

Avoiding flyaways

What are the rules?

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BEYOND

FLIGHT TERMINATION SYSTEM

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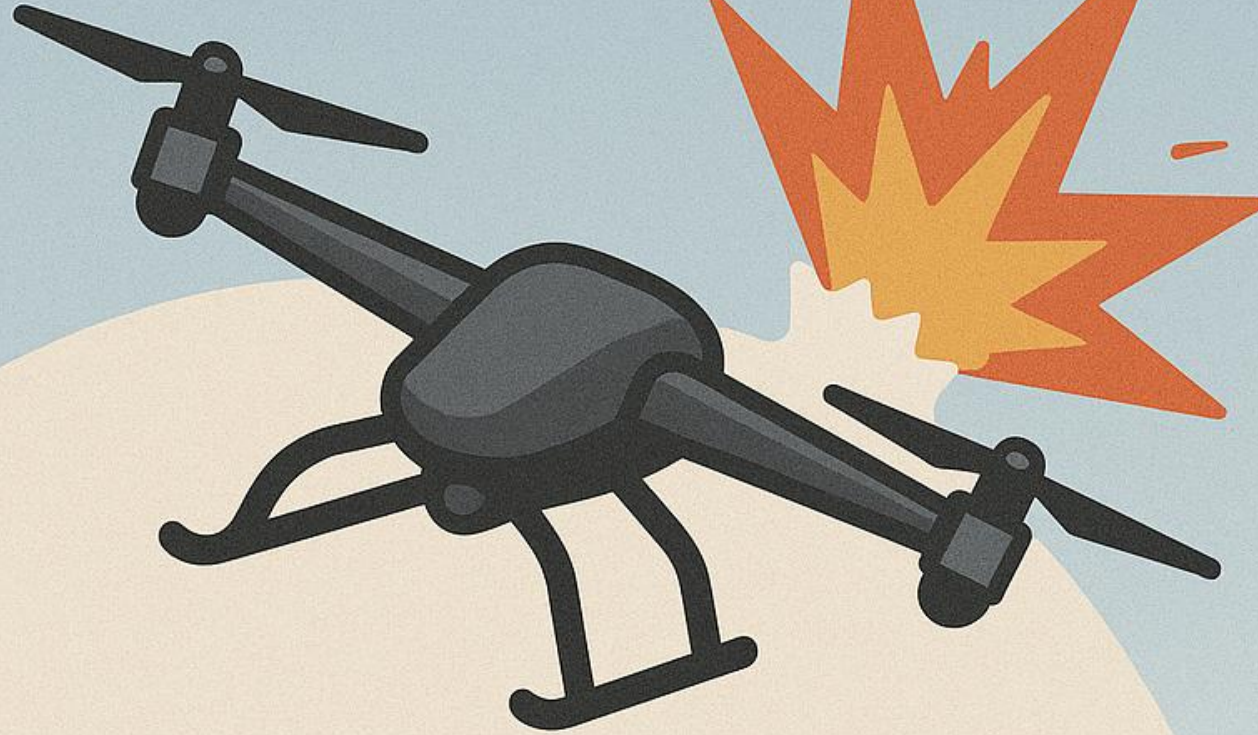
BEYOND

FLIGHT TERMINATION SYSTEM

Slides available at vixos.dk under Download



Flyaway – loss of control + leaving area



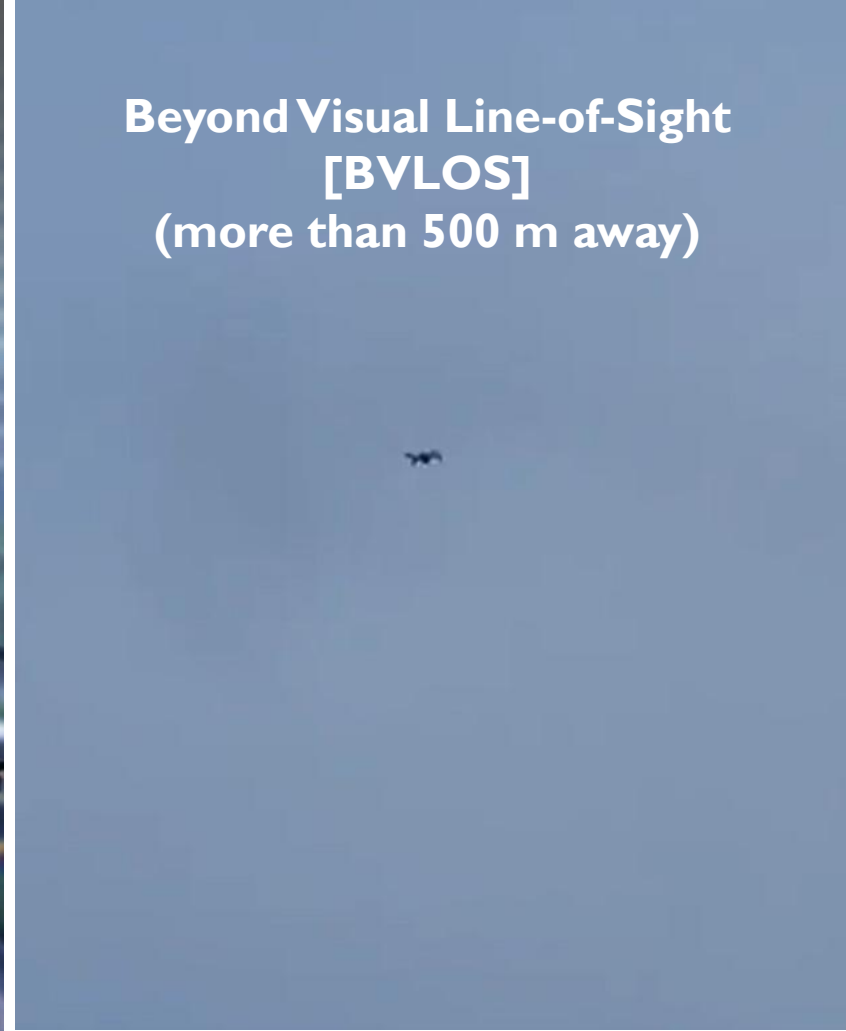
**OPERATIONAL
VOLUME**



Above 4 kg in urban



Beyond Visual Line-of-Sight
[BVLOS]
(more than 500 m away)



Above 25 kg everywhere



**Legal requirement Europe
and globally approximately**

Open and Specific categories

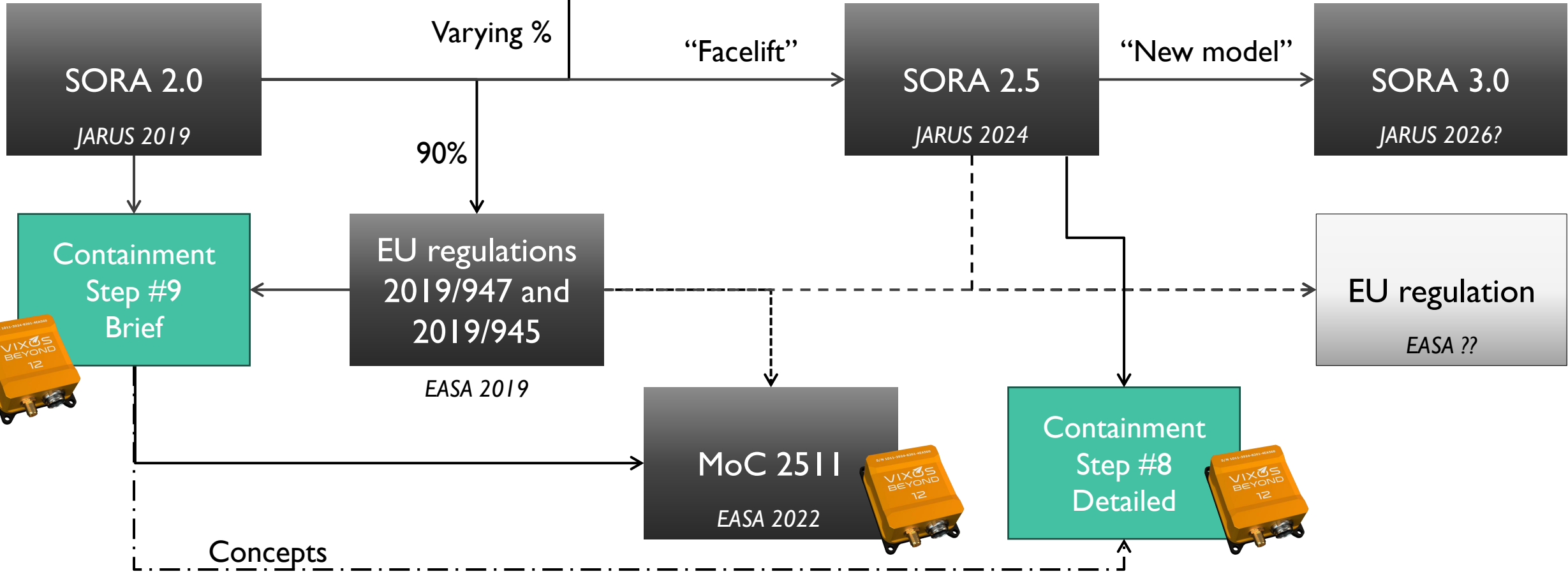
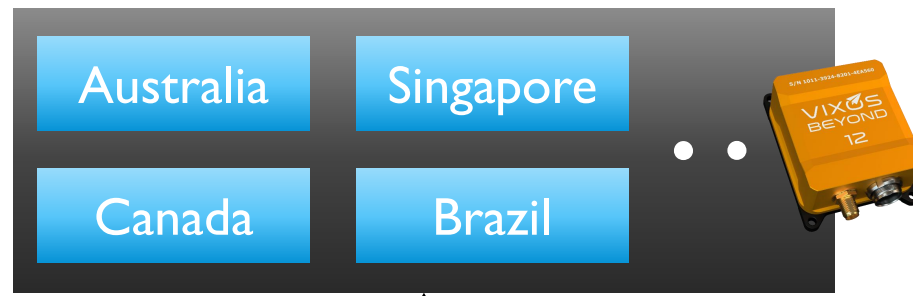
Category	Drones	Traits	Allows	Authorization	FTS required
OPEN		- Inherently low-risk - Limited through metrics (height, speed, distance, etc.)	- Up to 25 kg - Up to 4 kg in urban area - Visual line-of-sight (VLOS) - Below 120 m	No	No
SPECIFIC		- Higher risk - Limited through risk assessment done by operator	- Above 25 kg - Above 4 kg in urban area - BVLOS - Above 120 m - Dispersing from drone	Yes	Yes See table below.

FTS requirement

	Regulatory regime	Region	Containment required	Limitations	Difficulty	Quality assurance
SPECIFIC	SORA 2.0	Global	Always (step #9)	None	High	Yes
	SORA 2.5		Always (step #8)			
	EU regulations 2019/945 and 947	EU	Always (SORA 2.0 step #8)			
	EASA MoC 2511		Always (method for compliance with SORA 2.0 step #8)	SAIL I and II, aircraft less than 3 m	Low	No

www.vixos.dk/rules-explained

Rules



SORA 2.0: Adjacent airspace (step #9)

Annex D p. 10: 10^{-3}
(TMPR)

JARUS AMC
RPAS.1309: 10^{-3}

(b) Safety requirements for containment are:

ASTM F3298: 10^{-3}

1. No **probableⁱ failure^j** of the UAS or any external system supporting the operation **shall** lead to operation outside of the operational volume.

Compliance with the requirement above **shall** be substantiated by a **design and installation appraisal** and **shall** minimally include:

- design and installation features (independence, separation and redundancy);
- any relevant particular risk (e.g. hail, ice, snow, electro-magnetic interference...) associated with the ConOps.

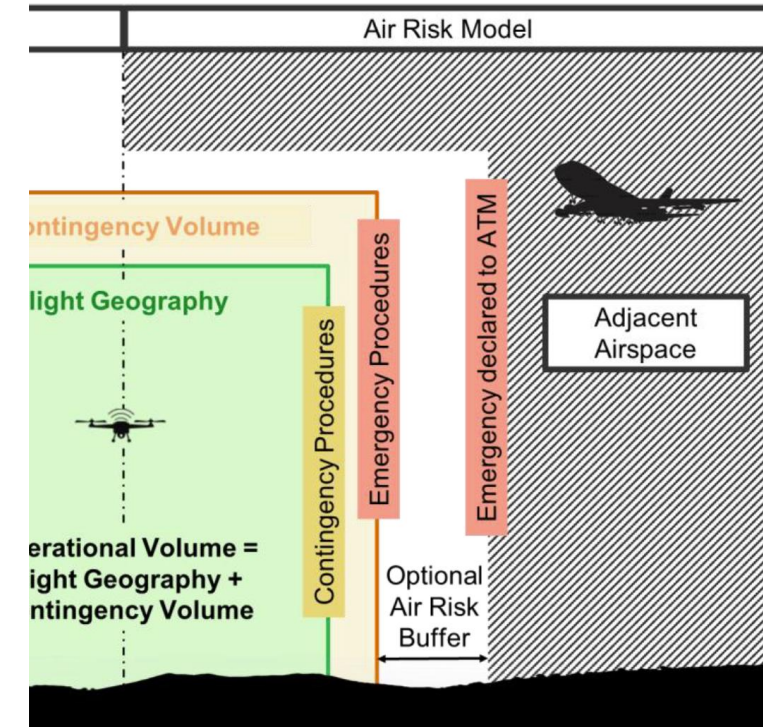
ⁱ The term “probable” needs to be understood in its qualitative interpretation, i.e. “Anticipated to occur one or more times during the entire system/operational life of an item.”

^j 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 as failures. Some structural or mechanical failures may be excluded from the criterion if it can be shown that these mechanical parts were designed to aviation industry best practices.

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This is not optional!
Typically goes into OM

ASTM F3309 sec 4.4



This applies unconditionally for any Specific category operation!

Design and Installation Appraisal

ASTM F3309 sec 4.4

Design appraisal

- Qualitative appraisal of the integrity of the design
- An effective appraisal requires experienced judgment.
- Use of system architecture/block diagram is recommended
- Functional Hazard Assessment (FHA) can be used
- Make sure to include
 - component qualification
 - independence
 - separation
 - redundancy

Installation appraisal

- Qualitative appraisal of the integrity of the installation.
- An effective appraisal requires experienced judgment.
- Use installation drawings and equipment installation requirements.
- Deviations from normal installation practice need to be evaluated.
- Must consider any potential interference with other aircraft systems and issues.
- Potential for events or influences outside of the systems concerned that might invalidate independence must also be considered.

MoC 2511 – EASA to the rescue – Use FTS!

Method of Compliance with SORA 2.0 step #9 – but only for SAIL I+II and < 3 m!

Segregation

1. Air: FTS should be segregated from the FCS and all other systems.
2. Ground: The trigger should be segregated from the GCS.
3. Frequency: FTS frequency should be separated from GCS frequency.

Testing

1. Bench: Test of FTS in lab conditions (“Hello world”). **At least 10.**
2. Ground: Test of FTS installed on drone on ground. **At least 10.**
3. Flight: Test of FTS installed and in flight. No need for crash.
At least 5 at min altitude; at least 2 at max distance.
At least 5 at max altitude; at least 2 at max distance.
4. End-to-end: Simulate lifetime of system. **At least as many as needed in real life.**

Manual

1. Limitations of the system.
2. Maintenance instruction.
3. Ground risk buffer definition: $GRB = (v_{max} + v_{wind})t_{latency} + d_{descent}$
4. Template for completion of testing.

MoC 2511 – EASA to the rescue!

My personal take on MoC 2511.

Quality

1. No requirement for quality in design/manufacturing.
2. No requirement for quality of components.
3. No specification for assurance except testing.

FTS

1. Very specific on separation (independence).
A bit fuze in SORA 2.5.
2. Only applicable to FTS on drone.
3. Assumes terrestrial radio.

Operations

1. Tangible and operational.
2. Specific requirements for operations manual.
3. Logging of use required.
4. No preflight requirements.
5. No use of standards or third parties
(but this is also the point).

'Kill switch' failed as drone hit controlled space near Gatwick

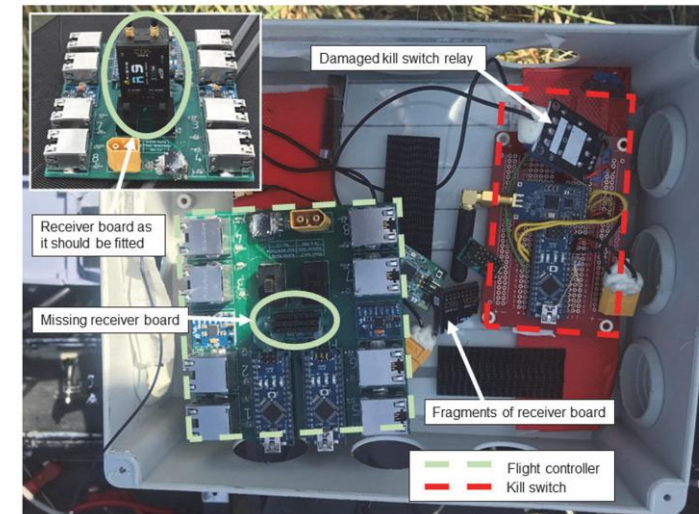
18 February 2021

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The drone crashed in a field of crops, the AAIB said

<https://www.bbc.com/news/uk-england-sussex-56112694>



https://assets.publishing.service.gov.uk/media/602bb22f8fa8f50388f9f000/Alauda_Airspeeder_Mk_II_UAS_reg_na_03-21.pdf

SORA 2.5 – Main body

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

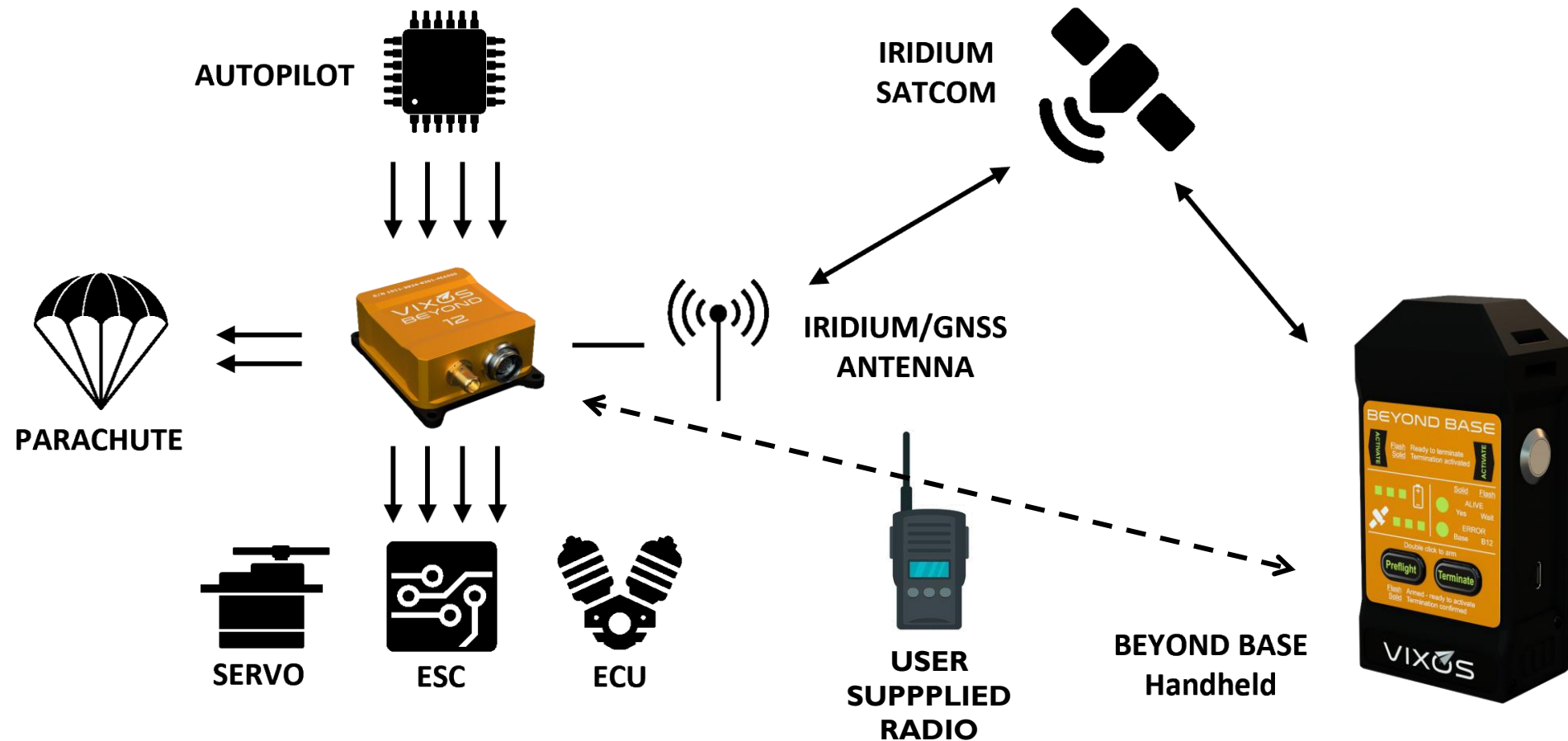
Table 10 - Containment requirements 3 m UA without shelter assumption

SORA 2.5 – Annex E

	Low	Medium	High
Criterion #1 (Operational volume containment)	- No probably single failure of leaving OV. [SORA 2.0] OR - Probability of leaving OV less than 10^{-3}.		- No remote failure. OR - Probability 10^{-4}.
	Design and installation appraisal. [SORA 2.0]		
Criterion #2 (Termination)	UA leaves the OV, an immediate end of the flight must be initiated through a combination of procedures/processes and/or available technical means.		
Criterion #3 (Ground risk buffer)	- GRB as least 1:1. [SORA 2.0] OR - Compute it yourself. [2511]	Consider: [SORA 2.0] - Probable single failure. - Weather - UAS latencies. - UA crash behaviour.	
Criterion #4 (GRB containment)	N/A	- No single failure of USA or external system. - Standards for development of software and hardware. <i>Independent FTS is specifically a means to achieve this criterion.</i> [2511]	
Assurance	Declaration	Supporting evidence	Third party

Operating principle

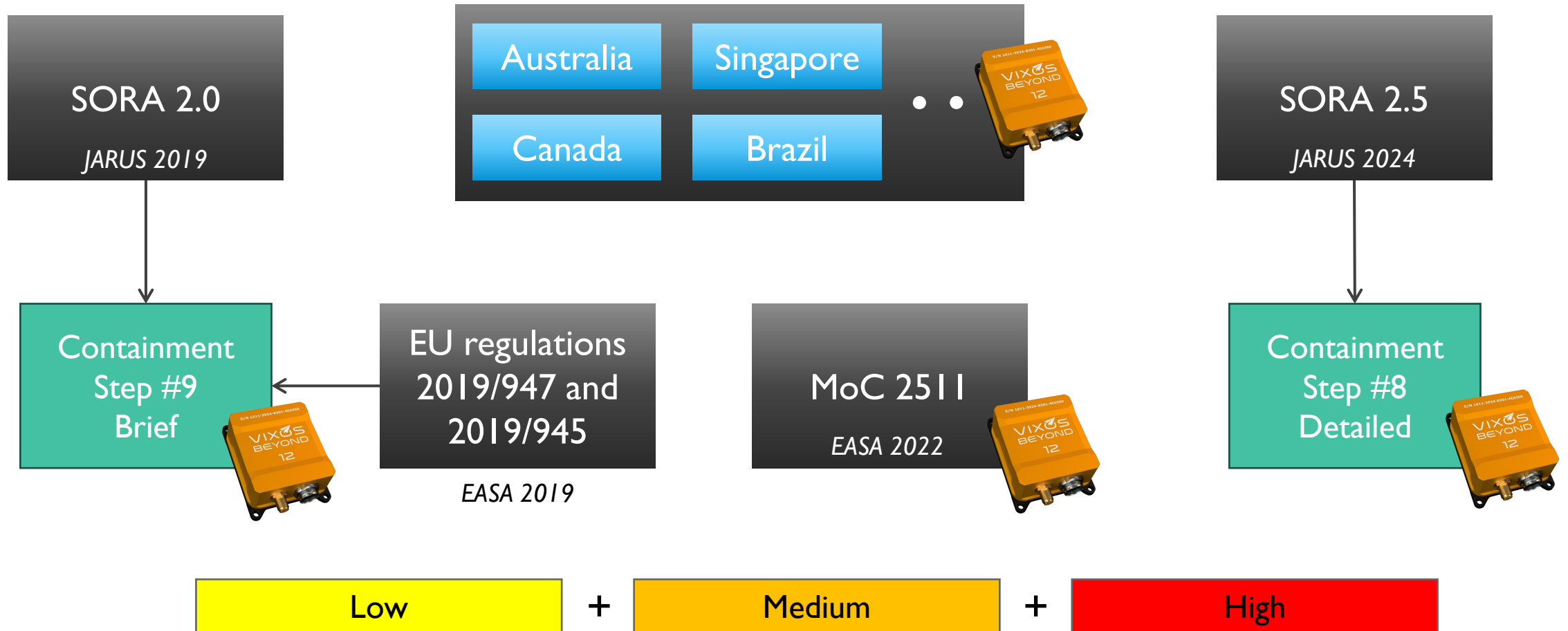
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Specs



Compliance





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+ brochure, spec sheet, 3D model etc.

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