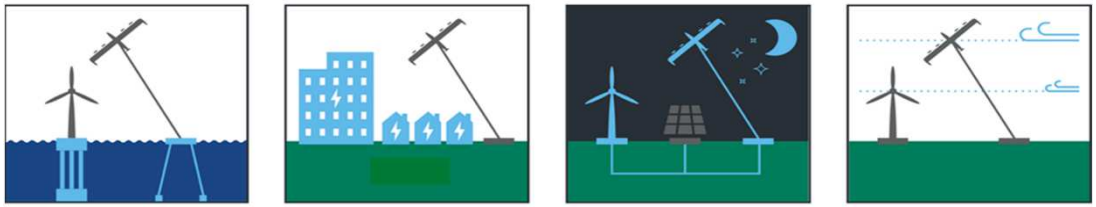
iea wind

Topical Expert Meeting TEM#102
Airborne Wind Energy



Session 3:
Safety aspects and airspace regulation

23-24 September 2020

Michiel Kruijff
Airborne Wind Europe
michiel@airbornewindeurope.org

Overview of topics

Safe operations

1. Concept of Operations
2. Risk assessment
3. Safety and operational zones
4. U-Space integration

Aviation certification

5. Type certification
6. Organizational certification

Industry Standards

7. Building on existing standards
8. Joint regulation development
9. Lighting and marking
10. Planning and zoning vs. HAWT

Safe operations – 1. Concept of Operations

- International Civil Aviation Organization (ICAO) definition of **aircraft**:

An aircraft is any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface. (ICAO Annex 1, Annex 6 Part I)

- AWES are aircraft and unmanned, hence they are UAS (drones).
- In the EU, drones are regulated by Commission Implementing Regulation **(EU) 2019/947** of 24 May 2019 and Commission Delegated Regulation **(EU) 2019/945** of 12 March 2019: **Concept of Operations.**
- Most AWES will fall into the **Specific Category** of operations

Safe operations – 1. Concept of Operations

1. Will EU national legislation become obsolete, e.g. on obstacles, small and/or experimental aircraft?
2. To what extent will other countries accept AWES under similar arrangement?
3. Will the FAA and Americas maintain approach of their own? E.g. ANAC/RBAC-E No. 94
4. …

Safe operations – 2. Risk Assessment

The Specific Operations Risk Assessment v2 (JARUS) is an Accepted Means of Compliance

- Intrinsic Ground Risk Class (GRC) + Mitigations → Final **GRC**
- Initial Air Risk Class (ARC) + Mitigations → Residual **ARC**
- ARC + GRC → Specific Assurance and Integrity Level (**SAIL**)
- SAIL → Operational Safety Objectives (**OSO**) robustness level

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 a sparsely populated environment	2	3	4	5
BVLOS in a sparsely populated environment	3	4	5	6
VLOS in a populated environment	4	5	6	8
BVLOS in a populated environment	TBD[7]	TBD[7]	TBD[7]	TBD[7]
VLOS over an assembly of people	7			
BVLOS over an assembly of people	TBD[7]			

Table 2 — Determination of the intrinsic GRC

SAIL determination				
	Residual ARC			
Final GRC	a	b	c	d
≤2	I	II	IV	VI
3	II	II	IV	VI
4	III	III	IV	VI
5	IV	IV	IV	VI
6	V	V	V	VI
7	VI	VI	VI	VI
>7	Category C operation			

Table 5 — SAIL determination

Safe operations – 2. Risk Assessment

1. Other suitable methods than SORA that should be acceptable?
2. Test sites can define “Standard Scenario” (STS) to ease access for AWES testing
3. AWES community could develop templates, share successful applications
4. …

Safe operations – 3. Safety and Operational Zones

1. Align on definitions
2. Operate AWES in restricted airspace
3. Acceptable level of co-use : farming, shipping, ….

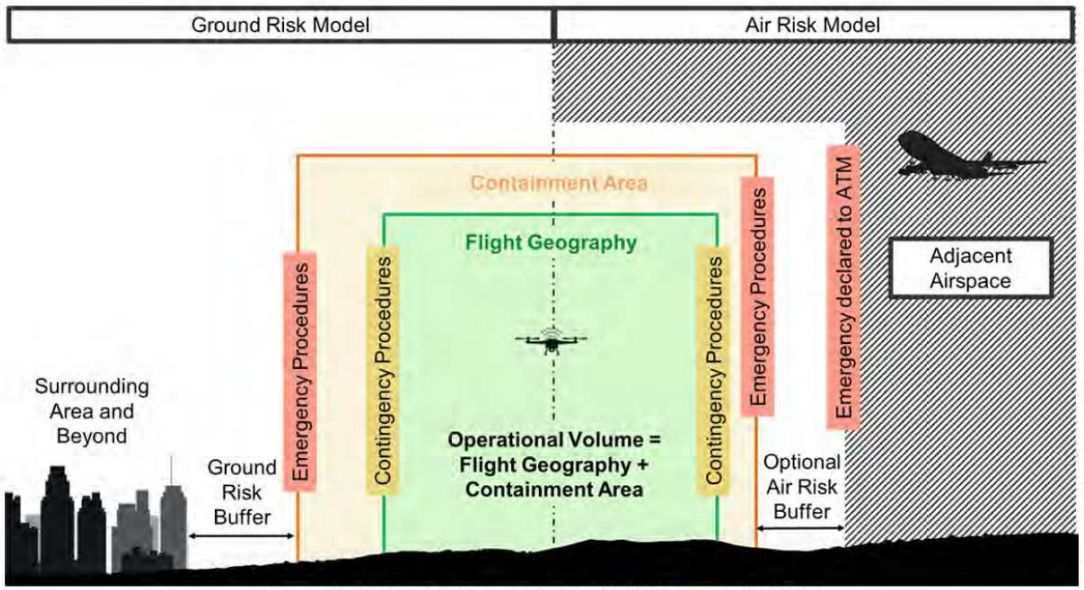
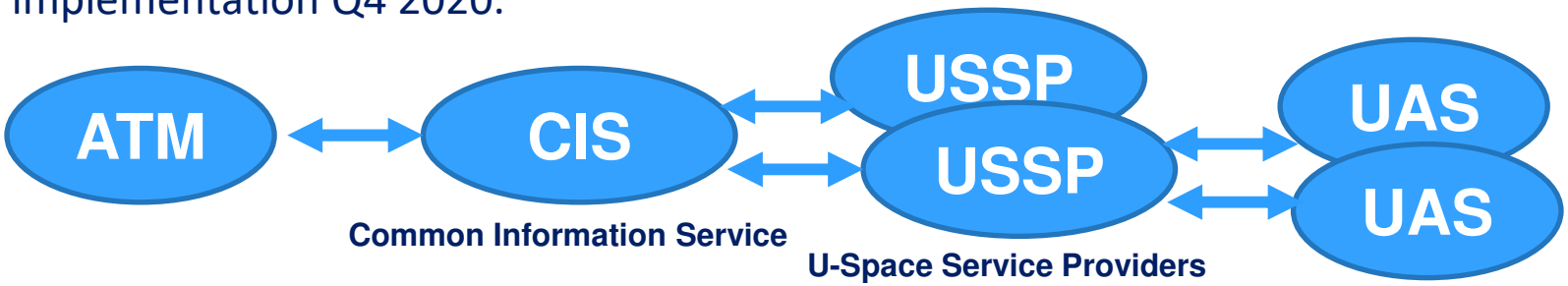


Figure 2 - Graphical Representation of SORA Semantic Model

Safe operations – 4. U-Space integration

- Enabling (highly automated) drone integration into Air Traffic Management (ATM)
- U-Space EASA Opinion 01/2020 – high level regulatory framework. Expected EU implementation Q4 2020.



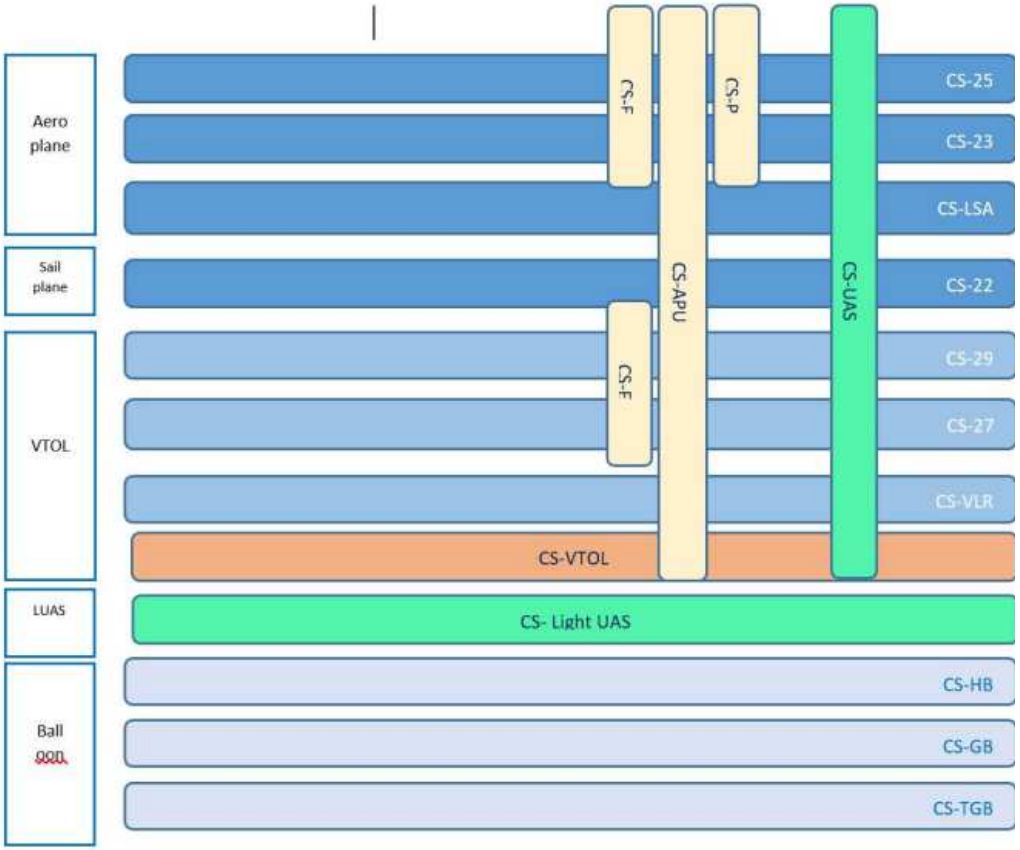
Type of service
Geo-awareness
E-identification
Traffic information service
Flight authorisation
Tracking service
Weather service
Conformance monitoring service
Other (as defined by the Member State)

1. Interaction with USSP: geofencing and alerting
2. First responders
3. Other drone exclusion or avoidance?
4. AWES operator as USSP?
5. …

Aviation Certification.

5. Type Certification (TC)

- In the EU, high risk Specific Operations may require (partial or restricted) TC
  Below 600 kg: SC Light-UAS 01 Issue 1 (July 2020), will become CS-Light UAS
  - Above: CS-23 Amdt. 5 plus UAS elements (eventually, CS-UAS).
- EASA, CS-23 Amdt. 5 allows for own AMC definition and tailoring, e.g.
  - Load cases: CS-22, CS-23 Amdt. 4
  - Composite structures: AMC 20-29
  - Systems safety: SC-RPAS.1309
  - Ground systems: 2006/42/EC



Aviation Certification

6. Organizational certification

- With Type Certification comes requirement for Design Organization Approval (**DOA**). This also helps changes during testing. Primarily about having suitable organization structure for product assurance and certification data production.
- Production Organization Approval (**POA**) will probably be needed
- Continued airworthiness may require Maintenance Organization Approval (**MOA**), TBD

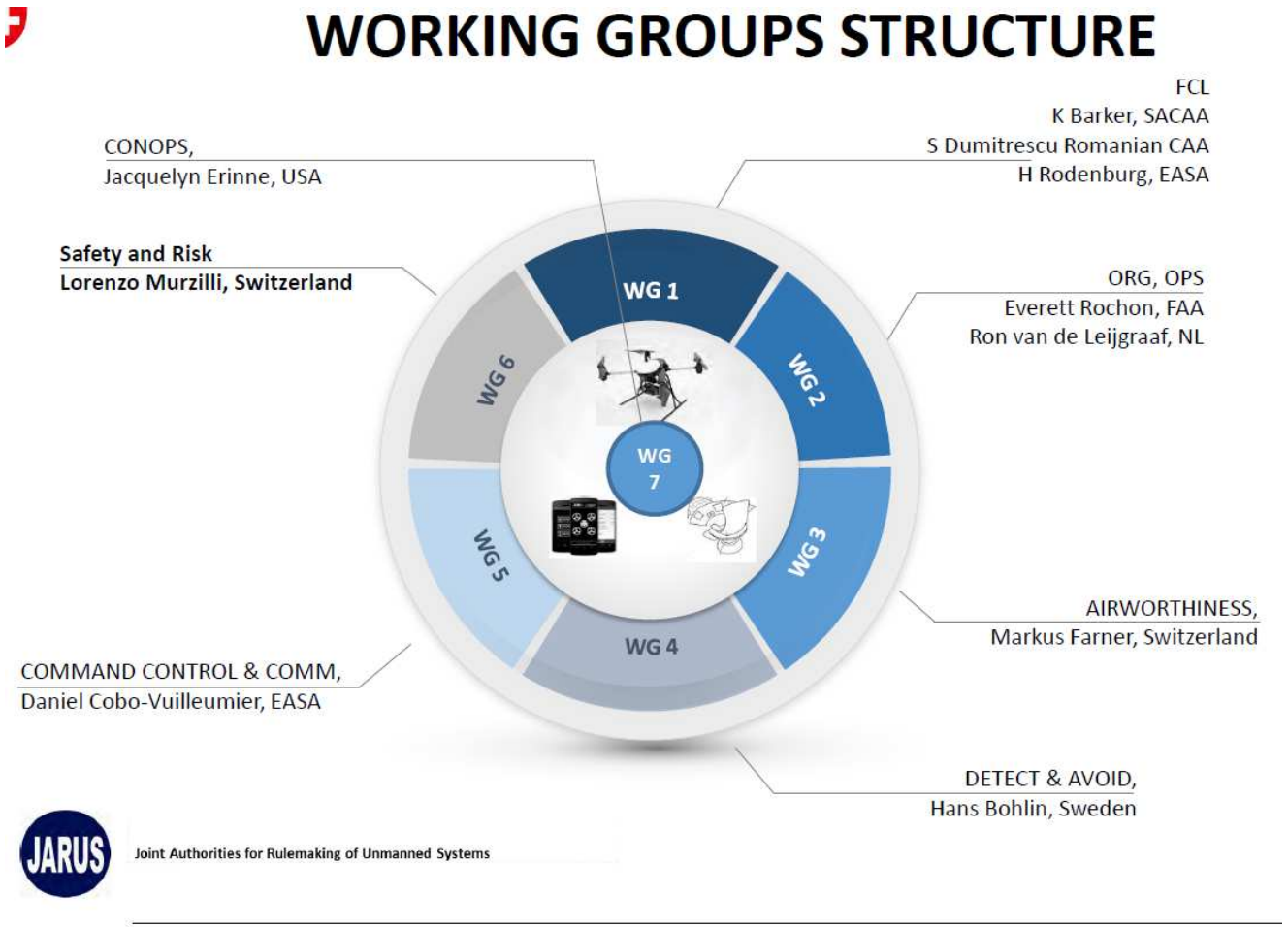
1. ED-79A/ARP4754A (design processes) tailoring for AWES community
2. Suitable Reliability and Design Assurance Level for AWES?
3. Use of commercial components (non-aviation grade)
4. What about >5670 kg?
5. What about co-use?
6. When apply for DOA? Clarify POA/MOA requirements for AWES
7. Non-EU applicability

Industry Standards

7. **Building on existing standards**
8. **Joint regulation development**
9. **Lighting and marking**
10. **Planning and zoning vs. HAWT**

1. IEC 64100 and need for others? What topics? Power curve, foundation, installation, grid connection, noise, …
2. Common regulation stakeholders world-wide: who, what topics? EASA, NAA, JARUS, EuroCAE etc.
3. Lighting and marking, via aviation? CS-23? Obstacles? Restricted area? Transponders? Tether?
4. Planning and zoning: topics?

Industry Standards



Thank you for your attention!

Dr. Michiel Kruijff
Ampyx Power
+31 627 027 807
michiel@ampyxpower.com