SORA Hand-in

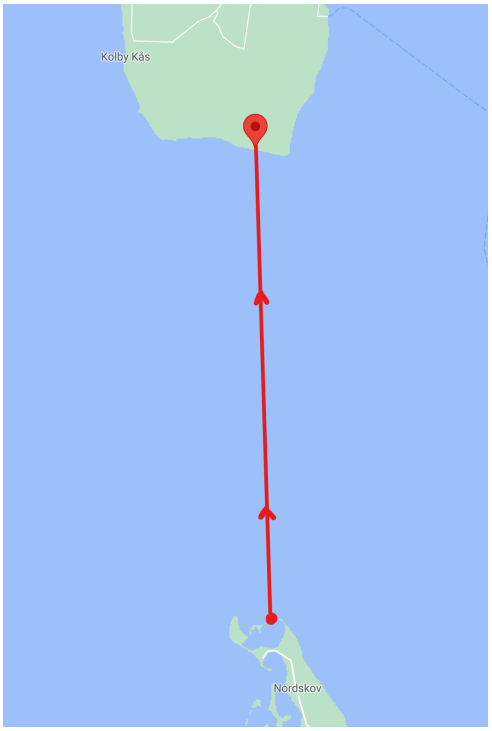

Figure 1 - The route the drone will fly.

Ground Risk Class, Air Risk Class, and Specific Assurance and Integrity Level

- What will the Intrinsic UAS Ground Risk Class (GRC) be?

The biggest dimension of the drone is 2.4m, putting it in the 3m class. It will fly BVLOS over the ocean, which is a sparsely populated area. **The GRC is 4.**

- What could you do to reduce the final GRC?

To reduce final GRC, it would be possible to choose a smaller dimension drone for this operation. This could reduce the CRC to a value of 3.

- What is the initial Air Risk Class (ARC)?

We imagine that the plane will be flying under 150 meters (~500ft). It is flying in a controlled airspace over the ocean. This puts the **ARC at class c**.

- With your final GRC and initial ARC, what is the SAIL?

With GRC being 4 and ARC is c, the **SAIL is IV**.

Operational Safety Objectives (OSOs)

- Which OSOs are optional in a SAIL II scenario?

OSO#02 - UAS manufactured by competent and/or proven entity
OSO#04 - UAS developed to authority recognised design standards
OSO#05 - UAS is designed considering system safety and reliability
OSO#18 - Automatic protection of the flight envelope from human error
OSO#19 - Safe recovery from human error
OSO#24 - UAS is designed and qualified for adverse environmental conditions

- According to the OSOs, is a procedure manual for maintenance required for a SAIL III?

This is relevant for OSO#03, UAS maintained by competent and/or proven entity (e.g. industry standards). For SAIL III this is a medium priority, which **does not require a procedure manual for maintenance**.

- What are the OSO#02 integrity requirements for a SAIL IV and how is it assured?

- specification of materials
- suitability and durability of
- materials used,
- processes necessary to allow
- for repeatability in
- manufacturing and conformity
- within acceptable tolerances.
- configuration control,
- verification of incoming
- products, parts, materials, and
- equipment,
- identification and traceability,
- in-process and final

- inspections & testing,
- control and calibration of tools,
- handling and storage,
- non-conforming item control.

Level of assurance :
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. In addition, evidence is available that the UAS has been manufactured in conformance to its design.

Step #9

To eliminate the risk of drones falling down, we could use the same approach as used in airplanes - use multiple engines for thrust generation. In this case the drone would still keep flying if there is a motor failure. Although, this needs to be a fixed wing drone. The same airplane approach could be used to make the drone more reliable in all the other aspects. For example, in case of navigation malfunction, there should be multiple different navigation systems fitted on the drone to eliminate risk of getting completely lost. As well as an electronics backup system should be fitted - emergency ESCs for motor control.

If anything goes wrong, for instance complete motor failure or if the drone flies out of the designated zone, a flight termination system (FTS) should be engaged. “For Fixed Wing aircraft, the throttle shall be set to ‘engine off’ and the control surfaces set to initiate a rapid spiral descent.” [IMechE - 3.1.9].

Our design includes 4 motors for vertical take-off. With the very front propeller being 2 motors on top of each other. Then there are 2 motors for horizontal flying occupied with 2 Electronic Speed Controllers in case of one of the ESC stops working. The design also includes external satellite GPS and embedded GPS module in the main flight controller.

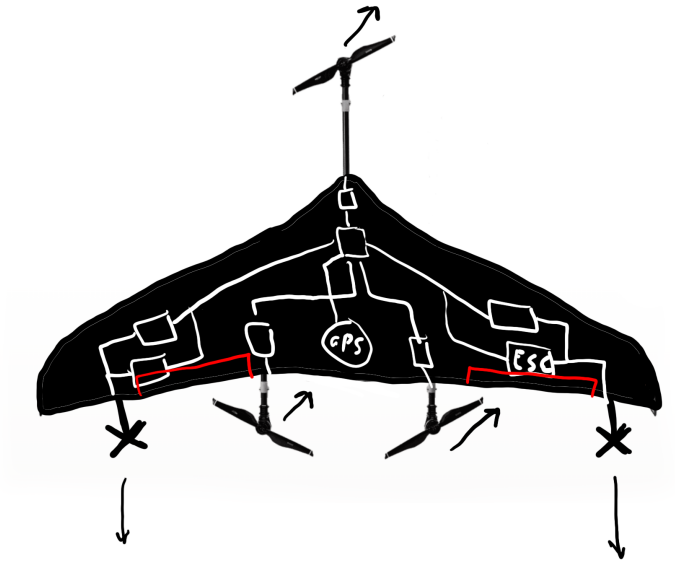

Figure 2 - Sketch of redundant motor design (The red line indicates the ailerons)

Bibliography

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