Odense December 3’rd 2018

Dear students,

In the following pages you will find comments to your respective SORA’s. Please do not read the comments as an evaluation of the quality of your SORA. The comments will only address some identified weaknesses or problems found.

Your SORA’s are quite different and each of you seem to have something that the other teams are missing, such as structure vs. technical details vs. standard operating procedures vs. …. etc. I therefore recommend that you share your work across the teams as this will definitely increase your knowledge and experience outcome from working with the SORA.

Kjeld

Team 1
Your technical description of the drone is weak. A few examples...

- Under “2 Concept of operation” you state that *“The UAV will throughout the flight mitigate dynamic obstacles, like other drones or no-fly zones, and change its path accordingly.”* In a real world SORA, arguments like this needs to be documented thoroughly and tested under VLOS operations before considered valid. I do not expect you to do this to the full extent, but it would be better to “go meta” on the question and state what you would put into this section.

- You have only brief documentation of your communication links to the extent that you name the brand of the radios. What about frequencies used, output power, duty cycle, and are these allowed according to Danish regulation? I do not expect you to do this to the full extent, but some of this is quite relevant (frequencies, output power permissions for use in Denmark). For the things that are more cumbersome it would be better to “go meta” on the question and state what you would put into this section.

- Appendix G *“The ground control station will determine what to do based on the current situation.”* This begs for an explanation of what that means.

Step #3 *“In the event that the UAV experiences a malfunction, failure or collision with a foreign object and crashes, it will not be able to travel more than 86 meters horizontally. This number has been calculated using”* In your entire document you are not considering the risk of a fly-away due to a malfunction of the flight controller. This is the perhaps most critical problems as this may result in breach of geofence implemented by that same flight controller, thereby perhaps exposing the drone to non-segregated airspace or a higher ground risk. Elsewhere you state that the robustness of the drone is low. Redoing the SORA with this information in mind will likely put you at a higher SAIL.

OSO#03 *“The crew is authorized to maintain the UAS because they all have prior education in the field of UAS technology through their education at SDU.”* The above is an example of documentation that is not measureable or verifyable. In a real world SORA this involves detailed description of relevant competencies and procedures available at the company. I do not expect you to do this, but it would be better to “go meta” on the question and state what you would put into this section.

You do have a few conflicts, e.g. 1.9 kg vs. 2 kg. And OSO 9 is in conflict with section 2 on who operates the drone.

Team 2
Your technical description of the drone is somewhat week. There are many things undescribed and little information about logged flight hours, tests of subsystems etc.

3. Technical information *"One motor can break mid air without falling out of the sky. In the case where one motor breaks, the mission will be terminated, and the UAS will fly back to it's home position"* In a real world SORA, arguments like this needs to be documented thoroughly and tested under VLOS operations before considered valid. I do not expect you to do this to the full extent, but it would be better to "go meta" on the question and state what you would put into this section. For reference we have learned that the ability of a Pixhawk to keep a drone in the air with n-1 motors working is heavily dependent on the drone weight and battery cells (3 vs. 4).

3. Technical information You have only brief documentation of your communication links to the extent that you name the brand of the radios. What about frequencies used, output power, duty cycle, and are these allowed according to Danish regulation? I do not expect you to do this to the full extent, but some of this is quite relevant (frequencies, output power permissions for use in Denmark). For the things that are more cumbersome it would be better to "go meta" on the question and state what you would put into this section.

Step #2 One could almost argue that Ekin calculations were fitted to hit < 700 J. That said you are probably not far from the real world, and since we have no empricial data on terminal velocity (yet) your guestimate may be as good as any other.

Step #6 "Containment Robustness Level"→ "Containment integrity Level". Your argument is not substantiated. "Small drone", "large controlled airspace"? Not quantified and does not necessarily make sense.

Appendix C You are missing g in the formula but the result indicated that you included it in the calculations.

Appendix G: This is a matter of preference but I would not plan for 3 persons to run a sUAS operation. It becomes too cumbersome and the risk of erroneous communication between the crew increases. What about adding clear audiovisual alerts to the GCS thereby leaving the ground controller out of job?

Team 3

Step 1. I am unsure from where you derived the sectioning of this step. It looks like something from last year when the SORA looked quite different? While this enforce that you quantify some of your technical information you also seem to loose focus several places, and it appears that you loose more than you gain. A few examples…

- Why do you state that crew is from SDU and would you expect the CAA to grant you permission based on: *"All crew is from SDU and the RC operator have more than 2 hours flight time with similar UAV."*.

- What does this mean in a SORA context? *"Rain, hail, snow, ashes resistance or sensitivity: 179 days of rain average 765 mm rain 12 . Snow and hail is generally not a problem."*

- A.1.3.4 Abnormal operation and emergency operation: Can you imagine no other abnormal operations than the described? That said this and some of the other information presented here now belongs in the OSO's which is a change from a previous SORA version. You seem to try to put this at both places.

- *"Maximum altitude: 100 m"* probably way higher, this is a legal limitation unless you enforced this by changing the software?

- *"a branch of MAVLink, that has less overhead as it only uses the packages needed to do a specific task. The path planner is developed using a visibility graph"* Text such as this would belong in a report, not in a SORA.

OSO 1 "The operators are students at SDU with a specialization in Drone Technology, and thus is considered to have the right level of competenze." You are applying for a permission by stating more or less *"we know what we are doing"*. In a real world SORA we have named operators with complete SORA related CV. I do not expect you to do this, but it would be better to "go meta" on the question and state what you would put into this section.

OSO 10 "If a single motor fails the UAV should be able to transition into failure mode and proceed to a designated landing location based on GPS coordinates as described in the ConOps A.2.9." You are applying for a permission, so "should" is a problem here, and the lack of testing of any specification also. I do not expect you to do this, but it would be better to "go meta" on the question and state what you would put into this section.

OSO 14 *"All members of the crew knows the checklist in this OSO and follows them together to ensure no step is skipped, thus creating some redundancy."* Same comment as in OSO 1, and where are the checklists?