REQUEST FOR EXPERIMENTAL SPACE STATION PAYLOAD AUTHORIZATION

Lockheed Martin Corporation ("Lockheed Martin") hereby seeks authority under Part 5 of the Federal Communications Commission's rules to conduct secondary payload experimental satellite operations of a cubesat in conjunction with the NASA Artemis mission. The Artemis mission is currently projected for a launch as early as September 2021 from the Kennedy Space Center, and will include multiple cubesat secondary payloads that will be deployed in lunar vicinity.

Specifically, Lockheed Martin herein seeks authority for the Lunar InfraRed (LunIR) experimental program, which it will conduct in coordination with the National Aeronautics and Space Administration ("NASA") under Contract No. NNH16CO94C. The LunIR payload will transmit payload data from lunar orbit for a period of up to 6 months. Given the complexity of the Artemis mission, Lockheed Martin is herein seeking full experimental authority, rather than Special Temporary Authority, to account for any potential shifts in the deployment schedule of the launch and orbit-raising activity.

The system is comprised of one (1) satellite.

Experimental mission overview.

The subject cubesat will host Lockheed Martin's LunIR capabilities, based on a new, compact mid-wave infrared sensor to scan and image the surface as it flies over the moon.

Lockheed Martin consulted with NOAA, which has made the determination that no separate remote sensing satellite license is required for this mission.

Space station segment.

LunIR will ride along on the upper stage of the Space Launch System as a secondary payload to the Artemis mission. After it is deployed, LunIR's trajectory will carry it over the lunar surface.

The spacecraft will capture IR images of the Lunar surface and downlink those images to Earth in the X-band frequency band identified in the accompanying FCC Form 442. Mission data will be analyzed for extensibility and application toward NASA lunar, Mars and deep space Strategic Knowledge Gaps.

The primary onboard instrument is a compact, low-power Mid-Wave Infrared (MWIR) Sensor. Key technology elements of the MWIR sensor are an integrated micro-cryocooler and a high temperature nBn based 1 Megapixel focal plane.

At the end of the mission, the spacecraft will be disposed in a heliocentric parking orbit. Lockheed Martin attaches to the instant application a comprehensive Orbital Debris Assessment, based on NASA-STD-8719.14.

Ground station segment.

The Lockheed Martin spacecraft will be under the control of up to one earth station facility at any given time. Lockheed Martin has contracted with both Tyvak and KSAT for use of one or more earth station facilities to support this mission over the course of its duration. Because the specific station or stations is not currently known, Lockheed Martin is providing a full list of possible receive locations out of an abundance of caution. The operators of those facilities are obligated to have in place their own authority to participate in this mission. The location details of those receiver facilities follow:

Table 1. Possible LunIR ground stations: Tyvak owned/operated.

Station	Location	Dish sizes	LunIR capabilities
Petaluma, CA	38.274° N 122.664° W	3.7m	X-band downlink S-band uplink
Peterborough, Australia	32.962° S 138.849° E	3.7m	X-band downlink S-band uplink
Abu Dhabi, UAE	24.2 ° N 55.7° E	3.7m	X-band downlink S-band uplink
Svalbard, Norway	78.230 ° N 15.362 ° E	3.7m	X-band downlink S-band uplin

Table 2. Possible LunIR ground stations: KSAT Lite / KSAT

Station	Location	Dish sizes	LunIR capabilities
Troll, Antarctica	71.001° S 2.525° E	3.7m, 7.3m	X-band downlink S-band uplink
Grimstad	58.352° N 8.544° E	3.7m	X-band downlink S-band uplink
Hartebeesthoek, South Africa	25.890 ° S 27.686° E	3.7m, 7.3m	X-band downlink S-band uplink

Punta Arenas, Chile	52.56 ° S 70.51 ° W	3.7m, 7.3m	X-band downlink S-band uplink
Athens, Greece	37.849° N 22.622° E	3.7m, 15m	X-band downlink S-band uplink
Svalbard, Norway	78.230 ° N 15.362 ° E	7.3m, 11m, 13m	X-band downlink S-band uplink
Tromso	69.663° N 18.941° E	10m	X-band downlink S-band uplink
Puertollano, Spain	38.7° N 4.2° E	10m	X-band downlink S-band uplink
Cordoba, Argentina	31.5° S 64.5° W	11m	X-band downlink S-band uplink
Invuik	68.24° N 133.30° W	3.7m, 13m	X-band downlink S-band uplink
Azores, Portugal	37.0° N 25.13° W	15m	X-band downlink S-band uplink
Invercargill, New Zealand	46.4° S 168.4° E	3.7m	X-band downlink
Long Beach, CA	33.77° N 118.19° W	3.7m	X-band downlink
Bangalore, India	12.9° N 77.4° E	32m	X-band downlink S-band uplink
Fucino, Italy	41.9° N 13.6° E	27m	X-band downlink S-band uplink
Maspalomas, Spain	27.8° N 15.6° W	15m	X-band downlink S-band uplink

Kourou, French Guiana	5.2° N 52.° W	15m	X-band downlink S-band uplink

Additional technical details.

Lockheed Martin supplements the details on its Form 442 with these details related to the LunIR mission:

a) Orbital characteristics – LunIR will not orbit the earth; LunIR is deployed from the SLS upper stage beyond LEO on a trajectory resulting in a flyby of the moon and heliocentric disposal; LunIR is non-propulsive (got your response Humberto, this is just for documentation)

b) Apogee – spacecraft's farthest distance from the Earth is approximately 2 AU

c) Perigee – spacecraft's closest position to Earth occurs at deployment, approximately 64,000 km

d) Uplink tuning range – 2025–2120 MHz

e) Satellite receive antenna gain and receive system noise temperature - Antenna Gain: 3 dBic, SNT: 488 deg K

f) Earth station transmit antenna gain and sidelobe characteristics - Transmit Antenna Gain: 36 dBic; Tyvak is contacting KSAT for side lobe characteristics; let us know if this is no longer needed

g) Uplink carrier bandwidth, power and power density delivered to the earth station antenna – 107.5 kHz necessary bandwidth, 3.3W output at power amplifier, see list data below for power density

h) Earth station receive antenna gain, sidelobe characteristics and receive system noise temperature – various KSAT antennas will be used during mission. 51 dBW EIRP for 3.7m dishes, 51 dBW EIRP and SNT of 60 deg K

i) Downlink carrier bandwidth and power density delivered to the satellite transmit antenna – see email below for spacecraft (payload) transmit data; see list data below for power density

j) Downlink polarization used – RHCP