AMC2 Article 11 Rules for conducting an operational risk assessment

PREDEFINED RISK ASSESSMENT PDRA-01 Version 1.0

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(a) Scope

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

(1) UA with maximum characteristic dimensions (e.g. wingspan, rotor diameter/area or maximum distance between rotors in case of multirotor) up to 3 m and typical kinetic energies 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 (or any other altitude reference defined by the state); and

(5) in uncontrolled airspace.

(b) PDRA characterisation and provisions

Characterisation and provisions for this PDRA are summarised in Table PDRA-01.1.

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 control the UA, except in case of a lost link. 1.2 The remote pilot should only operate one UA at a time. 1.3 The remote pilot should not operate from a moving vehicle. 1.4 Handover between RPSs should not be performed.
UA range limit	1.5 Launch/recovery: VLOS distance from the remote pilot 1.6 In flight: 1.6.1 If no VOs are used: UA is not operated 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 to continuously scan the airspace.* 1.6.2 If VOs are used: the range is not limited as long as the UA is not operated at more than 1 km (unless a different distance is defined by the competent authority) from the VO who is nearest to the UA.
Overflown areas	1.7 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 state). *Note: In addition to the vertical limit for the operational volume, an air risk buffer is to be considered (see 'air risk' under point 3 of this table).*
Airspace	1.11 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 that an 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 PDRA-01.1)	3.1 To determine the operational volume, the applicant 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 and the path definition error (e.g. map error) and latencies should be considered and addressed in this determination. 3.3 If the UA leaves the operational volume, emergency procedures should be activated immediately.
Ground risk	3.4 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. 3.6 The applicant 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 An air risk buffer should be defined. 3.8 This air risk buffer should be contained in the F or G airspace class (uncontrolled airspace) over sparsely populated areas and in UAS geographical zones defined by 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 is in receipt of the appropriate permission. 3.10 Prior to flight, the proximity of the planned operation to manned aircraft activity should be assessed.
VOs	3.11 The remote pilot should determine the correct placement and number of VOs along the intended flight path. Prior to each flight, the UAS operator should check: 3.11.1 the compliance between the visibility and planned range for VOs; 3.11.2 the presence of potential terrain obstructions for VOs; and 3.11.3 that there are no gaps between the zones covered by each of the VOs. 3.12 The VO(s) necessary to safely conduct the operation should be in place during flight operations. Note: The remote pilot may perform the visual scan of the airspace instead of a VO provided that the workload is adequate to perform his or her duties as the remote pilot.
4. Operator 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 operations	4.3 The UAS operator should develop an OM (for the template, refer to GM1 UAS.SPEC.030(3)(e)). 4.4 The operational procedures should be validated against standards recognised by the competent authority and/or in accordance with a means of compliance acceptable to that authority. 4.5 The adequacy of the contingency and emergency procedures should be proved through: 4.5.1 dedicated flight tests; or 4.5.2 simulations, provided that the representativeness of the simulation means is proven for the intended purpose with positive results; or 4.5.3 any other means acceptable to the competent authority. 4.6 The UAS operator should develop an ERP (see GM2 UAS.SPEC.030(3)(e)) 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. 4.10 The applicant should have a policy that defines how the remote crew can declare themselves fit to operate before conducting any operation.
UAS maintenance	4.11 The UAS maintenance instructions should be defined by the UAS operator, documented and 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 The maintenance staff should use the UAS maintenance instructions while 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 The applicant should ensure that the level of performance for any externally provided service necessary for the safety of the flight is adequate for the intended operation. The applicant should declare that this adequate level of performance is achieved. 4.20 The roles and responsibilities between the applicant and the external service provider should be defined.
5. Provisions for the personnel in charge of duties essential to the UAS operation	

	As per Appendix A
6. Technical provisions	
General	6.1 Means to monitor critical parameters for 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 minute, or have a descent rate of at least 2.5 m/s (500 fpm).
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 such that this could adversely affect the safety of the operation. 6.4 If an electronic means is used to support VOs 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 VOs to determine the position of the UA during the operation; and 6.4.2 not degrade the VOs' 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 should conduct an evaluation of the UAS considering and addressing human factors to determine whether the HMI is appropriate for the mission.
C2 links and communication	6.6 The UAS should comply with the appropriate 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 Link (mechanisms such as FHSS, technology or frequency de-confliction by procedure). 6.8 Communication between the remote pilot and the VO(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 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 VOs 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 involving the UAS or an external system supporting the operation, the UAS operator should ensure: 6.11.1 that no probable failure of the UAS or any external system supporting the operation should lead to operation outside the operational volume. 6.11.2 that it is reasonably expected that a fatality will not occur from any probable failure of the UAS, or 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 state). *Note: The term 'probable' 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: 6.13.1 design and installation features (independence, separation and redundancy); 6.13.2 particular risks (e.g. hail, ice, snow, electro-magnetic 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): 6.141 The probability of leaving the operational volume should be less than 10-4/FH. 6.14.2 No single failure of the UAS or any external system supporting the operation should lead to operation outside the ground risk buffer. *Note: The term 'failure' needs to be understood as an occurrence, which 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.* 6.16.3 SW and AEH whose development error(s) could directly lead to operations outside the ground risk buffer should be developed to an industry standard or methodology 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 recognised as adequate by the competent authority. For instance, if the UA design includes an <u>independent</u> engine shutdown function which 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 provisions 6.16.2 and 6.16.3 could be considered to be met.* 6.15 Compliance with provisions 6.16.1 and 2 above should be substantiated by analysis and/or test data with supporting evidence.

Table PDRA-01.1 — Main limitations and provisions for PDRA-01

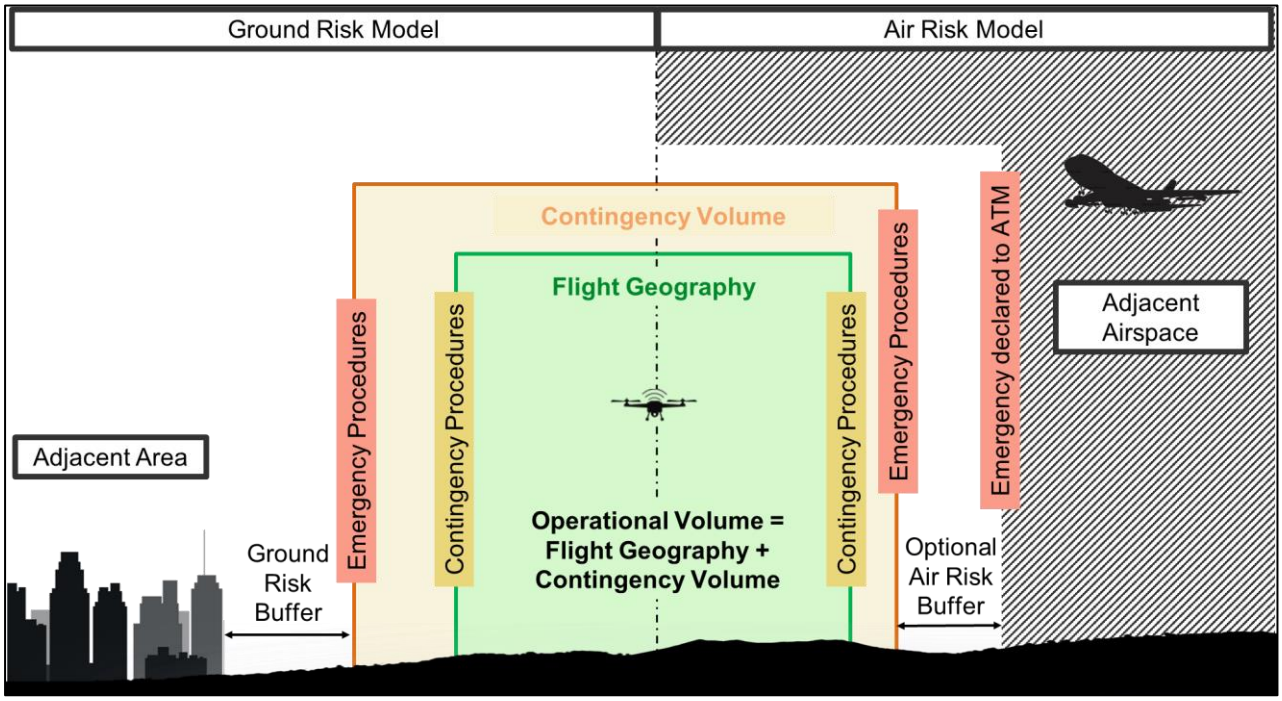

Figure PDRA-01.1 — Graphical representation of the SORA semantic model

APPENDIX A: The personnel in charge of duties essential to the UAS operation

The following are provisions applicable to UAS operators in relation to ensuring the proficiency, competency and clear duty assignment to the personnel in charge of duties essential to the UAS operation. UAS operators may decide to expand these requirements as applicable to its operation.

A.1 Training and qualifications for the personnel in charge of duties essential to the UAS operation

A.1.1 The UAS operator should ensure that all the personnel in charge of duties essential to the UAS operation (i.e. any people involved in the operation) are provided with competency-based theoretical and practical training specific to their duties that consists of the following elements:

A.1.1.2 The basic competencies from the competency framework that are necessary for staff to be adequate for the operation, to ensure safe flight, are as follows:

A.1.1.2.1 the UAS regulation,

A.1.1.2.2 UAS airspace operating principles,

A.1.1.2.3 airmanship and aviation safety,

A.1.1.2.4 human performance limitations,

A.1.1.2.5 meteorology,

A.1.1.2.6 navigation/charts,

A.1.1.2.7 UA knowledge,

A.1.1.2.8 operating procedures,

A.1.1.2.9 assignment of tasks to the crew,

A.1.1.2.10 establishment of step-by-step communications, and

A.1.1.2.11 coordination and handover.

A.1.1.3 Familiarisation with the 'specific' category of operations

A.1.1.3.1 The training programme should be documented (at least the training syllabus should be available).

A.1.1.3.2 Evidence of training should be presented for inspection upon request from the competent authority or authorised representative.

A.2. VOs

A.2.1 The VO's main responsibilities should be to:

A.2.1.1 perform unaided visual scanning of the airspace where the UA is operating for any potential hazard in the air;

A.2.1.2 maintain awareness of the position of the UA through direct visual observation or through assistance provided by an electronic means; and

A.2.1.3 alert the remote pilot if a hazard is detected and assist in avoiding or minimising the potential negative effects.

A.3 Remote pilot

A.3.1 The remote pilot has the authority to cancel or delay any or all flight operations under the following conditions:

A.3.1.1 the safety of persons is threatened; or

A.3.1.2 property on the ground is threatened; or

A.3.1.3 other airspace users are in jeopardy; or

A.3.1.4 there is a violation of the terms of this authorisation.

A.3.2 If VOs are used, then the remote pilot should ensure that the necessary VOs are available and correctly placed, and that the communications with them can be adequately performed.

A.3.3 The remote pilot should ensure that the UA remains clear of clouds, and that the ability of the remote pilot, or one of the VOs, to perform unaided visual scanning of the airspace where the unmanned aircraft is operating for any potential collision hazard is not hampered by clouds.

A.4. Multi-crew cooperation (MCC)

A.4.1 In applications where MCC might be required, the UAS operator should:

A.4.1.1 include procedures to ensure coordination between the remote crew members with robust and effective communication channels. Those procedures should cover as a minimum:

A.4.1.1.1 the assignment of tasks to the remote crew members; and

A.4.1.1.2 the establishment of step-by-step communication; and

A.4.1.2 ensure that the training of the remote crew covers MCC.

A.5. The remote crew is fit to operate

A.5.1 The UAS operator should have a policy defining how the remote crew can declare themselves fit to operate before conducting any operation.

A.5.2 The remote crew shall declare that they are fit to operate before conducting any operation based on the policy defined by the UAS operator.

A.6. Maintenance staff

A.6.1 Any staff member authorised by the UAS operator to perform maintenance activities should have been duly trained regarding the documented maintenance procedures.

A.6.2 Evidence of training should be presented for inspection upon request from the competent authority or authorised representative.

A.6.3 The UAS operator may declare that the maintenance team has received training regarding the documented maintenance procedures; however, evidence of this training shall be made available upon request from the competent authority or authorised representative.