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Applicant: Aerospace Corporation, The

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1. The ODAR is marked proprietary and is unsigned. A public version will need to be prepared and submitted to the file.

The ODAR initially submitted has been submitted for review for public release with minimal changes. That release process could take up to 6 weeks. However, the signed coversheet now has been uploaded as an exhibit (the information in the publicly released version is the same or less, so their signatures are valid). Our satellite integration date is April 2nd, 2018, so we can't wait for the publicly releasable version. However, we certainly can agree to add it to the license after it is granted.

2. One of the satellites uses an unidentified "zero vapor pressure ionic liquid" in a propulsion system. The applicant should indicate whether this liquid will evaporate in space - for example if there is a leak. We are looking for assurances that there is no possibility of leaked liquid forming droplets that persist in space.

"The propulsion system, carried only on AeroCube 12-B, is free-venting, including the propellant reservoir, which is assumed to be completely filled with propellant and capped with a porous substrate. Therefore, it will not become a pressure vessel upon launch as it contains no gas and the vapor pressure of the ionic liquid propellant is immeasurably small. The electric ion propulsion system aboard AeroCube 12-B contains no pressurized liquids, and therefore poses no explosion risk.

Random vibration testing at protoqual levels and thermal vacuum testing, are performed prior to delivery to ensure that the thruster reservoirs will not leak in space. However, if the system were to leak for some reason that was not covered by the testing, the propulsion system design does not allow droplets to escape. Since there is no sealed volume and no pressurization, there is no force that would expel droplets from the propellant reservoirs. Any leak that could develop in the system may allow liquid to get out of the reservoir, but surface forces would be the dominant (only) force acting on the liquid, so a leak could allow the liquid to spread out along some of the satellite surfaces but would not create free-flying droplets.

If there were some unforeseen mechanism for droplets to escape, they would not evaporate in space due to the negligible vapor pressure of the ionic liquid propellant, however they would have very short orbital lifetimes. In the AeroCube-12 orbit, droplets smaller than 1 mm would only have an orbital lifetime from a few days to a couple of weeks, and even if all the propellant in a single reservoir were to form into a single large droplet, it should re-enter in ~2 months." (Response from Dr. Brian Hardy, PI for AC12)

3. There is a DAS output that shows multiple re-entering debris that re-enter at potentially lethal energies, i.e. > 15J. The applicant may wish to conduct a higher fidelity analysis to determine whether DAS predictions verify. To the extent they do, the applicant will need to provide a

justification for use of these materials, and consider substituting materials in order to minimize casualty risk.

The energy and size of the debris combine to form a casualty assessment. While the energy for a few components is larger than the 15 J level, the casualty assessment meets the requirement. The components in question use high temperature materials for their thermal stability (optics mounts) and manufacturability (light baffle): No other material could meet the same performance requirements. We can run more refined analysis tools on the three parts that DAS predicts will reach earth, however because the casualty assessment is met in DAS2.02, perhaps we can also add that after the license is granted – it will take a week or so.

4. The ODAR indicates that signatures indicate acceptance of ODAR-defined risks. Is this just carryover boilerplate? If not is Aerospace purporting to accept risk on behalf of USG?

That implication was not intended. We have rewritten that note to state that the signatories take responsibility for The Aerospace Corporation that the information stated in the ODAR is correct.

5. The BR requires an EMC analysis for all NGSO networks in the 902-928 MHz band, since this band has no allocation to any space service. Please provide.

Since there is no allocation for space services in the 902-928 MHz band, we understand that we must operate on a non-interference basis under Article 4.4 of the Radio Regulations. Similarly, any other NGSO network using this band will have had to similarly agree to agree to forfeit protection from interference. Some guidance on performing the analysis would be helpful.