# 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.

# 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** | |
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| **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.<br>1.2 The remote pilot should ~~only~~ operate only one UA at a time.<br>1.3 The remote pilot should not operate from a moving vehicle.<br>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.<br>*Note: 'safe prepared area' means a controlled ground area that is suitable for the safe launch/recovery of the UA.*<br>1.6 In flight:<br>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. |

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| | | *Note: The remote pilot's workload should ~~be adequate to~~ allow ~~him or her~~the remote pilot to continuously scan the airspace.*<br>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).<br>*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:<br>1.11.1 in uncontrolled airspace (Class F or G) (corresponding to an air risk that can be classified as ARC-b); or<br>1.11.2 in a segregated area (corresponding to an air risk that can be classified as ARC-a); or<br>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.<br>*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)** | | | | | |
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| Final GRC | **3** | Final ARC | **ARC-b** | SAIL | **II** |

| 3. Operational mitigations | |
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| 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).<br>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.<br>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.<br>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).<br>3.5 The operational volume and the ground risk buffer should be all contained in a sparsely populated ~~environment~~area.<br>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.~~<br>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.<br>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.<br>3.10 Prior to the flight, the remote pilot should assess the proximity of the planned operation to manned aircraft activity~~ should be assessed~~. |

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| ~~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.<br><br>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:<br><br>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);<br><br>3.~~11~~12.2 there are no~~presence of~~ potential terrain obstructions for each ~~VOs~~AO; ~~and~~<br><br>3.~~11~~12.3 there are no gaps between the zones that are covered by each of the ~~VOs~~AOs~~.~~;<br><br>3.12.4 communication with each AO is established and effective; and<br><br>3.12.5 if means are used by the AOs to determine the position of the UA, those means are functioning and effective.<br><br>~~3.12 The VO(s) necessary to safely conduct the operation should be in place during flight operations.~~<br><br>*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:~~<br><br>~~4.1.1 have knowledge of the UAS being used; and~~<br><br>~~4.1.2 develop relevant procedures including at least the following as a minimum: operational procedures (e.g. checklists), maintenance, training, responsibilities, and duties.~~<br><br>~~4.2 The aforementioned aspects should be addressed in the ConOps (see Annex A to AMC1 to Article 11 of the UAS Regulation).~~ |

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| 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:<br><br>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)); ~~.~~<br><br>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));<br><br>4.~~4~~1.3 validate ~~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;<br><br>4.~~5~~1.4 ensure ~~T~~the adequacy of the contingency and emergency procedures ~~should~~ and ~~be~~ prove~~d~~ them through any of the following:<br><br>~~4. 5.1~~(a) dedicated flight tests; or<br><br>~~4. 5.2~~(b) simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or<br><br>~~4. 5.3~~(c) any other means acceptable to the competent authority.<br><br>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.<br><br>~~4.7 The remote crew should be competent and be authorised by the UAS operator to carry out the intended operations.~~<br><br>~~4.8 A list of the remote crew members authorised to carry out UAS operations is established and kept up to date.~~<br><br>~~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.~~ |

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| 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.<br>~~4.12 The maintenance staff should be competent and should have received an authorisation from the UAS operator to carry out maintenance.~~<br>4.~~13~~3 The maintenance staff should ~~use~~follow the UAS maintenance instructions ~~while~~when performing maintenance.<br>~~4.14 The maintenance instructions should be documented.~~<br>~~4.15 The maintenance conducted on the UAS should be recorded in a maintenance log system.~~<br>~~4.16 A list of the maintenance staff authorised to carry out maintenance should be established and kept up to date.~~<br>~~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.~~<br>~~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.<br>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:<br>6.1.1 UA position, height or altitude, ground speed or airspeed, attitude and trajectory;<br>6.1.2 UAS energy status (fuel, battery charge, etc.); and ~~the~~<br>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.<br>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). |

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| 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.<br>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:<br>6.4.1 be sufficiently easy to understand to allow the ~~V~~AOs to determine the position of the UA during the operation; and<br>6.4.2 not degrade the ~~V~~AOs' ability to:<br>6.4.2.1 perform unaided visual scanning of the airspace where the UA is operating for any potential collision hazard; and<br>6.4.2.2 maintain effective communication with the remote pilot at all times.<br>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.<br>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).<br>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.<br>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:<br>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~~.~~<br>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.<br>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).<br>*Note: The term 'probable' should~~needs to~~ be understood in its qualitative* |

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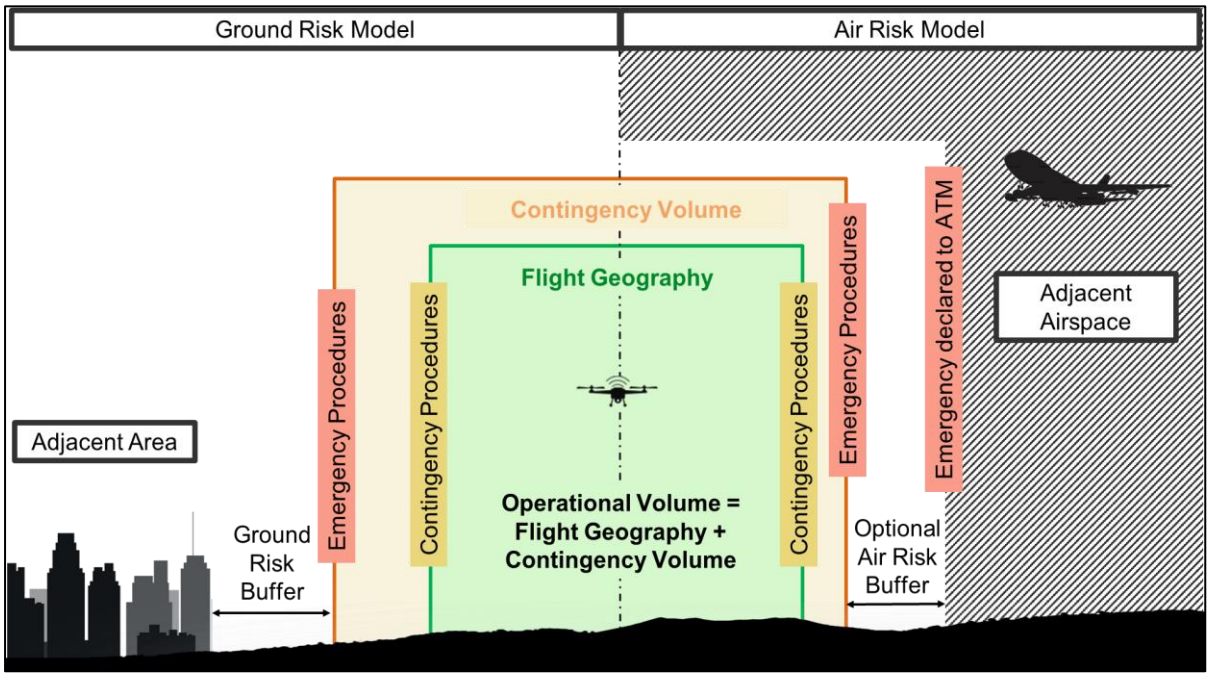
| | *interpretation, i.e. 'anticipated to occur one or more times during the entire system/operational life of an item'.'*<br><br>6.13 A design and installation appraisal should be made available and should ~~minimally include~~cover at least:<br><br>6.13.1 the design and installation features (independence, separation, and redundancy); and<br><br>6.13.2 the particular risks (e.g. hail, ice, snow, ~~electro-magnetic~~electromagnetic interference, etc.) relevant to the ConOps.<br><br>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)~~:~~.<br><br>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:<br><br>6.14.1.1 ~~T~~the probability of the UA leaving the operational volume should be less than ~~10-4~~$10^{-4}$/FH; and~~.~~<br><br>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.<br><br>*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.*<br><br>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.<br><br>*Note 1: The proposed additional safety provisions cover both the integrity and assurance levels.*<br><br>*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.*<br><br>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~~;

[…]