria for technical OSO

		LEVEL of ASSURANCE		
		Low	**Medium**	**High**
TECHNICAL OSO	Criteria	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. The competent authority may request EASA to validate the claimed integrity.	EASA validates the claimed level of integrity.
	Comments	*[1] Supporting evidence may or may not be available.*	*[2] When simulation is performed~~used~~, the validity of the targeted environment that is used in the simulation needs to be justified.*	*N/A*

GM1 to AMC1 Article 11 Rules for conducting an operational risk assessment

GENERAL

The operational risk assessment required by Article 11 of the UAS Regulation may be conducted using the methodology described in AMC1 ~~to~~ Article 11. This methodology is basically the specific operations risk assessment (SORA) developed by JARUS. Other methodologies may be used by the UAS operator as alternative means of compliance.

Aspects other than safety, such as security, privacy, environmental protection, the use of the radio frequency (RF) spectrum, etc., should be assessed in accordance with the applicable requirements established by the Member State in which the operation is intended to take place, or by other EU regulations.

For some UAS operations that are classified as being in the 'specific' category, alternatives to carrying out a full risk assessment are offered to UAS operators:

(a) for UAS operations with lower intrinsic risks, a declaration may be submitted when the operations comply with the standard scenarios (STSs) listed in Appendix 1 to the UAS Regulation. Table 1 provides a summary of the STSs; and

(b) for other UAS operations, a request for authorisation may be submitted based on the mitigations and provisions described in the predefined risk assessment (PDRA) when the UAS operation meets the operational characterisation described in AMC2 et seq. ~~to~~ Article 11 to the UAS Regulation. Table 2 below provides a summary of the PDRAs that have been published so far.

While the STSs are described in a detailed way, the provisions and mitigations in the PDRAs are described in a rather generic way to provide flexibility to UAS operators and the competent authorities to establish more prescriptive limitations and provisions that are adapted to the particularities of the intended operations. Two types of PDRAs are provided:

— those derived from an STS, which allow the UAS operator to conduct similar operations, but using, for example, UAS without the class label that is mandated by the STS (e.g. privately built UAS); and

— more generic PDRAs.

The codification of a PDRA includes the letter 'G' or 'S' (e.g. PDRA-G01 or PDRA-S01):

— 'G' is used for generic PDRAs.

— 'S' is used for PDRAs that are derived from an STS whose level of prescriptiveness is the same as of the corresponding STS. Therefore, those PDRAs, although they address UAS operations that are subject to operational authorisations (to allow the use of UAS without a class label), are expected to provide an even more simplified authorisation process compared to other (non-STS-related) PDRAs. Ideally, for UAS operations that are performed based on those PDRAs, the competent authorities may implement expedited operational-authorisation processes. Those processes may be based on the review of the documentation that is submitted by the UAS operator to support the declaration of compliance with the PDRA provisions.

In accordance with Article 11 of the UAS Regulation, the applicant must collect and provide the relevant technical, operational and system information needed to assess the risk associated with the intended operation of the UAS, and the SORA (AMC1 ~~to~~ Article 11 of the UAS Regulation) provides a detailed framework for such data collection and presentation. The concept of operations (ConOps) description is the foundation for all other activities, and should be as accurate and detailed as possible. The ConOps should not only describe the operation, but also provide insight into the UAS operator's operational safety culture. It should also include how and when to interact with the air navigation service provider (ANSP) when applicable.

PDRAs only address safety risks; consequently, additional limitations and provisions might need to be included after the consideration of other risks (e.g. security, privacy, etc.).

STS#	Edition/date	UAS characteristics	BVLOS/ VLOS	Overflown area	Maximum range from remote pilot	Maximum height	Airspace	~~n~~Notes
STS-01	June 2020	Bearing a C5 class marking (maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg)	VLOS	Controlled ground area that might be located in a populated area	VLOS	120 m	Controlled or uncontrolled, with low risk of encounter with manned aircraft	
STS-02	June 2020	Bearing a C6 class marking (maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg)	BVLOS	Controlled ground area that is entirely located in a sparsely populated area	2 km with an AO 1 km, if no AO	120 m	Controlled or uncontrolled, with low risk of encounter with manned aircraft	

Table 1 — List of STSs published as 'Appendix 1 for standard scenarios supporting a declaration' to the Annex to the UAS Regulation

PDRA#	Edition/date	UAS characteristics	BVLOS/ VLOS	Overflown area	Maximum range from remote pilot	Maximum height	Airspace	AMC# to Article 11	~~n~~Notes
PDRA-S01	1.0/July 2020	Maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg	VLOS	Controlled ground area that might be located in a populated area	VLOS	120 m	Controlled or uncontrolled, with low risk of encounter with manned aircraft	AMC4	
PDRA-S02	1.0/July 2020	Maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg	BVLOS	Controlled ground area that is entirely located in a sparsely populated area	2 km with an AO 1 km, if no AO	120 m	Controlled or uncontrolled, with low risk of encounter with manned aircraft	AMC5	
PDRA-G01	~~1.0/xx.xx.2019~~ 1.1/July 2020	~~m~~Maximum characteristic dimension of up to 3 m and ~~a~~ typical kinetic energy of up to 34 kJ	BVLOS	~~s~~Sparsely populated area~~s~~	If no ~~V~~AO, up to 1 km	150 m (operational volume)	~~Controlled~~ Uncontrolled, with low risk of encounter with manned aircraft	AMC2	
PDRA-G02	1.0/July 2020	Maximum characteristic dimension of up to 3 m and typical kinetic energy of up to 34 kJ	BVLOS	Sparsely populated area	N/a	As established for the reserved airspace	As reserved for the operation	AMC3	

Table 2 — List of PDRAs published as AMC2-5 ~~to~~ Article 11 to the UAS Regulation

AMC2 Article 11 Rules for conducting an operational risk assessment

PREDEFINED RISK ASSESSMENT ~~PRRA-G1~~**PDRA-G01** Version 1.1

EDITION ~~September 2019~~December 2020

(a) Scope

This PDRA is the result of applying the methodology that is described in AMC1 ~~to~~ Article 11 of the UAS Regulation to UAS operations that are conducted~~performed~~ in the 'specific' category ~~with the following main attributes~~:

(1) with UA with maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of up to 3 m and typical kinetic energy~~ies~~ of up to 34 kJ;

(2) ~~operated~~ BVLOS of the remote pilot with visual air risk mitigation;

(3) over sparsely populated areas;

(4) less than 150 m (500 ft) above the ~~overflown~~ surface overflown (or any other altitude reference defined by the Member ~~s~~State); and

(5) in uncontrolled airspace.

(b) PDRA characterisation and provisions

The ~~C~~characterisation and provisions for this PDRA are summarised in ~~Table PDRA-01.1~~**Table PDRA-G01.1** below:~~.~~

PDRA characterisation and provisions	
1. Operational characterisation (scope and limitations)	
Level of human intervention	1.1 No autonomous operations: the remote pilot should have the ability to maintain control of the UA, except in case of ~~a~~ loss of the command and control (C2) link. 1.2 The remote pilot should ~~only~~ operate only one UA at a time. 1.3 The remote pilot should not operate from a moving vehicle. 1.4 The remote pilot should not hand over the control of the UA to another command unit.~~Handover between RPSs should not be performed.~~
UA range limit	1.5 Launch/recovery: at VLOS distance from the remote pilot, if not operating from a safe prepared area. *Note: 'safe prepared area' means a controlled ground area that is suitable for the safe launch/recovery of the UA.* 1.6 In flight: 1.6.1 If no ~~VOs~~AOs are employed~~used~~: the UA is not operated further~~at more~~ than 1 km (or other distance defined by the competent authority) from the remote pilot. *Note: The remote pilot's workload should ~~be adequate to~~ allow ~~him or her~~the*

	remote pilot to continuously scan the airspace. 1.6.2 If ~~VOs~~AOs are employed~~used~~: the range is not limited as long as the UA is not operated further~~at more~~ than 1 km (unless a different distance is defined by the competent authority) from the ~~VOs~~AO who is nearest to the UA.
Areas ~~O~~overflown ~~areas~~	1.7 UAS operations should be conducted over ~~S~~sparsely populated areas.
UA limitations	1.8 Maximum characteristic dimension (e.g. wingspan, rotor diameter/area or maximum distance between rotors in ~~the~~ case of a multirotor): 3 m 1.9 Typical kinetic energy (as defined in paragraph 2.3.1(k) of AMC1 ~~to~~ Article 11 of the UAS Regulation: up to 34 kJ
Flight height limit	1.10 The maximum height of the operational volume should not be greater than 150 m (500 ft) above the overflown surface (or any other altitude reference defined by the Member ~~s~~State). *Note: In addition to the vertical limit ~~for~~of the operational volume, an air risk buffer is to be considered (see '~~a~~Air risk' under point 3 of this table).*
Airspace	1.11 The UA should be ~~O~~operated: 1.11.1 in uncontrolled airspace (Class F or G) (corresponding to an air risk that can be classified as ARC-b); or 1.11.2 in a segregated area (corresponding to an air risk that can be classified as ARC-a); or 1.11.3 as otherwise established by the Member States in accordance with Article 15 (with an associated air risk that can be classified as not higher than ARC-b).
Visibility	1.12 The UA should be operated in an area where ~~the minimum~~ flight visibility is more than 5 km. *Note: This flight visibility should be understood as the distance from which~~that~~ a~~n~~ UA~~aircraft~~ can be visually detected by the remote crew.*
Others	1.13 The UA should not be used to ~~drop material or~~ carry dangerous goods, except for dropping items in connection with agricultural, horticultural or forestry activities in which the carriage of the items does not contravene any other applicable regulations.

2. Operational risk classification (according to the classification defined in AMC1 ~~to~~ Article 11 of the UAS Regulation)

Final GRC	**3**	Final ARC	**ARC-b**	SAIL	**II**

3. **Operational mitigations**	
Operational volume (see Figure 2 of AMC1 Article 11~~PDRA-01.1~~)	3.1 To determine the operational volume, the UAS operator should consider the position-keeping capabilities of the UAS in 4D space (latitude, longitude, height, and time). 3.2 In particular, the accuracy of the navigation solution, the flight technical error of the UAS, as well as~~and~~ the flight path definition error (e.g. map error) and latencies should be considered and addressed ~~in this determination~~when determining the operational volume. 3.3 ~~If the UA leaves the operational volume, emergency procedures should be activated immediately.~~The remote pilot should apply emergency procedures as soon as there is an indication that the UA may exceed the limits of the operational volume.
Ground risk	3.4 The UAS operator should establish a ground risk buffer~~A ground risk buffer should be established~~ to protect third parties on the ground outside the operational volume. 3.4.1 The minimum criterion should be the use of the ‘1:1 rule’ (e.g. if the UA is planned to operate at a height of 150 m, the ground risk buffer should at least be 150 m). 3.5 The operational volume and the ground risk buffer should be all contained in a sparsely populated ~~environment~~area. 3.6 The UAS operator should evaluate the area of operations typically by means of an on-site inspection or appraisal, and should be able to justify a lower density of people at risk.
Air risk	3.7 The UAS operator should establish an air risk buffer to protect third parties in the air outside the operational volume.~~An air risk buffer should be defined.~~ 3.8 This air risk buffer should be contained in the ‘airspace class F or G’ ~~airspace class~~ (uncontrolled airspace) over sparsely populated areas and in UAS geographical zones defined by the MSs where the probability of encounter with manned aircraft and other airspace users is not low. 3.9 The operational volume should be outside any geographical zone corresponding to a flight restriction zone~~ of a protected aerodrome or of any other type~~, as defined by the responsible authority, unless the UAS operator has been granted~~is in receipt of the~~an appropriate permission. 3.10 Prior to the flight, the remote pilot should assess the proximity of the planned operation to manned aircraft activity~~ should be assessed~~.

~~VOs~~Observers	3.11 If the UAS operator decides to employ one or more airspace observers (AOs), the remote pilot may operate the UA up to the distance that is specified in point 1.6.2. 3.~~11~~12 The ~~remote pilot~~UAS operator should ~~determine~~ensure the correct placement and number of ~~VOs~~AOs along the intended flight path. Prior to each flight, the UAS operator should ~~check~~verify that: 3.~~11~~12.1 ~~the compliance between the visibility and planned range for VOs~~visibility and the planned distance of the AO are within acceptable limits that are defined in the operations manual (OM); 3.~~11~~12.2 there are no~~presence of~~ potential terrain obstructions for each ~~VOs~~AO; ~~and~~ 3.~~11~~12.3 there are no gaps between the zones that are covered by each of the ~~VOs~~AOs~~.~~; 3.12.4 communication with each AO is established and effective; and 3.12.5 if means are used by the AOs to determine the position of the UA, those means are functioning and effective. ~~3.12 The VO(s) necessary to safely conduct the operation should be in place during flight operations.~~ Note: *Instead of an AO, ~~T~~the remote pilot may perform the visual scan of the airspace, ~~instead of a VO~~ provided that the workload allows the remote pilot~~is adequate~~ to perform ~~his or her~~their duties~~ as the remote pilot~~.*
4. UAS ~~O~~operator and UAS operations provisions	
~~Operator~~	~~4.1 The UAS operator should:~~ ~~4.1.1 have knowledge of the UAS being used; and~~ ~~4.1.2 develop relevant procedures including at least the following as a minimum: operational procedures (e.g. checklists), maintenance, training, responsibilities, and duties.~~ ~~4.2 The aforementioned aspects should be addressed in the ConOps (see Annex A to AMC1 to Article 11 of the UAS Regulation).~~

UAS operator and UAS operations	4.1 In addition to the responsibilities that are defined in point UAS.SPEC.050 of the Annex to the UAS Regulation and the provisions for UAS operators in previous points of this AMC, the UAS operator should: 4.~~3~~1.1~~The UAS operator should~~ develop an operations manual (OM) (for the template, refer to AMC1 UAS.SPEC.030(3)(e) and to the complementary information in GM1 UAS.SPEC.030(3)(e));~~.~~ 4.~~6~~1.2~~The UAS operator should~~ develop an emergency response plan (ERP) (see point 7 of GM~~2~~1 UAS.SPEC.030(3)(e)); 4.~~4~~1.3validate ~~T~~the operational procedures ~~should be validated~~ against standards that are recognised by the competent authority and/or in accordance with a means of compliance acceptable to that authority; 4.~~5~~1.4ensure ~~T~~the adequacy of the contingency and emergency procedures ~~should~~and ~~be~~ prove~~d~~ them through any of the following: ~~4. 5.1~~(a) dedicated flight tests; or ~~4. 5.2~~(b) simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or ~~4. 5.3~~(c) any other means acceptable to the competent authority. 4.~~10~~1.5 ~~The applicant should~~ have a policy that defines how the remote ~~crew~~pilot and all other personnel in charge of duties essential to the UAS operation can declare themselves fit to operate before conducting any operation. ~~4.7 The remote crew should be competent and be authorised by the UAS operator to carry out the intended operations.~~ ~~4.8 A list of the remote crew members authorised to carry out UAS operations is established and kept up to date.~~ ~~4.9 A record of all the relevant qualifications, experience and/or training completed by the remote crew is established and kept up to date.~~

UAS maintenance	4.~~11~~2 The UAS maintenance instructions ~~should be~~that are defined by the UAS operator~~,~~ ~~documented~~should be included in the OM and should cover at least the UAS manufacturer's instructions and requirements, when applicable. ~~4.12 The maintenance staff should be competent and should have received an authorisation from the UAS operator to carry out maintenance.~~ 4.~~13~~3 The maintenance staff should ~~use~~follow the UAS maintenance instructions ~~while~~when performing maintenance. ~~4.14 The maintenance instructions should be documented.~~ ~~4.15 The maintenance conducted on the UAS should be recorded in a maintenance log system.~~ ~~4.16 A list of the maintenance staff authorised to carry out maintenance should be established and kept up to date.~~ ~~4.17 A record of all the relevant qualifications, experience and/or training completed by the maintenance staff should be established and kept up to date.~~ ~~4.18 The maintenance log may be requested for inspection/audit by the approving authority or an authorised representative.~~
External services	4.~~19~~4 The ~~applicant~~UAS operator should ensure that the level of performance for any externally provided service that is necessary for the safety of the flight is adequate for the intended operation. The ~~applicant~~UAS operator should declare that this ~~adequate~~ level of performance is adequately achieved. 4.~~20~~5 The UAS operator should define and allocate the roles and responsibilities between the ~~applicant~~UAS operator and the external service provider(s), if applicable. ~~should be defined.~~
5. Provisions for the personnel in charge of duties essential to the UAS operation	
	As per Appendix A to AMC2 Article 11 *The personnel in charge of duties essential to the UAS operation*
6. Technical provisions	
General	6.1 The UAS should be equipped with ~~M~~means to monitor the critical parameters ~~for~~of a safe flight ~~should be available~~, in particular the: 6.1.1 UA position, height or altitude, ground speed or airspeed, attitude and trajectory; 6.1.2 UAS energy status (fuel, battery charge, etc.); and ~~the~~ 6.1.3 status of critical functions and systems; as a minimum, for services based on RF signals (e.g. C2 Link, GNSS, etc.), means should be provided to monitor the adequate performance and trigger an alert if the level becomes too low. 6.2 The UA should have the performance capability to descend safely from its operating altitude to a 'safe altitude' in less than ~~a~~1 minute, or have a descent rate of at least 2.5 m/s (500 fpm).

Human-machine interface (HMI)	6.3 The UAS information and control interfaces should be clearly and succinctly presented and should not confuse, cause unreasonable fatigue, or contribute to causing any disturbance to the personnel in charge of duties essential to the UAS operation in such a way that ~~this ~~could adversely affect the safety of the operation. 6.4 If an electronic means is used to support ~~V~~AOs in their role of maintaining awareness of the position of the unmanned aircraft, its HMI should: 6.4.1 be sufficiently easy to understand to allow the ~~V~~AOs to determine the position of the UA during the operation; and 6.4.2 not degrade the ~~V~~AOs’ ability to: 6.4.2.1 perform unaided visual scanning of the airspace where the UA is operating for any potential collision hazard; and 6.4.2.2 maintain effective communication with the remote pilot at all times. 6.5 The ~~applicant~~UAS operator should conduct a~~n~~ UAS evaluation ~~of the UAS ~~that considers~~ing~~ and addresses~~ing~~ human factors to determine whether the HMI is appropriate for the operation~~mission~~.
C2 links and communication	6.6 The UAS should comply with the ~~appropriate~~applicable requirements for radio equipment and ~~the ~~use of the RF spectrum. 6.7 Protection mechanisms against interference should be used, especially if unlicensed bands (e.g. ISM) are used for the C2 ~~L~~link (mechanisms such as FHSS, technology or frequency de~~-~~confliction by procedure). 6.8 Communication between the remote pilot and the ~~V~~AO(s) should allow the remote pilot to manoeuvre the UA with sufficient time to avoid any risk of collision with manned aircraft, in accordance with point UAS.SPEC.060(3)(b) of the UAS Regulation.
Tactical mitigation	6.9 The UAS design should be adequate to ensure that the time required between a command given by the remote pilot and the UA executing it does not exceed 5 seconds. 6.10 Where an electronic means is used to assist the remote pilot and/or ~~V~~AOs in being aware of the UA position in relation to potential ‘airspace intruders’, the information is provided with a latency and an update rate for intruder data (e.g. position, speed, altitude, track) that support the decision criteria.
Containment	6.11 To ensure a safe recovery from a technical issue that involves~~ing~~ the UAS or an external system supporting the operation, the UAS operator should ensure that: 6.11.1 ~~that ~~no probable failure of the UAS or of any external system supporting the operation should lead to operation outside the operational volume; and~~.~~ 6.11.2 ~~that ~~it is reasonably expected that a fatality will not occur ~~from~~due to any probable failure of the UAS~~,~~ or of any external system supporting the operation. 6.12 The vertical extension of the operational volume should be 150 m above the surface (or any other altitude reference defined by the Member ~~s~~State). *Note: The term ‘probable’ should~~needs to~~ be understood in its qualitative*

interpretation, i.e. 'anticipated to occur one or more times during the entire system/operational life of an item'.~~'~~

6.13 A design and installation appraisal should be made available and should ~~minimally include~~cover at least:

6.13.1 the design and installation features (independence, separation, and redundancy); and

6.13.2 the particular risks (e.g. hail, ice, snow, ~~electro-magnetic~~electromagnetic interference, etc.) relevant to the ConOps.

6.14 The following additional provisions should apply if the adjacent area includes an assembly of people or if the adjacent airspace is classified as ARC-d (in accordance with AMC1 ~~to~~ Article 11 of the UAS Regulation)~~:~~.

6.14.1 The UAS should be designed to standards that are considered adequate by the competent authority and/or in accordance with a means of compliance that is acceptable to that authority such that:

6.14.1.1 ~~T~~the probability of the UA leaving the operational volume should be less than ~~10-4~~10^{-4}/FH; and~~.~~

6.14.1.2 ~~N~~no single failure of the UAS or of any external system supporting the operation should lead to operation outside the ground risk buffer.

Note: The term 'failure' should~~needs to~~ be understood as an occurrence~~,~~ that~~which~~ affects the operation of a component, part, or element in such a way that it can no longer function as intended. Errors may cause failures but are not considered to be failures. Some structural or mechanical failures may be excluded from this~~e~~ criterion if it can be shown that these mechanical parts were designed according to aviation industry best practices.

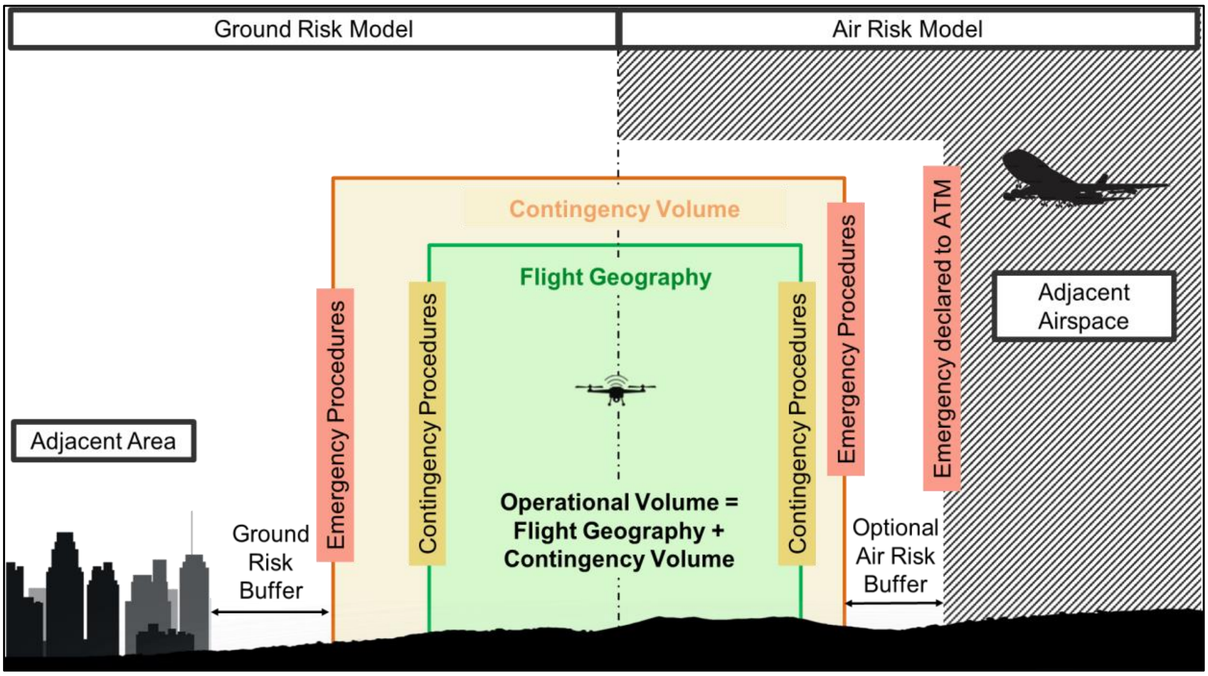
6.14.2~~6.3~~ SW and AEH whose development error(s) could directly lead to operations outside the ground risk buffer should be developed according to an industry standard or methodology that are recognised as adequate by the competent authority.

Note 1: The proposed additional safety provisions cover both the integrity and assurance levels.

Note 2: The proposed additional safety provisions do not imply a systematic need to develop the SW and AEH according to an industry standard or methodology that are recognised as adequate by the competent authority. For instance, if the UA design includes an independent engine shutdown function ~~which~~that systematically prevents the UA from exiting the ground risk buffer due to single failures or a SW/AEH error of the flight controls, the intent of the provisions of point 6.14.1~~6.16.2 and 6.16.3~~ above could be considered to be met.

6.15 Compliance with the provisions of points 6.14.1~~16.1~~ and 6.14.2 above should be substantiated by analysis and/or test data with supporting evidence.

Table PDRA-G01.2~~1~~ — Main limitations and provisions for PDRA-G01



~~Figure PDRA-01.1 — Graphical representation of the SORA semantic model~~

Appendix A to AMC2 Article 11~~:~~ The personnel in charge of duties essential to the UAS operation

[…]

A.2. ~~VOs~~AOs

A.2.1 The ~~VOs~~AOs’ main responsibilities should be to:

A.2.1.1 ~~perform unaided~~maintain a thorough visual scan~~ning~~ of the airspace that is surrounding the UA, to identify any risk of collision with manned aircraft~~where the UA is operating for any potential hazard in the air~~;

[…]

AMC3 Article 11 Rules for conducting an operational risk assessment

PREDEFINED RISK ASSESSMENT **PDRA-G02** Version 1.0

EDITION December 2020

(a) Scope

This PDRA is the result of applying the methodology that is described in AMC1 Article 11 of the UAS Regulation to UAS operations that are conducted in the ‘specific’ category:

(1) with UA with maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of up to 3 m and typical kinetic energy of up to 34 kJ;

(2) BVLOS of the remote pilot;

(3) over sparsely populated areas;

(4) in airspace that is reserved for the operation: either a danger area or a restricted area appropriate for UAS operations.

(b) PDRA characterisation and provisions

The characterisation and provisions for this PDRA are summarised in Error! Reference source not found. **PDRA-G02.1** below:

PDRA characterisation and provisions	
1. Operational characterisation (scope and limitations)	
Level of human intervention	1.1 No autonomous operations: the remote pilot should have the ability to maintain control of the UA, except in case of loss of the command and control (C2) link. 1.2 The remote pilot should operate only one UA at a time.
UA range limit	1.3 Launch/recovery: at VLOS distance from the remote pilot, if not operating from a safe prepared area. *Note: 'safe prepared area' means a controlled ground area that is suitable for the safe launch/recovery of the UA.* 1.4 In flight: The range limit should be within the C2 link coverage that ensures the safe conduct of the flight.
Areas overflown	1.5 UAS operations should be conducted over sparsely populated areas.
UA limitations	1.6 Maximum characteristic dimension (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of a multirotor): 3 m 1.7 Typical kinetic energy (as defined in paragraph 2.3.1(k) of AMC1 Article 11 of the UAS Regulation): up to 34 kJ
Flight height limit	1.8 The maximum height of the operation volume is limited by the size of the reserved airspace. *Note: In addition to the vertical limit of the operational volume, an air risk buffer is to be considered (see 'Air risk' under point 3 of this table).*
Airspace	1.9 Operations should only be conducted in airspace that is reserved for the operation (corresponding to an air risk that can be classified as ARC-a). *Note: 'Reserved airspace' means here either a danger area or a restricted area that is designated for UAS operations.*
Visibility	1.10 If take-off and landing are conducted in VLOS of the remote pilot, visibility should be sufficient to ensure that no people are in danger during the take-off/landing phase. The remote pilot should abort the take-off or landing in case people on the ground are in danger.
Others	1.11 The UA should not be used to drop material or carry dangerous goods, except for dropping items in connection with agricultural, horticultural or forestry activities in

<table>
<tr><td></td><td colspan="5">which the carriage of the items does not contravene any other applicable regulations.</td></tr>
<tr><td colspan="6">2. Operational risk classification (according to the classification defined in AMC1 Article 11 of the UAS Regulation)</td></tr>
<tr><td>Final GRC</td><td>3</td><td>Final ARC</td><td>ARC-a</td><td>SAIL</td><td>II</td></tr>
<tr><td colspan="6">3. Operational mitigations</td></tr>
<tr><td>Operational volume (see Figure 2 of AMC1 Article 11)</td><td colspan="5">3.1 To determine the operational volume, the UAS operator should consider the position-keeping capabilities of the UAS in 4D space (latitude, longitude, height, and time).
3.2 In particular, the accuracy of the navigation solution, the flight technical error of the UAS, as well as the flight path definition error (e.g. map error) and latencies should be considered and addressed when determining the operational volume.
3.3 The remote pilot should apply the emergency procedures as soon as there is an indication that the UA may exceed the limits of the operational volume.</td></tr>
<tr><td>Ground risk</td><td colspan="5">3.4 The UAS operator should establish a ground risk buffer to protect third parties on the ground outside the operational volume.
3.4.1 The minimum criterion should be the use of the ‘1:1 rule’ (e.g. if the UA is planned to operate at a height of 150 m, the ground risk buffer should at least be 150 m).
3.5 The operational volume and the ground risk buffer should be all contained in a sparsely populated area.
3.6 The UAS operator should evaluate the area of operations typically by means of an on-site inspection or appraisal, and should be able to justify a lower density of people at risk.</td></tr>
<tr><td>Air risk</td><td colspan="5">3.7 The operational volume should be entirely contained in the reserved airspace.
3.8 The operational volume should be outside any geographical zone corresponding to a flight restriction zone, as defined by the responsible authority, unless the UAS operator has been granted an appropriate permission.</td></tr>
<tr><td>Observers</td><td colspan="5">N/A</td></tr>
</table>

4. UAS operator and UAS operations provisions	
UAS operator and UAS operations	4.1 In addition to the responsibilities that are defined in point UAS.SPEC.050 of the Annex to the UAS Regulation and the provisions for UAS operators in previous points of this AMC, the UAS operator should: 4.1.1 develop an operations manual (OM) (for the template, refer to AMC1 UAS.SPEC.030(3)(e) and to the complementary information in GM1 UAS.SPEC.030(3)(e)); 4.1.2 develop an emergency response plan (ERP) (see point 7 of GM2 UAS.SPEC.030(3)(e)); 4.1.3 validate the operational procedures against standards that are recognised by the competent authority and/or in accordance with a means of compliance acceptable to that authority; 4.1.4 ensure the adequacy of the contingency and emergency procedures and prove it through any of the following: (a) dedicated flight tests; or (b) simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or (c) any other means acceptable to the competent authority; 4.1.5 have a policy that defines how the remote pilot and all other personnel in charge of duties essential to the UAS operation can declare themselves fit to operate before conducting any operation. 4.1.6 as part of the procedures that are contained in the OM (point 4.1.1 above), include the description of the following: (a) The method and means of communication with the authority or entity responsible for the management of the airspace during the entire period of the reserved or restricted airspace being active, as mandated by the authorisation. *Note: The communication method should be published in the notice to airmen (NOTAM), which activates the reserved airspace to also allow coordination with manned aircraft.* (b) The member(s) of personnel in charge of duties essential to the UAS operation, who are responsible for establishing that communication.
UAS maintenance	4.2 The UAS maintenance instructions that are defined by the UAS operator should be included in the OM and should cover at least the UAS manufacturer's instructions and requirements, when applicable. 4.3 The maintenance staff should follow the UAS maintenance instructions when performing maintenance.

External services	4.4 The UAS operator should ensure that the level of performance for any externally provided service that is necessary for the safety of the flight is adequate for the intended operation. The UAS operator should declare that this level of performance is adequately achieved. 4.5 The UAS operator should define and allocate the roles and responsibilities between the UAS operator and the external service provider(s), if applicable.
5. Provisions for the personnel in charge of duties essential to the UAS operation	
	As per Appendix A to AMC2 Article 11 *The personnel in charge of duties essential to the UAS operation*
6. Technical provisions	
General	6.1 The UAS should be equipped with means to monitor the critical parameters of a safe flight, in particular the: 6.1.1 UA position, height or altitude, ground speed or airspeed, attitude, and trajectory; 6.1.2 UAS energy status (fuel, battery charge, etc.); and 6.1.3 status of critical functions and systems; as a minimum, for services based on RF signals (e.g. C2 link, GNSS, etc.), means should be provided to monitor the adequate performance and trigger an alert if the performance level becomes too low.
Human–machine interface (HMI)	6.3 The UAS information and control interfaces should be clearly and succinctly presented and should not confuse, cause unreasonable fatigue, or contribute to causing any disturbance to the personnel in charge of duties essential to the UAS operation in such a way that could adversely affect the safety of the operation. 6.4 The UAS operator should conduct a UAS evaluation that considers and addresses human factors to determine whether the HMI is appropriate for the operation.
C2 links and communication	6.5 The UAS should comply with the applicable requirements for radio equipment and use of the RF spectrum. 6.6 Protection mechanisms against interference should be used, especially if unlicensed bands (e.g. ISM) are used for the C2 link (mechanisms such as FHSS, technology or frequency deconfliction by procedure). 6.7 The UAS operator should ensure that reliable and continuous means of two-way communication for the purpose that is indicated in point 4.1.6(a) above are available.
Tactical mitigation	N/A
Containment	6.8 To ensure a safe recovery from a technical issue that involves the UAS or an external system supporting the operation, the UAS operator should ensure that: 6.8.1 no probable failure of the UAS or of any external system supporting the operation should lead to operation outside the operational volume; and

	6.8.2 that it is reasonably expected that a fatality will not occur due to any probable failure of the UAS or of any external system supporting the operation. *Note: The term ‘probable’ should be understood in its qualitative interpretation, i.e. ‘anticipated to occur one or more times during the entire system/operational life of an item’.* 6.9 A design and installation appraisal should be made available and should cover at least: 6.9.1 the design and installation features (independence, separation, and redundancy); and 6.9.2 the particular risks (e.g. hail, ice, snow, electromagnetic interference, etc.) relevant to the ConOps. 6.10 The following additional provisions should apply if the adjacent area includes an assembly of people or if the adjacent airspace is classified as ARC-d (in accordance with AMC1 Article 11 of the UAS Regulation). 6.10.1 The UAS should be designed to standards that are considered adequate by the competent authority and/or in accordance with a means of compliance that is acceptable to that authority such that: 6.10.1.1 the probability of the UA leaving the operational volume should be less than 10^{-4}/FH; and 6.10.1.2 no single failure of the UAS or of any external system supporting the operation should lead to operation outside the ground risk buffer. *Note: The term ‘failure’ should be understood as an occurrence that affects the operation of a component, part, or element in such a way that it can no longer function as intended. Errors may cause failures but are not considered to be failures. Some structural or mechanical failures may be excluded from the criterion if it can be shown that these mechanical parts were designed according to aviation industry best practices.* 6.10.2 SW and AEH whose development error(s) could directly lead to operations outside the ground risk buffer should be developed according to an industry standard or methodology that are recognised as adequate by the competent authority. *Note 1: The proposed additional safety provisions cover both the integrity and assurance levels.* *Note 2: The proposed additional safety provisions do not imply a systematic need to develop the SW and AEH according to an industry standard or methodology that are recognised as adequate by the competent authority. For instance, if the UA design includes an independent engine shutdown function that systematically prevents the UA from exiting the ground risk buffer due to single failures or an SW/AEH error of the flight controls, the intent of the provisions of point 6.10.1 above could be considered to be met.* 6.11 Compliance with the provisions of points 6.10.1 and 6.10.2 above should be substantiated by analysis and/or test data with supporting evidence.

Table PDRA-G02.1 — Main limitations and provisions for PDRA-G02

AMC4 Article 11 Rules for conducting an operational risk assessment

PREDEFINED RISK ASSESSMENT **PDRA-S01** Version 1.0

EDITION December 2020

(a) Scope

This PDRA addresses the same type of operations that are covered by the standard scenario STS-01 (Appendix 1 to the Annex to the UAS Regulation); however, it provides the UAS operator with the flexibility to use UAS that do not need to be marked as Class C5.

This PDRA addresses UAS operations that are conducted:

(1) with UA with maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of up to 3 m and MTOM of up to 25 kg;

(2) in VLOS of the remote pilot;

(3) over a controlled ground area that might be located in a populated area;

(4) not higher than 120 m above the surface overflown (except when close to obstacles); and

(5) in controlled or uncontrolled airspace, provided that there is a low probability of encountering manned aircraft.

(b) PDRA characterisation and provisions

The characterisation and provisions for this PDRA are summarised in **Table PDRA-S01.1** below:

PDRA characterisation and provisions	
1. Operational characterisation (scope and limitations)	
Level of human intervention	1.1 No autonomous operations: the remote pilot should have the ability to maintain control of the UA, except in case of loss of the command and control (C2) link. 1.2 The remote pilot should operate only one UA at a time. 1.3 The remote pilot should not operate from a moving vehicle. 1.4 The remote pilot should not hand over the control of the UA to another command unit.
UA range limit	1.5 VLOS distance from the remote pilot at all times.
Areas overflown	1.6 UAS operations should be conducted over a controlled ground area. 1.7 For the operation of a tethered UA, the area should have a radius equal to the tether length plus 5 m and should be centred on the point of the surface of the Earth where the tether is fixed.
UA limitations	1.8 The UA should have an MTOM of less than 25 kg, including payload.

	1.9 The UA should have a maximum characteristic dimension (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of less than 3 m.				
Flight height limit	1.10 The remote pilot should maintain the UA within 120 m from the closest point of the surface of the Earth. The measurement of the distances should be adapted according to the geographical characteristics of the terrain, such as plains, hills, and mountains. 1.11 When flying a UA within a horizontal distance of 50 m from an artificial obstacle that is taller than 105 m, the maximum height of the UAS operation may be increased up to 15 m above the height of the obstacle, at the request of the entity responsible for the obstacle. 1.12 The maximum height of the operational volume should not exceed by 30 m the maximum height that is allowed by points 1.10 and 1.11 above.				
Airspace	1.13 The UA should be operated: 1.13.1 in uncontrolled airspace (Class F or G), unless different limitations are provided for by the Member States for their UAS geographical zones in areas where the probability of encountering manned aircraft is not low; or 1.13.2 in controlled airspace after coordination and flight authorisation in accordance with the published procedures for the area of operation, to ensure a low probability of encountering manned aircraft. *Note: An airspace with an air risk that is classified as not higher than ARC-b can be considered having a low probability of encountering manned aircraft.*				
Visibility	1.14 The flight visibility should allow the remote pilot to conduct the entire flight in VLOS.				
Others	1.15 The UA should not be used to carry dangerous goods, except for dropping items in connection with agricultural, horticultural or forestry activities in which the carriage of the items does not contravene any other applicable regulations.				
2. Operational risk classification (according to the classification defined in AMC1 Article 11 of the UAS Regulation)					
Final GRC	**3**	Final ARC	**ARC-b**	SAIL	**II**

<table>
<tr><th colspan="2">3. Operational mitigations</th></tr>
<tr><td>Operational volume (see Figure 2 of AMC1 Article 11)</td><td>3.1 The UAS operator should define the operational volume for the intended operation, including:
3.1.1 the flight geography; and
3.1.2 the contingency volume, with its external limit(s) at least 10 m beyond the limit(s) of the flight geography if the operation is conducted with untethered UA.
3.2 To determine the operational volume, the UAS operator should consider the position-keeping capabilities of the UAS in 4D space (latitude, longitude, height, and time).
3.3 In particular, the accuracy of the navigation solution, the flight technical error of the UAS, as well as the flight path definition error (e.g. map error) and latencies should be considered and addressed when determining the operational volume.
3.4 The remote pilot should apply emergency procedures as soon as there is an indication that the UA may exceed the limits of the operational volume, as per point 5.1.4(d) below.</td></tr>
<tr><td>Ground risk</td><td>3.5 The UAS operator should establish a ground risk buffer to protect third parties on the ground outside the operational volume.
3.6 For the operation of untethered UA, the ground risk buffer should cover a distance beyond the external limit(s) of the contingency area. That distance should be at least as defined below:
<table>
<tr><th rowspan="2">Maximum height above ground</th><th colspan="2">Minimum distance to be covered by the ground risk buffer for untethered UA</th></tr>
<tr><th>with an MTOM of up to 10 kg</th><th>with an MTOM of more than 10 kg</th></tr>
<tr><td>30 m</td><td>10 m</td><td>20 m</td></tr>
<tr><td>60 m</td><td>15 m</td><td>30 m</td></tr>
<tr><td>90 m</td><td>20 m</td><td>45 m</td></tr>
<tr><td>120 m</td><td>25 m</td><td>60 m</td></tr>
</table>
3.7 For the operation of tethered UA, the ground risk buffer is considered in point 1.7 above.</td></tr>
<tr><td>Air risk</td><td>3.8 The operational volume should be outside any geographical zone corresponding to a flight restriction zone of a protected aerodrome or of any other type, as defined by the responsible authority, unless the UAS operator has been granted an appropriate permission.
3.9 Prior to the flight, the UAS operator should assess the proximity of the planned operation to manned aircraft activity.</td></tr>
<tr><td>Observers</td><td>Airspace observers (AOs): N/A.
UA observers: refer to point 5.1.4(b) below.</td></tr>
</table>

4. UAS operator and UAS operations provisions

UAS operator and UAS operations	4.1 In addition to the responsibilities that are defined in point UAS.SPEC.050 of the Annex to the UAS Regulation, and the provisions for UAS operators in previous points of this AMC, the UAS operator should: 4.1.1 develop an operations manual (OM) (for the template, refer to AMC1 UAS.SPEC.030(3)(e) and to the complementary information in GM1 UAS.SPEC.030(3)(e)); 4.1.2 define the operational volume and ground risk buffer for the intended operation, as per points 3.1 to 3.6 above, and include them in the OM; 4.1.3 ensure the adequacy of the contingency and emergency procedures and prove it through any of the following: (a) dedicated flight tests; or (b) simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or (c) any other means acceptable to the competent authority; 4.1.4 develop an effective emergency response plan (ERP) that is suitable for the intended operation (see GM1 UAS.SPEC.030(3)(e)); 4.1.5 upload updated information into the geo-awareness function, if such system is installed on the UAS, when required by the UAS geographical zone for the intended location of the operation; 4.1.6 ensure that before starting the operation, the controlled ground area is in place, effective, and compliant with the minimum distance that is defined in points 3.1 and 3.5 above and, when required, coordination with the appropriate authorities has been established; 4.1.7 ensure that before starting the operation, all persons that are present in the controlled ground area: (a) have been informed of the risks of the operation; (b) have been briefed on or trained in, as appropriate, the safety precautions and measures that the UAS operator has established for their protection; and (c) have explicitly agreed to participate in the operation; and 4.1.8 ensure that the UAS that is used in the intended operation complies with the technical provisions of point 6 below. 4.2 A UAS operation under this PDRA should be conducted: 4.2.1 keeping the UA in VLOS of the remote pilot at all times; 4.2.2 in accordance with the OM that is referred to in point 4.1.1 above; 4.2.3 over a controlled ground area that comprises the area of the operational volume that is indicated in point 3.1 above and the ground risk buffer that is indicated in point 3.5 above, both projected on the surface of the Earth; 4.2.4 at a ground speed of less than 5 m/s in case of untethered UA; 4.2.5 by a remote pilot that complies with point 5.1 below; and 4.2.6 with a UA that complies with point 6 below.

UAS maintenance	4.3 The UAS maintenance instructions that are defined by the UAS operator should be included in the OM and should cover at least the UAS manufacturer's instructions and requirements, when applicable. 4.4 The maintenance staff should follow the UAS maintenance instructions when performing maintenance.
External services	4.5 The UAS operator should ensure that the level of performance for any externally provided service that is necessary for the safety of the flight is adequate for the intended operation. The UAS operator should declare that this level of performance is adequately achieved. 4.6 The UAS operator should define and allocate the roles and responsibilities between the UAS operator and the external service provider(s), if applicable.

5. Provisions for the personnel in charge of duties essential to the UAS operation	
Remote pilot	5.1 In addition to complying with the requirements of point UAS.SPEC.060 of the Annex to the UAS Regulation and with the provisions for remote pilots in previous points of this AMC, a remote pilot who is engaged in operations under this PDRA should: 5.1.1 hold a certificate of remote-pilot theoretical knowledge, in accordance with Attachment A to Chapter I of Appendix 1 to the Annex to the UAS Regulation, which is issued by the competent authority or by an entity that is designated by the competent authority of a Member State; 5.1.2 hold an accreditation of completion of a practical-skill training course for this PDRA, in accordance with Attachment A to Chapter I of Appendix 1 to the Annex to the UAS Regulation, which is issued by: (a) an entity that has declared compliance with the requirements of Appendix 3 to the Annex to the UAS Regulation and is recognised by the competent authority of a Member State; or (b) a UAS operator that has declared to the competent authority of the Member State of registration compliance with this PDRA and with the requirements of Appendix 3 to the Annex to the UAS Regulation; 5.1.3 before starting the UAS operation, verify that the means to terminate the flight of the UA as well as the remote identification system are operational; and 5.1.4 during the flight: (a) keep the UA in VLOS and maintain a thorough visual scan of the airspace that is surrounding the UA to avoid any risk of collision with manned aircraft; the remote pilot should discontinue the flight if the operation poses a risk to other aircraft, people, animals, environment or property; (b) for the purpose of point (a) above, be possibly assisted by a UA observer; clear and effective communication should be established between the remote pilot and the UA observer; (c) use the contingency procedures that are defined by the UAS operator for abnormal situations, including situations where the remote pilot has an indication that the UA may exceed the limits of the flight geography; and (d) use the emergency procedures that are defined by the UAS operator for emergencies, including triggering the means to terminate the flight when the remote pilot has an indication that the UA may exceed the limits of the operational volume; the means to terminate the flight should be triggered at least 10 m before the UA reaches the limits of the operational volume.

6. Technical provisions	
UAS	6.1 A UAS that is to be used in operations under this PDRA should comply with the requirements of Part 16 of the Annex to Regulation (EU) 2019/945[5], except that the UAS does not need to: 6.1.1 bear a Class C3 UAS or Class C5 UAS identification on itself; 6.1.2 be exclusively powered by electricity, if the UAS operator ensures that the environmental impact that is caused by the use of non-electric UAS is minimised; 6.1.3 include a notice that is published by EASA and provides the applicable limitations and obligations, as required by the UAS Regulation; and 6.1.4 include the manufacturer's instructions for the UAS if it is privately built; however, information on its operation and maintenance, as well as on the training of the remote pilot, should be included in the OM. *Note 1: The UAS can comply with point (9) of Part 4 of the Annex to Regulation (EU) 2019/945 by using an add-on that complies with Part 6 of the Annex to said Regulation.* *Note 2: If the UA does not have a physical serial number that is compliant with standard ANSI/CTA-2063-A 'Small Unmanned Aerial Systems Serial Numbers' and/or does not have an integrated system of direct remote identification, it can comply with point (9) of Part 4 of the Annex to Regulation (EU) 2019/945 by using an add-on that complies with Part 6 of the Annex to said Regulation.* *Note 3: If the UAS is privately built, there may be no identification on the UA of its MTOM. In that case, the operator should ensure that the MTOM of the UA, in the configuration of the UA before take-off, does not exceed 25 kg.*

Table PDRA-S01.1 — Main limitations and provisions for PDRA-S01

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[5] Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems (OJ L 152, 11.6.2019, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0945).

AMC5 Article 11 Rules for conducting an operational risk assessment

PREDEFINED RISK ASSESSMENT **PDRA-S02** Version 1.0

EDITION December 2020

(a) Scope

This PDRA addresses the same type of operations that are covered by the standard scenario STS-02 (Appendix 1 to the Annex to the UAS Regulation); however, it provides the UAS operator with the flexibility to use UAS that do not need to be marked as Class C6.

This PDRA addresses UAS operations that are conducted:

(1) with UA with maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of up to 3 m and MTOM of up to 25 kg;

(2) at a distance of up to 2 km from the remote pilot if airspace observers (AOs) are employed; otherwise at a distance of up to 1 km;

(3) over a controlled ground area that is entirely located in a sparsely populated area;

(4) not higher than 120 m above the surface overflown (except when close to obstacles); and

(5) in controlled or uncontrolled airspace, provided that there is a low probability of encountering manned aircraft.

(b) PDRA characterisation and provisions

The characterisation and provisions for this PDRA are summarised in **Table PDRA-S02.1** below:

PDRA characterisation and provisions	
1. Operational characterisation (scope and limitations)	
Level of human intervention	1.1 No autonomous operations: the remote pilot should maintain control of the UA, except in case of loss of the command and control (C2) link. 1.2 The remote pilot should operate only one UA at a time. 1.3 The remote pilot should not operate from a moving vehicle. 1.4 The remote pilot should not hand over the control of the UA to another command unit.
UA range limit	1.5 UAS operations should be conducted: 1.5.1 keeping the UA in sight of the remote pilot during the launch and recovery of the UA, unless the recovery of the UA is the result of an emergency flight termination; 1.5.2 if no airspace observer (AO) is employed in the operation, with the UA no further than 1 km from the remote pilot; and

	1.5.3 if one or more AOs are employed in the operation, with the UA no further than 2 km from the remote pilot.
Areas overflown	1.6 UAS operations should be conducted over a controlled ground area.
UA limitations	1.7 The UA should have an MTOM of less than 25 kg, including payload. 1.8 The UA should have maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) of less than 3 m. 1.9 The UA should have a maximum ground speed in level flight of not more than 50 m/s.
Flight height limit	1.10 The remote pilot should maintain the UA within 120 m from the closest point of the surface of the Earth. The measurement of the distances should be adapted according to the geographical characteristics of the terrain, such as plains, hills, and mountains. 1.11 When flying a UA within a horizontal distance of 50 m from an artificial obstacle that is taller than 105 m, the maximum height of the UAS operation may be increased up to 15 m above the height of the obstacle at the request of the entity responsible for the obstacle. 1.12 The maximum height of the operational volume should not exceed by 30 m the maximum height that is allowed by points 1.10 and 1.11 above.
Airspace	1.13 The UA should be operated: 1.13.1in uncontrolled airspace (Class F or G), unless different limitations are provided for by the Member States for their UAS geographical zones in areas where the probability of encountering manned aircraft is not low; or 1.13.2in controlled airspace after coordination and flight authorisation in accordance with the published procedures for the area of operation, to ensure a low probability of encountering manned aircraft. *Note: An airspace with an air risk that is classified as not higher than ARC-b can be considered having a low probability of encountering manned aircraft.*
Visibility	1.14 The UA operation should be conducted in an area where the flight visibility is more than 5 km.
Others	1.15 The UA should not be used to carry dangerous goods, except for dropping items in connection with agricultural, horticultural or forestry activities in which the carriage of the items does not contravene any other applicable regulations.

2. Operational risk classification (according to the classification defined in AMC1 Article 11 of the UAS Regulation)

Final GRC	**3**	Final ARC	**ARC-b**	SAIL	**II**

3. Operational mitigations	
Operational volume (see Figure PDRA-G01.1 of AMC2 Article 11)	3.1 The UAS operator should define the operational volume for the intended operation, including the flight geography and the contingency volume. 3.2 To determine the operational volume, the UAS operator should consider the position-keeping capabilities of the UAS in 4D space (latitude, longitude, height, and time). 3.3 In particular, the accuracy of the navigation solution, the flight technical error of the UAS, as well as the flight path definition error (e.g. map error) and latencies should be considered and addressed when determining the operational volume. 3.4 The remote pilot should apply emergency procedures as soon as there is an indication that the UA may exceed the limits of the operational volume, as per point 5.1.4(h) below.
Ground risk	3.5 The UAS operator should establish a ground risk buffer to protect third parties on the ground outside the operational volume. 3.6 The ground risk buffer should cover a distance that is at least equal to the distance specified by the UAS manufacturer’s instructions, considering the operational conditions within the limitations specified by the UAS manufacturer.
Air risk	3.7 The operational volume should be outside any geographical zone corresponding to a flight restriction zone of a protected aerodrome or of any other type, as defined by the responsible authority, unless the UAS operator has been granted an appropriate permission. 3.8 Prior to the flight, the UAS operator should assess the proximity of the planned operation to manned aircraft activity.
Observers	3.9 If the UAS operator decides to employ one or more airspace observers (AOs), the UA may be operated at a distance from the remote pilot greater than that referred to in point 1.5.2 above. 3.10 In relation to AOs, the UAS operator should comply with the provisions of point 4.1.8 below. 3.11 AOs should comply with the provisions of point 5.2 below.

4. UAS operator and UAS operations provisions	
UAS operator and UAS operations	4.1 In addition to the responsibilities that are defined in point UAS.SPEC.050 of the Annex to the UAS Regulation, the UAS operator should: 4.1.1 develop an operations manual (OM) (for the template, refer to AMC1 UAS.SPEC.030(3)(e) and to the complementary information in GM1 UAS.SPEC.030(3)(e)); 4.1.2 define the operational volume and ground risk buffer for the intended operation, as per points 3.1 to 3.6 above, and include them in the OM; 4.1.3 ensure the adequacy of the contingency and emergency procedures and prove it through any of the following: (a) dedicated flight tests; or (b) simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or (c) any other means acceptable to the competent authority; 4.1.4 develop an effective emergency response plan (ERP) that is suitable for the intended operation (see GM1 UAS.SPEC.030(3)(e)); 4.1.5 upload updated information into the geo-awareness function, if such system is installed on the UAS, when required by the UAS geographical zone for the intended location of the operation; 4.1.6 ensure that before starting the operation, the controlled ground area is in place, effective, and compliant with the minimum distance that is defined in points 3.1 to 3.6 above as well as that, when required, coordination with the appropriate authorities has been established; 4.1.7 ensure that before starting the operation, all persons that are present in the controlled ground area: (a) have been informed of the risks of the operation; (b) have been briefed on or trained in, as appropriate, the safety precautions and measures that the UAS operator established for their protection; and (c) have explicitly agreed to participate in the operation; and 4.1.8 before starting the operation, and if airspace observers (AOs) are employed: (a) ensure the correct placement and number of AOs along the intended flight path; (b) verify that: (i) visibility and the planned distance of the AO are within acceptable limits as defined in the OM; (ii) there are no potential terrain obstructions for each AO; (iii) there are no gaps between the zones that are covered by each of the AOs;

	(iv) the communication with each AO is established and effective; and (v) if means are used by the AOs to determine the position of the UA, those means are functioning and effective; and (c) ensure that the AOs have been briefed on the planned flight path of the UA and on the associated timing; and 4.1.9 ensure that the UAS that is used in the intended operation complies with the technical provisions of point 6 below. 4.2 A UAS operation under this PDRA should be conducted: 4.2.1 keeping the UA in sight of the remote pilot during the launch and recovery of the UA, unless the recovery of the UA is the result of an emergency flight termination; 4.2.2 in accordance with the OM that is referred to in point 4.1.1 above; 4.2.3 over a controlled ground area that comprises the area of the operational volume that is indicated in point 3.1 above and the ground risk buffer that is indicated in point 3.5 above, both projected on the surface of the Earth; 4.2.4 by a remote pilot that complies with point 5.1 below; and 4.2.5 with a UA that complies with point 6 below and is operated with: (a) an active system to prevent the UA from exceeding the limits of the flight geography; and (b) an active and updated system of direct remote identification. 4.3 If no AO is employed in the operation, the operation should be conducted with the UA flying no further from the remote pilot than the distance that is indicated in point 1.2.2 above and following a preprogrammed trajectory when the UA is not in VLOS of the remote pilot. 4.4 If one or more AOs are employed in the operation, the following conditions should be complied with: 4.4.1 the AO(s) should be positioned so as to adequately cover the operational volume and the surrounding airspace, having the minimum flight visibility that is indicated in point 1.10 above; 4.4.2 the UA should be operated no further than 1 km from the AO who is nearest to the UA; 4.4.3 the distance between any AO and the remote pilot should not be more than 1 km; and 4.4.4 robust and effective means are available for communication between the remote pilot and the AO(s).
UAS maintenance	4.5 The UAS maintenance instructions that are defined by the UAS operator should be included in the OM and should cover at least the UAS manufacturer's instructions and requirements, when applicable. 4.6 The maintenance staff should follow the UAS maintenance instructions when performing maintenance.

External services	4.7 The UAS operator should ensure that the level of performance for any externally provided service that is necessary for the safety of the flight is adequate for the intended operation. The UAS operator should declare that this level of performance is adequately achieved. 4.8 The UAS operator should define and allocate the roles and responsibilities between the UAS operator and the external service provider(s), if applicable.

5. Provisions for the personnel in charge of duties essential to the UAS operation	
Remote pilot	5.1 In addition to complying with the requirements of point UAS.SPEC.060 of the Annex to the UAS Regulation and with the provisions for remote pilots in previous points of this AMC, a remote pilot who is engaged in operations under this PDRA should: 5.1.1 hold a certificate of remote-pilot theoretical knowledge, in accordance with Attachment A to Chapter II of Appendix 1 to the Annex to the UAS Regulation, which is issued by the competent authority or by an entity that is designated by the competent authority of a Member State; 5.1.2 hold an accreditation of completion of a practical-skill training course for this PDRA, in accordance with Attachment A to Chapter II of Appendix 1 to the Annex to the UAS Regulation, which is issued by: (a) an entity that has declared compliance with the requirements of Appendix 3 to the Annex to the UAS Regulation and is recognised by the competent authority of a Member State; or (b) a UAS operator that has declared to the competent authority of the Member State of registration compliance with this PDRA and with the requirements of Appendix 3 to the Annex to the UAS Regulation; 5.1.3 before starting the UAS operation: (a) set the programmable flight volume of the UA to keep it within the flight geography; and (b) verify that the means to terminate the flight as well as the programmable flight volume functionality of the UA are operational; and 5.1.4 during the flight: (a) unless supported by visual observers (VOs), maintain a thorough visual scan of the airspace that is surrounding the UA to avoid any risk of collision with manned aircraft; the remote pilot should discontinue the flight if the operation poses a risk to other aircraft, people, animals, environment or property; (b) maintain control of the UA, except in case of loss of the command and control link; (c) operate only one UA at a time; (d) not operate the UA from a moving vehicle; (e) not hand over the control of the UA to another control unit; (f) inform the AO(s), when employed, in a timely manner of any deviations of the UA from the intended flight path, and of the associated timing; (g) use the contingency procedures that are defined by the UAS operator for abnormal situations, including situations where the remote pilot has an indication that the UA may exceed the limits of the flight geography; and (h) use the emergency procedures that are defined by the UAS operator for emergencies, including triggering the means to terminate the flight

	when the remote pilot has an indication that the UA may exceed the limits of the operational volume.
Airspace observer (AO)	5.2 The AO's main responsibilities are laid down in point A.2 of Appendix A to AMC2 Article 11 *The personnel in charge of duties essential to the UAS operation*.
6. Technical provisions	
UAS	6.1 A UAS that is to be used in operations under this PDRA should comply with the requirements of Part 17 of the Annex to Regulation (EU) 2019/945, except that the UAS does not need to: 6.1.1 bear a Class C3 or Class C6 UAS identification on itself; 6.1.2 be exclusively powered by electricity, if the UAS operator ensures that the environmental impact that is caused by the use of non-electric UAS is minimised; 6.1.3 include a notice that is published by EASA and provides the applicable limitations and obligations, as required by the UAS Regulation; and 6.1.4 include the manufacturer's instructions for the UAS if it is privately built; however, information on its operation and maintenance, as well as on the training of the remote pilot, should be included in the OM. *Note 1: The UAS can comply with point (9) of Part 4 of the Annex to Regulation (EU) 2019/945 by using an add-on that complies with Part 6 of the Annex to said Regulation.* *Note 2: If the UA does not have a physical serial number that is compliant with standard ANSI/CTA-2063-A 'Small Unmanned Aerial Systems Serial Numbers' and/or does not have an integrated system of direct remote identification, it can comply with point (9) of Part 4 of the Annex to Regulation (EU) 2019/945 by using an add-on that complies with Part 6 of the Annex to said Regulation.* *Note 3: If the UAS is privately built, there may be no identification on the UA of its MTOM. In that case, the UAS operator should ensure that the MTOM of the UA, in the configuration of the UA before take-off, does not exceed 25 kg.*

Table PDRA-S02.1 — Main limitations and provisions for PDRA-S02

GM1 Article 14(1) Registration of UAS operators and 'certified' UAS

ACCURACY OF THE REGISTRATION SYSTEMS

UAS operators, when registering themselves or their certified UAS, are required to provide accurate information and update the registration data when it changes.

Member States are required to keep that information and registration data accurate in their registration systems.

An example of data that may change over time is:

— a UAS operator address, email address, and telephone number; and

— the validity of the insurance policy for the UAS.

To verify the validity of the insurance policy, Member States may require, at the time of registration, the UAS operator to provide the expiry date of the insurance policy and to consider the registration invalid after that date.

UAS operators, especially those conducting UAS operations for leisure, may decide to fly their UAS only for a short period; therefore, it is possible that even if the database of a registration system contains many registered UAS operators, only some of them are active. Member States may define a duration period for the validity of registration of all UAS operators and may revoke the registration number if the UAS operator does not renew that number before it expires. Member States may also decide to suspend or revoke the registration number if the UAS operator's conduct justifies such a measure.

AMC1 Article 14(6) Registration of UAS operators and 'certified' UAS

UAS OPERATOR REGISTRATION NUMBER

(a) The unique UAS operator digital registration number that is issued by the Member States should consist of sixteen (16) alphanumerics in total, arranged as follows:

  (1) the first three (3) alphanumerics (upper-case only) corresponding to the ISO 3166 Alpha-3 code of the Member State of registration;

  (2) followed by twelve (12) randomly generated characters that consist of alphanumerics (lower-case only); and

  (3) one (1) character corresponding to the checksum that is generated in line with point (c).

(b) The Member States should randomly generate three (3) additional alphanumerics (lower-case only) called 'secret digits'.

(c) The Member States should generate a checksum by applying the Luhn-mod-36 algorithm to the fifteen (15) alphanumerics that result from the concatenation, in the following order, of:

  (1) the twelve (12) alphanumerics of the UAS operator registration number defined in point (a)(2); and

  (2) the three (3) randomly generated 'secret digits' that are defined in point (b).

(d) For the Luhn-mod-36 algorithm, the mapping of the alphanumerics to the code-points should start with digits that are followed by lower-case letters, as shown below:

Alphanumeric	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*a*	*b*	*c*	*d*	*e*	*f*	…	*z*
Code-point	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	…	35

(e) At the time of registration, the Member State should provide the UAS operator with the full registration string that consists, in the following order, of:

(1) the UAS operator registration number as defined in point (a); and

(2) the three (3) randomly generated 'secret digits', separated by a hyphen '-' (ASCII code [DEC] 45).

GM1 to AMC1 Article 14(6) Registration of UAS operators and 'certified' UAS

UAS OPERATOR REGISTRATION NUMBER

An example of a UAS operator registration number as defined in point (a) of AMC1 Article 14(6) *Registration of UAS operators and 'certified' UAS* is 'FIN87astrdge12k8', where:

— 'FIN' is the ISO 3166 Alpha-3 code of Finland;

— '87astrdge12k' is an example of the twelve (12) alphanumerics, as defined in point (a)(2) of AMC1 Article 14(6); and

— '8' is the checksum, i.e. the result of the application of the Luhn-mod-36 algorithm to the fifteen (15) alphanumerics that result from the concatenation of the twelve (12) alphanumerics of the UAS operator registration number and the three (3) randomly generated alphanumerics ('secret digits', as defined in point (b) of AMC1 Article 14(6)): '87astrdge12kxyz'.

An example of the full registration string, as defined in point (e) of AMC1 Article 14(6), to be provided by a Member State, is 'FIN87astrdge12k8-xyz', where:

— 'FIN87astrdge12k8' is the UAS operator registration number; and

— 'xyz' is an example of the three (3) randomly generated 'secret digits'.

The UAS operator must upload the UAS registration number and the three (3) 'secret digits' into the remote identification system of the UAS, if available, or into the electronic-identification system, if required by the geographical zone.

The UAS operator should not share with anybody the three (3) 'secret digits' that are used to enhance the protection of the UAS operator registration number from being illegally uploaded into a UA.

AMC1 Article 14(8) Registration of UAS operators and 'certified' UAS

DISPLAY OF REGISTRATION INFORMATION

(a) If the UAS operator owns the UAS or uses a UAS that is owned by a third party, it should: ~~display on the UA the registration number received at the end of the registration process in a way that this information is readable at least when the UA is on the ground without the need for any devices other than eyeglasses or corrective lenses.~~

(1) register itself;

(2) display on the UA the UAS operator registration number, which is received at the end of the registration process, in a way that the number is readable at least when the UA is on the ground, without using other devices than eyeglasses or corrective lenses; and

(3) upload the full string, which consists of the UAS operator registration number and the three (3) randomly generated alphanumerics, into the electronic identification system, if available.

(b) A QR code (quick response code) may be used.

(c) If the size of the UA does not allow the mark to be displayed in a visible way on the fuselage, or the UA represents a real aircraft where affixing the marking on the UA would spoil the realism of the representation, a marking inside the battery compartment is acceptable if the compartment is accessible.

~~(d) If a UAS operator uses a UAS owned by a third party, the UAS operator that operates the UAS should:~~

~~(1) register itself;~~

~~(2) display its registration number on the UA; and~~

~~(3) upload the registration number into the e-identification system, if the UA is equipped with one.~~