Raytheon Company
Experimental License Modification Application
Call Sign: WH2XYX
File Number: 0164-EX-CM-2018

Explanation of Modification Request

Raytheon Company holds experimental license WH2XYX for the operation of a small, experimental satellite system. The license was granted in 2016 for launch and operations that were to last approximately two years. Due to a variety of challenges faced by SpaceX, the original launch partner, Raytheon has changed some of the parameters of its satellite launch.

The purpose of this modification application is to seek FCC approval for the modified launch and orbit and orbital debris assessment report.

None of the technical parameters regarding spectrum use, power levels, or ground station locations have changed. The only changes relate to the launch location, launch timing, orbit, inclination, and orbital period. Raytheon has run a new orbital debris analysis using the new parameters. That report is attached.

Launch Location and Launch Window:

Raytheon has made arrangements to launch from:

Vandenburg AFB
Vandenburg, California

The estimated launch window is between September 30, 2018 and October 6, 2018.

Orbit, Orbital Period, Inclination:

The new orbit will be nearly circular, rather than elliptical. The circular orbit will have an elevation of 575 km. This differs from the previously proposed elliptical orbit with a perigee of 450 km.

Because the orbit is circular, the orbital period is now estimated to be 105 minutes rather than the 90 minutes previously estimated.

The new inclination is slightly different than originally proposed. The new inclination is 97.7 degrees, where the original inclination was 98 degrees. The orbit is sun synchronous.

Orbital Debris Assessment Report:

See Attachment 1.

Stop Buzzer Points of Contact:

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Conclusion:

Raytheon is submitting this application to modify its experimental license WH2XYX. The modification requests approval of a changed orbit, orbital period, inclination, and an updated Orbital Debris Assessment Report, a copy of which is attached. There are no changes proposed to the operations of the radios on the satellite or at the ground stations.

Should there be any questions regarding this application or the proposed operations, please contact me at Anne E. Cortez, Counsel to Raytheon, alc@conspecinternational.com or 520-360-0925.

Attachment 1: 0164-EX-CM-2018

Orbital Debris Mitigation Plan for the SeeMe Satellite

25 July 2018

Prepared by:
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The Orbital Debris Mitigation Plan is prepared as part of the frequency allocation request submitted to the FCC for operation approval of the SeeMe spacecraft. The plan addresses aspects of the spacecraft mission, expected orbit life, and end-of-mission disposal relevant to orbital debris guidelines published by the U.S. Government and NASA.

During launch, the SeeMe satellite is attached to the DARPA Phoenix/eXCITe satellite via a Lightband system from Planetary Systems Corporation (PSC). The separation system generates no debris during normal operation. No other actions of the satellite generate orbital debris of any kind during normal operation. The satellite has no propulsion or pressurized devices mitigating the risk of accidental explosion generating unintended debris.

The SeeMe satellite is expected to operate in a circular orbit apogee and perigee at 575 km. The inclination is 97.7°. No orbit maintenance is performed due to a lack of propulsion. Normal orbit perturbation and altitude degradation will occur over the course of the satellite orbit lifetime which is estimated to be approximately 18.6 years.

The post-mission disposal method selected for SeeMe is atmospheric reentry, specifically by natural altitude degradation due to atmospheric drag. The SeeMe satellite is less than 21 kg of total mass and evaluation of Casualty Risk from Reentry Debris using NASA's Debris Assessment Software (DAS) version 2.0.2, indicates compliance with that parameter per NASA guidelines.

The ORDEM 2000 based evaluation of collision risk with objects large enough to cause fragmentation (diameter > 0.27m, [from Vance et al, Advances in Space Research, 2013]) indicates a flux of 2.897e-6 objects/m^2/year, which produces a yearly probability of fragmentation of 5.0e-6 per year given our 0.232m^2 SeeMe cross section. The Probability of Damage from Small Objects, 1mm or larger is calculated from the flux (0.605 objects/m^2/year) and the satellite cross section (0.232m^2). The resulting probability of being damaged by existing orbital debris is therefore 0.140 per year. Natural orbit degradation will be monitored using the NORAD database of large objects to ensure that large objects in space will be avoided.